ST. MARY'S UNIVERSITY

SCHOOL OF GRADUATE STUDIES

INSTITUTE OF AGRICULURE AND DEVELOPMENT STUDIES

DETERMINANTS OF FARMERS' WILLINGNESS TO PAY FOR IRRIGATION WATER IN KOGA DAM IRRIGATION SCHEME, AMHARA NATIONAL REGIONAL STATE, ETHIOPIA

BY

ETSEGENET YELIBU

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DETERMINANTS OF FARMERS' WILLINGNESS TO PAY FOR IRRIGATION WATER IN KOGA DAM IRRIGATION SCHEME, AMHARA NATIONAL REGIONAL STATE, ETHIOPIA.

A THESIS SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES OF ST.MARY'S UNIVERSITY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF ARTS IN DEVELOPMENT ECONOMICS

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APPROVAL OF BOARD OF EXAMINERS

As a member of the Board of Examiners of the Master Thesis open defense examination, we testify that we have read and evaluated the thesis prepared by Etsegenet Yelibu and examined the candidate. We recommended that this thesis be accepted as fulfilling the thesis requirements for the degree of Master of Arts in Development Economics.

Signature

Dean of the Institute of Agriculture and Development Studies--

Advisor --

External Examiner --

Internal Examiner --

-

DECLARATION

I hereby declare that this thesis titled "**DETERMINANTS OF FARMERS' WILLINGNESS TO PAY FOR IRRIGATION WATER IN KOGA DAM IRRIGATION SCHEME OF AMHARA NATIONAL REGIONAL STATE, ETHIOPIA**" has been written by me and it is record of my own research work. No part of this work has been presented in any previous application for another degree or diploma at any institution. All borrowed ideas have been duly acknowledged in the text and a list of reference provided.

Etsegenet Yelibu -----------------------------------

ENDORESEMENT

This Thesis has been submitted to St. Mary's University, School of Graduate Studies for Examination with my approval as a university master's student advisor.

Wondimagegne Chekol (PhD) ________________

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ACRONYMS

ASCI	Acres International Limited and Shawel Consult International
ACSI	Amhara Credit and saving institution
CSA	Central Statistical Agency
CVM	Contingent Valuation Method
DBDC	Double Bounded Dichotomous Choice
DWWSES	Desta Worecha Water Supply Engineering Service
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
Ha	hectare
HH	Household
KIP	Koga Irrigation project
MM	Mott MacDonald
MOWE	Minister of Water and Energy
MOWR	Minister of Water and Resource
SBDC	Single Bounded Dichotomous Choice
UNESCO	United Nations Educational, Scientific and Cultural Organization
WB	World Bank
WTA	Willingness to Accept
WTP	Willingness to pay

Abstract

Governmental policy aims at optimizing its investment in irrigation development through the application of the principles of cost recovery or cost sharing by promoting full and meaningful participation of farmers. From this most important factor is farmer's willingness to pay. This study was undertaken to assess the determinants of farmer's willingness to pay for irrigation water they used from Koga irrigation project in Amhara National Regional State. The study employed simple random sampling techniques from four kebeles 246 respondents. Both qualitative and quantitative data analysis method was used to analyze the data collected. Contingent valuation method was used for elicit farmers willingness to pay specially single bounded dichotomous with open ended follow up question. The econometric models, namely Heckman two stage model was used the first stage model output showed that three of them significantly affect households' willingness to pay for irrigation water services., education level, Family size and household income are positively affects willingness to pay of the households; this implies that each of the variables increase willingness to pay of improved irrigation water household also increase. In the second stage of the Heckman model significantly affect namely age, access of credit and initial bid price negatively affects maximum willingness to pay. The other gender, family size, total livestock unit, frequency of development agent visit and income positively affects maximum willingness to pay.

Keywords: Farmer's willingness to pay, Contingent Valuation, Koga irrigation scheme, Heckman two stage model.

CHAPTER ONE
INTRODUCTION

1.1 Background of the study

The agriculture-based economy of the country accounts about 40% of national GDP, 80% of exports, and 80% of total employment (CSA, 2014). Ethiopia is the water tower of east Africa. However the most food insecure and frequently affected by drought due to high dependence of nature mainly rain fed at a peasant smallholder producer level and heavily dependent on rainfall, which is highly varies both spatially and temporally (FAO, 2011). Due to various internal and external pressures, Ethiopia has not been able to achieve its economic, political, and social development for several years. Natural resources are particularly affected by the slow progress in economic development. Water resources of Ethiopia, although still rich, but degrading quickly.

Moreover the country is also characterized by rapid population growth .The current population of Ethiopia is 102,883,014 as of December 6, 2016, based on the latest United Nations estimates. Population growth Causes leads to forest, land and water degradation. This environmental degradation can reduce agricultural productivity, which in turn worsens food insecurity and poverty. To fulfill the demand of growing population government should use like water utilization policy to increase production and productivity and development of new small scale to large scale irrigation project have vital role to increase agricultural production and productivity of the growing population.

According to (Asayehegn, 2012) irrigation contributes to livelihood improvement through increased income, food security, employment opportunity, social needs fulfillment and poverty reduction. Increase in agricultural production through diversification and intensification of crops grown, increased household income because of on/off/non-farm employment, source of animal feed, improving human health due to balanced diet and easy access and utilization for medication, soil and ecology degradation prevention and asset ownership are contributions of irrigation. Moreover Ethiopia receive an average high income from irrigation approximately $323/ha under smallholder managed irrigation system as compared to an average income received $147/ha from rain fed system during the 2005/2006 cropping season. Furthermore by the year 2009/2010, the contribution of irrigation to agricultural GDP and overall GDP is estimated to be approximately 9 % and 3.7%, respectively Fitsum *et al.* (2009). Ethiopia has 4.5 million ha of irrigable land, irrigation covers only 0.16 million ha or about 5% of the total irrigable land (MoWE, 2011)

Governmental policy aims at optimizing its investment in irrigation development through the application of the principles of cost recovery or cost sharing by promoting full and meaningful participation of farmers in all phases of the planning, implementation and operation and maintenance of small, medium and large scale irrigation schemes (MoWE, 2010). Cost recovery is the involvement or contribution of farmers for operation and maintenance of the irrigation infrastructure works. Moreover, proper cost recovery has paramount importance in order to achieve sustainable management and utilization of water resources and to provide water of Acceptable quality in sufficient quantities, and to ensure the availability of efficient and effective water services that satisfy the basic requirements of farmers.

However, due to underpricing of water and lack of cost recovery mechanisms government-managed irrigation systems have resulted in poor operation and maintenance Sampath (1992), Dinar and Mondy (2004) Chandrasekaran *et al*. (2009). According to Dinar and Mondy (2004) though cost recovery and irrigation pricing are important, it is highly influenced by social, local and political institutions (e.g. if price raises, it raises political tensions).This affects the sustainability of irrigation water management and makes irrigation schemes rendered non-functional. This is underlined by high investment cost in rehabilitation of old irrigation schemes by the Ethiopian government and donor organizations.

1.2 Statements of the problem

According to MOWR (2002), in Ethiopia, there is ground water potential of 2.6 billion m^3, eleven major lakes with a total area of 750,000 ha and total annual surface runoff of 123 billion m3. Contrary of this abundance of water country cannot escape from frequent drought, hunger poverty, sanitation and hygiene problem. Therefore, Ethiopia developed 15 years plan (2002-2016) regional and national water resource development plan to introduce efficient and sustainable uses of water resources for irrigation and other purposes.

According to Haab and McConnell, 2002, the idea of a potential Pareto improvement thus provides the rationale for public intervention to increase the efficiency of resource allocation. Therefore, the government and affected parties are faced with an urgent task of supplying irrigation water to rural communities in an effort to uplift rural livelihoods. As a result, the government of Ethiopia is developing small scale to large scale irrigation projects in different parts of the country. One of the irrigation project constructed is the Koga Irrigation scheme in the Abay River basin which has the objective of contributing the sustainable livelihoods of farmers by increasing agricultural productivity and hence food security, reducing the poverty in the rural community and improving the employment opportunities of rural community with active participation and involvement of the local communities (Gebre, Getachew *et al*.2007).

However ,the common pool and public good nature of irrigation water or the old-age thinking of water as a free good makes it difficult to establish property right and costly to enforce and hence leads to inefficient utilization of irrigation water Ayleward *et al*.(2010). Moreover, decisions on irrigation water use allocation in the study area, however, are currently taken on the basis of very limited information as it varies from time to time and season to season. Thus, environmental valuation attempts to quantify the benefits of environmental or public projects and policies, so that they are more transparent, and can be given due and appropriate weight in any decision making process or cost benefit analysis (CBA). Based on resource economics theory, government is justified to provide improved irrigation water services if the unit cost of establishing one is equal or less than the value the community attach to such a service. In the study area, there is also an inefficient water use practice and lack of incentives to water conservation. All these problems are faced by the country at large and the study area in particular. One reason for these problems is absence of irrigation water charges. In strict economic terms water pricing is the main mechanism for cost recovery Latinopoulos, (2005).Indeed, fee collection rates are near zero in some projects, even when water charges are well below the cost of project operation and maintenance (WB, 2005).Moreover, according Gebre, Getachew *et al*. (2007 to Koga irrigation scheme is operated using donor funding and zero levels of cost recovery contrary to the government of Ethiopia cost Recovery policy. This will contrary to the sustainable delivery of water services, inefficient water use practices and lack of incentives to water conservation as emphasized by Ethiopian water resource management and agriculture policy.

As already stated, there exists literatures on households Willingness to Pay (WTP) for household water and water demand, irrigation water use and demand in Ethiopia. Most researchers have been focusing on the impacts and sustainability factors of using irrigation. According to the author's knowledge, a study by Tesfahun, (2014), estimated smallholder household's willingness to pay of improved irrigation water use in the Koga irrigation scheme using double bounded dichotomous choice of contingent valuation based on two sample kebeles. However, as pointed out by a number of researchers, WTP for irrigation water varies from time to time and from location to location. Therefore, this study aims at estimating WTP for irrigation water using single bounded followed by open ended contingent valuation questions study based on four kebeles which is important for evaluating policy alternatives, setting socially acceptable irrigation water tariffs for cost recovery purposes.

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1.3 Objective of the study

1.3.1 General objective

The general objective of this study is to find out the major determinants of farmers WTP of irrigation water service and to estimate willingness to pay for irrigation water services.

1.3.2 Specific objectives

- To identify the major determinants of willingness to pay for irrigation water service
- To estimate the mean willingness to pay for the irrigation water service in the study area
- To estimate total willingness to pay for irrigation water service

1.4 Significance of the study

This study is useful in many ways; first it provides the determinants of farmer's willingness to pay for irrigation water provision in the study area, Second how government and other stakeholder can increase water use efficiency to achieve sustainability of irrigation water .According to Bongale, (2014) free or very low water charge encourages overuse discourage for farmers to cooperate or participate in irrigation originations, and may result in low system productivity and poor conservation .Therefore, the charge has significant use for that bring an ownership feeling and have great economic return to the farmers. Likewise, knowledge on how socio-economic characteristics influence responsiveness of water demand to price and non-price factors provides appropriate policy information on household demand characteristics

1.5 Scope and limitation of the study

There is no volumetric pricing mechanism for irrigation water in Ethiopia, this study focused on water pricing the amount of money that farmers' are willing to pay for the amount of water which is enough to irrigate 0.25 ha (one Kada) of land. The other limitation of the study area of a single district and 246 sample households determines the scope of the study. We cannot estimate WTP farmers based on the different crop growing seasons (dry or wet).

1.6 Structure of the thesis

This thesis organized as follows. In chapter two provides an extensive review of literature, from the theoretical foundations of welfare change to reviews of related empirical literature on WTP for water services and household water demand. Chapter three presents a detailed description of the conceptual, theoretical and empirical frameworks adopted in the study. The chapter also includes a description of the study areas, sampling size and sampling techniques adopted. Chapter four presents descriptive analysis from the survey data and also discusses the empirical findings of this study. Finally, chapter five presents a summary of findings, conclusions and recommendations from the study.

CHAPTER TWO
LITERATURE REVIEW

The purpose of this Chapter was to provide a theoretical and empirical review of literature pertaining the non-market economic valuation of water services and water demand.

2.1 Theoretical Literature reviews

2.1.1 Environmental Valuation

The fact that the environment was viewed as an open access resource implied a zero price for the environment. This perception of individuals on the environment leads to unwise use of the natural resources which leads to environmental degradation because of the over use of such resources. Hence with a zero price for environmental use, the economic system does not include control mechanisms to check over use of the environment. So environmental valuation is desirable to introduce a control mechanism in the wise use of environmental resources Folmer *et al*. (1989) The other aim of environmental valuation is to incorporate the environmental impacts in to cost benefit analysis and to allocate the environmental resources efficiently on the various competing uses in a way that brings the highest possible benefit to the society once monetary value of the non-priced goods are known (Perman *et. al*.2003).

2.1.2 Types of valuation

The total value of an environmental asset is composed of not one, but several willingness to pay. This is because in many instances environmental assets are characterized by economic factors, but also by special attributes such as uniqueness, irreversibility and uncertainty as to future demand and supply. When any one of the above attributes is relevant, the economic value of a natural resource should include both the use and nonuse values (Hussen, 2000).

Thus, Total Economic value = Use value + Nonuse value

Use value reflects the direct use of the environmental resource. If people used one of their senses to experience the resource—sight, sound, touch, taste, or smell—then they have used the resource. Some of these uses are called passive-use values or non-consumptive use values if the resource is not actually used up (consumed) in the process of experiencing it Tietenberg and Lewis (2012). Nonuse value reflects the common observation that people are more than willing to pay for improving or preserving resources that they will never use. The environmental and resource economics, nonuse values are hypothesized as having three separable components, namely option, bequest and existence values or demands (Hussen, 2000).

One type of nonuse values is a bequest value. Bequest value is the willingness to pay to ensure a resource is available for your children and grandchildren. A second type of nonuse value, a pure nonuse value, is called existence value. Existence value is measured by the willingness to pay to ensure that a resource continues to exist in the absence of any interest in future use Tietenberg and Lewis (2012) Option value refers to a sort of insurance premium individuals may be willing to pay to retain the option of possible future use.

Nonuse value = Option value + Bequest value + Existence value

2.1.3 Valuation method for non-market goods

Environmental goods are not traded, thus their value cannot be determined in the market. This is a challenge to policy makers in cost- benefit analysis of projects which involve environmental benefits and costs. We therefore require non- market valuation techniques to value improvements and/or reduction in environmental goods and services including water. "Although water is increasingly allocated by market mechanism its attributes makes it a classic example of the markets potential failure to achieve an economically efficient allocation. Externalities in public goods increase cost in supply and high transaction costs are among the reasons why markets will not always serve society in allocating water resources. Thus we use non- market valuation techniques to provide measures of value and scarcity for economic policy making related to water" (Young, 2005).

2.1.3.1 Revealed preference methods (indirect valuation methods)

The revealed preference/indirect approach/ methods infer the value of environmental goods by studying their actual or revealed behaviors in closely related markets through the application of some model of relationships between marketable goods and environmental services Bockstael *.et al.* (2005). The Indirect approaches rely on observed market behaviors to deduce values (FAO, 2004b). Some of the revealed preference methods that are in use in relation with water resource valuation are hedonic pricing method and the travel cost method.

I. The Hedonic Pricing Method (HPM)

Hedonic pricing is indirect valuation method that is used to estimate economic values for environmental services that directly affect market prices. It is most commonly applied to "variations in housing prices that reflect the value of local environmental attributes. It can be used to estimate economic benefits or costs associated with environmental quality, including air pollution, water pollution, or noise." (Letson *et al*. 2002). The hedonic pricing method for it is based on actual market prices, its application is straight forward and uncontroversial (Young, 2005). The main shortcoming of the method is it does not capture non-use values of environmental resource and requires real property markets (Bockstael *et al*, 2005). For this reason, hedonic pricing is rarely applied in developing countries (FAO, 2004b)

II. Travel Cost Method (TCM)

Travel cost methods have been used extensively to estimate the value of recreation. Using these methods, researchers can calculate the economic costs necessary to reach a recreational site as an estimate of user willingness to pay for recreation. That economic cost may include entry fees, monetary costs of travel, and foregone earnings. In effect, these travel expenses represent the "price" of the recreational experience and are an indirect but observable indicator of user value. By comparing the number of visits that individuals make at different levels of travel cost, economists are able to estimate economic value for site attributes, such as improved environmental quality Letson *et.al*. (2002). The travel cost method uses costs, such as travel costs, entrance fees and time, incurred in visiting a particular site for recreation or other purposes as a proxy of the value of that site for the purpose (Graves *et al*. 2009)

2.1.3.2 Stated preference methods (direct valuation methods)

Stated preference methods use survey techniques to elicit willingness to pay for a marginal improvement or for avoiding a marginal loss. Two main stated preference methods are the contingent valuation method (CVM) and the choice experiment method (CEM). Both methods depend on a hypothetical market which is presented to the respondent in a questionnaire. A main advantage of stated preference methods over the revealed preference method is that we can ask respondents for their WTP regardless of whether they make use of the hypothetical commodity or not.

2.1.4 Theoretical background of Contingent valuation method (CVM)

Contingent valuation is one of the direct stated preference methods where sample of respondents are asked their willingness to pay for the hypothetical scenario which is used to estimate the use and non-use values of environmental resources. Five main steps are identified in order to use contingent valuation technique Perman *et al*. (2003). Designing the survey instrument and construction of scenario is the first step for CVM implementation. The second step is collection of the data (marginal willingness to pay or accept) from the sample population using the designed survey instrument in step one. Analyzing and assessing the collected data is the third step. In this step the value of average willingness to pay (WTP) or willingness to accept (WTA) is estimated. Fourthly, aggregate WTP/WTA for the population will be computed. Cost benefit analysis by using the total WTP/WTA could be conducted. Finally, sensitivity analysis will be implemented using the estimated valuation function in step four. Even though contingent valuation method has the advantage of valuing both the use and non-use values (passive use values) of environmental resources, there are various possible problems in this valuation method.

CVM study undertaken using different valuation elicitation formats. The main value elicitation formats are open ended, iterative bidding game, payment cards and discrete choice questions: (Carson. *et al.* 2001, Haab and Mc Connell, 2002)

(i) open ended questions: it is a question format that asking respondents what their maximum WTP would be for a specified environmental improvement, or the minimum they would be willing to accept (WTA) as compensation for a decrease in environmental quality.

(ii) Iterative bidding games: a question format that seek to elicit maximum WTP (or minimum WTA compensation), but respondents are asked to say whether they would pay (or accept) each of a series amounts which ascend or descend from a specified starting point. This iterative process eventually arrives at the respondent’s maximum WTP (or minimum WTA compensation).

(iii) Payment card formats: Any of the approaches but with a payment card which respondents view while making their decision. In order to help respondents answer WTP questions these cards may be annotated with the mean amounts paid by respondents for other public goods.

(iv) Discrete choice questions: Respondents are required to answer yes or no to a question asking them whether they would be WTP (or WTA) a given amount for a given environmental change. The amounts specified are varied across respondents and the distribution of responses across respondents is then used to estimate mean WTP (or WTA). This can be single-bound dichotomous choice (SBDC) and double-bounded dichotomous choice (DBDC). Single bounded discrete choice questions is a one shot Yes/No response to a given value £X. Whereas, double-bounded dichotomous choice (DBDC) is use of a follow-up question following the initial question, e.g. if respondents says 'Yes' to £X then ask if they are willing to pay £2X or if respondents says 'No' to £X then ask if they are willing to pay £0.5X.

It is argued that, in theory we should expect different answers from different elicitation formats. In iterative bidding game the starting point influences the final willingness to pay or accept values and affected by respondents anchoring their bids to a starting point or some other perceived indication of the true worth of the good in question. Thus, it suffers from starting point biases and may lead to in appropriate WTP/WTA estimate (Carson and Hanemann 2005).

Empirical evidence suggests that in biding game, open ended format and payment card vehicles respondents can influence the outcomes by telling values other than true willingness to pay. However this study single bounded close ended yes or no questions with followed by open ended format method was use to elicit household's willingness to pay for the improved water service.

2.1.4.1 Strength and weakness of CVM

CVM has been increasingly advocated by economists and some specialists as a useful tool for gathering reasonably accurate data about how much a household can afford and is willing to pay and sanitation options presented to them Wedgwood, and Sanson(2003). CVM has two advantages over indirect methods. First, it can deal with both use and non-use values, whereas the indirect methods cover only the former, and involve weak complementarity assumptions. Second, in principle, and unlike the indirect methods, CVM answers to WTP or WTA questions go directly to the theoretically correct monetary measures of utility changes .Even though CVM is a good method in non-market valuation for environmental goods, it suffers from potential biases. Of these biases the following can be mentioned:

A. **Starting point bias:** This is a bias that occurs when the respondent's willingness to pay is influenced by the initial value suggested to the respondent to take it or leave it. This problem is encountered when the elicitation format involves starting values.
B. **Strategic bias:** arise when the respondents provides a biased answer in order to influence a particular outcome.
C. **Hypothetical bias:** The unique future of CVM is its hypothetical nature of the good and hence could be suffered from hypothetical bias. If respondents are not familiar with the scenario presented, their response cannot be taken as their real willingness to pay. This bias can be minimized by a careful description of the good under consideration for the respondents.
D. **Information bias:** may arise whenever respondents are forced to value attributes with which they have little or no experience.
E. **Compliance bias**: occurs when the interviewer is leading the respondent towards the answer he/she is expecting. Compliance bias can also come because of the sponsor of the good being valued. This bias can be reduced by carefully designing the survey, good training of the interviewer

2.2 Empirical Literature review

Chandrasekaran *et al.* (2009) determined the economic value of tank irrigation water in South India through Contingency Valuation Method by analyzing farmers' willingness to pay for irrigation water under improved water supply conditions during wet and dry seasons of paddy cultivation. Logit model was used to describe the farmer's decision on whether or not they agreed to pay for existing supply of irrigation water as well as under improved water supply conditions. It could be seen that the family labor force, area under rice cultivation and the water requirement found to be significant factors influencing farmers WTP in the wet season. While in dry season, the variables area under rice cultivation and the water requirement are found to be significantly influencing the farmers' WTP for irrigation water. Area under rice cultivation had significant bearing on WTP by farmers.

Shantha, and Ali (2014) attempts to determine the economic value of irrigation-water for government managed irrigation project in Sri Lanka using contingent valuation method followed by single bounded dichotomous choices. Logistic regression model was used to measure WTP and to determine the factors that influence the variation in WTP. Primary data were obtained from 367 farmer households in Nagadeepa irrigation schemes in dry zone. The Authors estimated that value of irrigation water was Rs. 5,275 ($40) per hectare per season. They found that farm income, existing knowledge of water management, Location of paddy(a field in which rice growing) field, ownership of paddy land, Extent cultivated of paddy, Irrigation scarcity, main income source were significant variables which influence the variation of farmers' WTP.

Herata and Gichuki, (2006) utilized a contingent valuation method to measure farmers' willingness to pay for irrigation system for the recovery of operation and management cost in Sri Lanka. The closed ended and open-ended types of technique were used to elicit farmers' willingness to pay. The study considered respondents' willingness to pay for irrigation water to be dependent on their education level, family size, age, family labor force, area of paddy cultivation, perception on water sufficiency, total agricultural income. The regression result showed that the age of the respondent has a positive and significant impact on the WTP and also perception about water sufficiency have a negative but a significant role in the WTP of the respondents. The study further indicated that the negative coefficient of the variable, perception about water sufficiency implied that when farmers are satisfied with existing irrigation system, they are reluctant to pay for improved irrigation water provision.

Mallios and Latinopoulos (2001) tried to determine the factors that influence farmers' WTP for irrigation water in Greece. A CVM study was used to analyze farmers' attitudes towards an efficient water provision system. A logistic regression model was used to assess the factors that influence the responders' behavior as well as to estimate their WTP. The study found out that, the main factors which dictated farmers' WTP were the perception of risk towards water shortage and the effectiveness of the proposed water users Association. The study further indicates that farmers behaved according to economic theory, by showing a conservative attitude towards payment. In addition they said that, personal attributes, like education level and the problems farmers' face in everyday practice were additional factors which influence their WTP.

Basarir *et.al* (2009) study analyzing producer's willingness to pay for high quality of irrigation water and analyzing the factors that effecting their payment decisions. In the case of Turhal and Suluova A survey technique was implemented via face to face interview with 130 randomly selected producers. The data was analyzed using tobit and Heckman sample selection model. According to the result the producer who is male, from Turhal region, has more vegetable land, and polluted water is willing to pay more for increasing the quality of irrigation water.

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

Jonse Bane (2005), tried to obtain the valuation of peasants for non-agricultural uses of irrigation water using 260 randomly selected households in two peasant associations in Bure district of west Gojam, Ethiopia. Using probit and bivariate probit models. The study employed double-bounded referendum style elicitation format with open ended follow up questions. The study identified the following determinants of WTP, income, sex, age, family size, irrigation water management, choices of water use rights, quantity of irrigation water consumption, distance from current sources, wealth, land tenure, Peasant Associations (Kebeles), quality of water, location and starting point bid. The study also finds that using double bounded value elicitation technique does not improve statistical efficiency over single bounded format. The study therefore used the single bounded elicitation format to calculate values of households‟ WTP for domestic uses of irrigation water.

Geberegiorgis (1999) also study to estimate farmers' willingness to pay for small scale irrigation schemes in Ethiopia by taking a case study in the eastern zone of the Tigary regional state by employing the contingent valuation method. A total of 82 farmers' were included in the survey from Genfel kebele of Wekero Woreda. The open ended elicitation method was used to elicit farmers WTP. The analysis was carried out by using the OLS (ordinary least square) method and order probit analysis. In the study the variables identified to determine the WTP of the farmers' were age, credit, education, experience with irrigation, total area cultivated, number of oxen owned by a household, family size, total revenue and quantity of fertilizer used. He found out that, credit availability and education level of the respondent were significant variables to explain the variation in the willingness to pay of farmers for irrigation water, both for seasonal and annual WTP equations ,total earning of the respondents was also significant variable to explain the variation in the annual willingness to pay but it was not significant for the seasonal WTP values and farmers' application of fertilizer was a significant variable in explaining variation in WTP in the dry season but it was not significant in the annual willingness to pay.

CHAPTER THREE

RESEARCH METDOLOGY

3.1 Description of the Study Area

3.1.1 Geographical Settings

The study area is Koga Irrigation and Watershed Management Project located in Koga catchment, south of Lake Tana in the Blue Nile River Basin (called Abay River in Ethiopia) (Figure 1). It is a major reservoir irrigation project in the Amhara National Regional State, near Merawi town at 37°09' E and 11°25' N and at an altitude of 2020 m. Koga Irrigation Scheme is the first large dam project in the Abay River basin since the extension of the Fincha'a reservoir in 1987, as well as the first operational large dam project in a series of a projects presently under construction or in the planning phase. For this reason, the Koga irrigation project gains significance as a pilot case with regard to water projects in the river basin implemented in the near future (Eguavoen and Tesfai,2011). 2

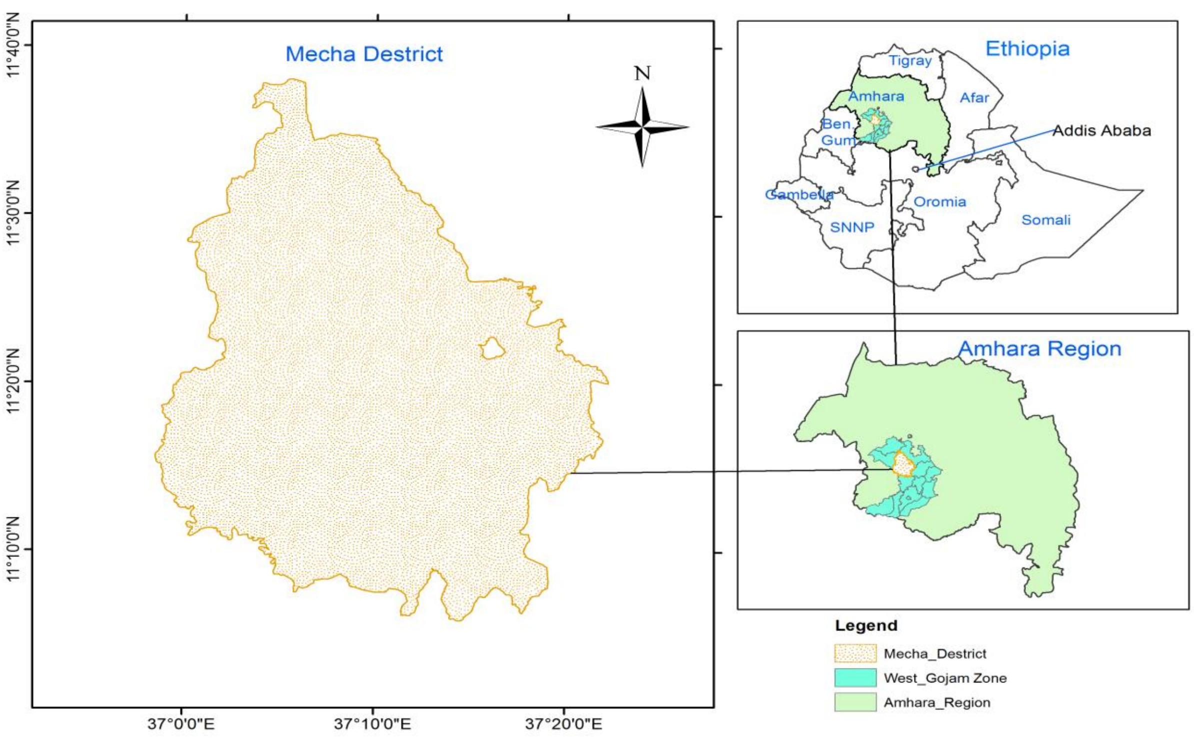

Figure 1: Map of the study area source: (Marx, 2011)

3.1.2 Koga catchment

The Koga catchment is situated in the North Western Ethiopian Highlands between latitudes of 11°9.7' and 11°30'N and Longitudes of 37°02' and 37°18'E. The catchment area is 250 km^2 (MM, 2004). The Koga River is a tributary of the Gilgel Abay River in the headwaters of the Blue Nile. The Gilgel Abay flows into Lake Tana. The Koga catchment can be divided into a narrow steep upper catchment draining the flanks of the Mount Adama range, and the remainder on a relatively flat plateau sloping gently to the North West. The source of the Koga River is close to Wezem, at an altitude of about 3 200 m. The river is 64 km long; flowing into the Gilgel Abay River downstream of the town of Wetet Abay, at an altitude of 1985 m.

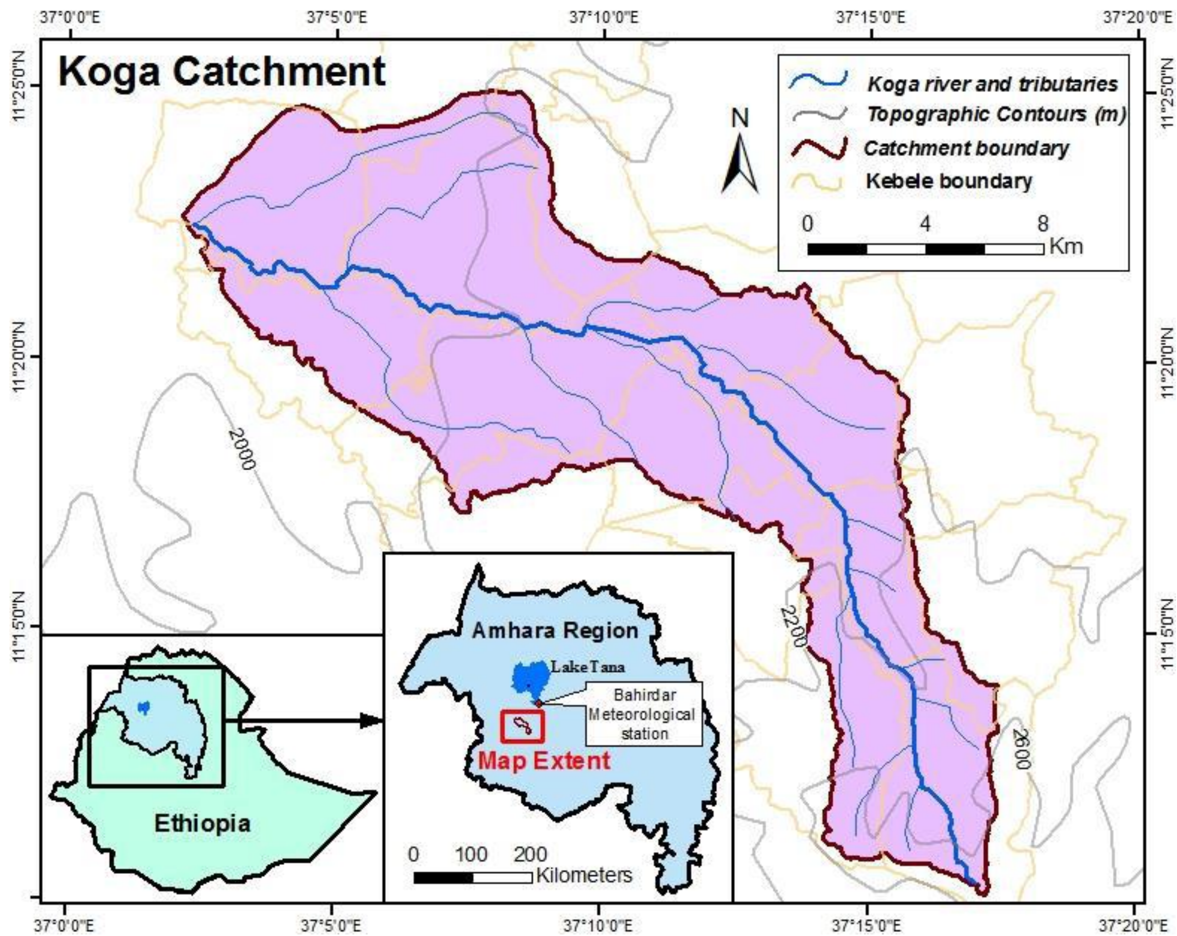

Figure 2.Location map of koga irrigation project

Source: Eleni *et al*. (2013)

3.1.3 Land Use/Cover

The land use/cover classes for Koga catchment for the year 2010 is shown in Table 1 Eleni *et al.* (2013). According to Eleni *et al*. (2013), the woody vegetation decreased from 5,576 ha to 3,012 ha from the 1950s to 2010. Most of the deforestation took place between the 1970s and 1980s, but there is an increasing trend since then. No significant changes were observed in the area used for agriculture that comprises the pastures and crop fields since the 1950s, while there is an enormous increase in the area used for settlement, due to a tremendous increase in population from one point in time to another.

The bare lands that used to exist in previous years were found to be totally covered with other land cover/use classes and no bare lands were observed in the study area in the year 2010. Population pressure and land use policies were found to be reasons for the changes in land use/cover while soil degradation decrease in the indigenous woody vegetation and erosion were the observed consequences of the land use/cover changes (Eleni *et al*. 2013).

Table 1: Land use/cover classes of Koga catchment for the year 2010

Land use	Area coverage (ha)
Woody vegetation	3,012
Pasture	4,728
Crop field	16
Bare land	0
Settlement	1,535
Water	1,108
Agricultural land (pasture crop field)	20,411

Source: Eleni *et al*. (2013)

3.1.4 Climate

The climate in Ethiopia is related to the topography and to the movements of the Inter- Tropical Convergence Zone (ITCZ) during the year. The study area is subject to the ITCZ, northern trade winds and the southern monsoon (UNESCO, 2004). The Merawi meteorological station (37^{o}09’ E and 11^{o}25’ N) is located adjacent to the project irrigation area, at an altitude of about 2020 m. Available data is limited to the period from 1981 to 1995, covering daily rainfall, and average monthly minimum and maximum temperatures. The station has not operated since the beginning of 1996. The average annual rainfall for Merawi is 1588.8 mm.

Maximum, minimum and average monthly temperatures for Merawi are 27.4, 10.8 and 19.1 mm respectively. Bahir Dar, 35 km to the north east of the project area on the edge of Lake Tana, is the only synoptic station. Studies on climate change for the area seldom shows uniform results concerning rainfall and dry spells Marx (2011). The rainfall in the project area has a uni-modal characteristic that extends from May to October. It allows only one rain fed cropping. The dry season extends from November to April. Its average annual rainfall is 1546.94 mm. The highest concentration of rainfall occurs in July. The average daily and the annual reference evapo-transpirations (ETO) are 4.24 mm and 1546.94 mm, respectively.

3.2 Demography and Agricultural Practices

3.2.1 Demography

The population projection data from CSA (2013)[1] showed that the district where Koga catchment located has a total population of 334,789. Out of this total population 301,182 and 33,607 lives in the rural and urban parts, respectively. Average family size is 6 persons and the population growth were almost 3% per annum.

3.2.2 Agriculture in the Koga Area

Agricultural production is the main part of livelihood for the rural population. Subsistence rain fed production of cereals comprising teff, maize, barley and millet, as well as pulses, oilseeds and some legumes is dominant in the area while irrigated agriculture takes up a small percentage of the cultivated area of the Koga catchment. Income from livestock also contributes to the livelihood of the small scale poor farmers in the area.

According to Marx (2011) the majority of farmers in the area used traditional means of cultivation until the scheme was introduced i.e. oxen for plowing, river diversion or abstraction as irrigation for horticulture if any and the amount of chemicals like fertilizer and especially insecticides and pesticides was considerably low. Despite the growth in the total fertilizer consumption, the average nutrient used per hectare of cultivated area in Ethiopia is one of lowest.in the world due to high

[1]Federal demographic republic of Ethiopia central statistical agency population projection of Ethiopia for all regions at district level from 2014 – 2017: http://www.csa.gov.et/images/general/news/pop_pro_wer_2014-2017

prices and lack of supply. Accordingly, yields are generally low (average cereal yields were at 7 qt. per hectare (ASCI, 1995).

Most of the produce was consumed for household subsistence and if a part of the harvest was sold it usually consisted of horticulture crops like peppers, shallots and tomatoes. In good years when there was a surplus production also parts of the rain fed cereals like maize, teff, wheat or finger millet which account for the lion share of agricultural production in the research area were sold (Marx, 2011).

3.2.3 Koga irrigation and drainage systems

The Koga irrigation and drainage system can be classified as a technical irrigation system; i.e. all flows are regulated and controlled from the water source to the farm MM (2008). The delivery of irrigation water to all individual farms is via a network of irrigation canals with all discharges to each canal controlled by a series of gates which regulate the discharge and the command operational head. The drainage system makes use of the natural slope of the command area and the existing natural drainage lines and gullies which remove resultant rainfall flows from the area. Into these natural drainage lines discharge constructed tertiary drains (TDs) which remove rainfall and irrigation runoff from the farm fields which has been discharged through field drains and quaternary drains which run parallel to the quaternary canals. The Irrigation and Drainage System comprises the following components.

3.2.4 Irrigation System

The principal components of the irrigation canal system are detailed below (MM, 2008):

(i) Irrigation outlet to the main canal from the Koga Dam and Reservoir (KDR) with flows delivered through a pipe-work arrangement in the upper level of a draw-off conduit and released into the head of the main canal. Flow measurement of the bulk supply is done by an electro-magnetic flow-meter installed in the pipe-work.

(ii) 19.7 km lined main canal (MC) which flows in a northerly direction from the KDR with 11.95 km following the contour and 7.75 km following a ridge running down a steeper gradient and servicing a total 12 irrigation command areas.’

(iii) 42 km of lined secondary canals (SCs) servicing 117 km of lined and unlined tertiary canals (TCs) through gated regulator structures.

(iv) 783 km of unlined quaternary canals (QCs).

(v) Four gated cross regulator structures and 3 Duckbill Weir Regulator structures; i.e. main canal cross regulators (MCCR) for control of the depth of water in the upstream section of the MC and correct delivery of irrigation flows to the downstream section of the MC.

(vi) Twelve secondary canal head regulators (SCHR) which deliver irrigation flows to the SCs and are set at pre-determined openings for each irrigation period.

3.3 Sampling technique and sample size determination

3.3.1 Population

In CVM, the population should be in principle all beneficiaries of the environmental values to be evaluated. For this survey, the scope of the population is deemed to be all farmers of irrigation scheme.

3.3.2 Data collection method

The study used both primary and secondary sources of data to gather information for the study. Primary data were collected from 246 sampled households through interviews using structured questionnaires from four kebeles namely Chohna, kudmi, Tagelwedfet and AmboMesk. Secondary data collected included published and unpublished sources such as kebeles administration and internet. In this study the single-bounded dichotomous choice approach with an open-ended follow up question is applied. Pilot survey was made for five days. From the four areas 60 households were interviewed. The pre-test has a paramount significance in making appropriate modifications in the content of the questionnaire. In addition, the main purpose of the pilot survey was to set the bid price in the elicitation part of the questionnaire. Initial bids are 22, 40 and65 birr frequently mentioned by the households.

3.3.3 Value elicitation format

In this study CVM elicitation questions have two basic forms: With a closed-ended CV question the respondent is asked whether he or she is willing to pay or not for the improvement service the respondent is expected to answer "yes" or "no."

The second stage is an open-ended question, the respondent is asked to state the maximum amount that he or she is willing to pay for improved irrigation water service.

3.3.4 Sampling techniques

The sample size for this study was based on probabilistic sampling method formula recommended by Scott Smith (2013) sample size was determined by the following formula

$$\textbf{Sample size} = (Z - score)2 * Std.Dev * \frac{(1-Std.Dev)}{Margin} of\ error$$

Where Z-score =confidence level at 95% (standard value of 1.96) Std.Dev=standard deviation

$$(1.96)2 * 0.2 * (1 - 0.2)/ (0.05)2 \quad = 246 \textbf{ sample household}$$

By applying this formula the total sample size is given by n=246 sampled households.

Table 2 Summary of total sampled households

Name of District	Total number of Kebeles in KIS	Number of sample Kebeles	Name of sample Kebeles	Total population	Sampled[2] households
Mecha	**10**	**4**	**Chihona**	**5080**	**47**
			Kudmi	**8264**	**76**
			Ambo Meskel	**6842**	**63**
			Tagel Wedfit	**6515**	**60**
Total				**26701**	**246**

1

[2] Sample households from each Kebele's was calculated using the formula, Sample households from each Kebele's $= \frac{\text{Number of households in each Kebele's}}{\text{Total sample households infour kebele's}} * Total\ sampled\ households.$

3.3.5 Data Analysis

Data obtains from the questionnaire were as properly coded and entered into STATA data analysis computer software. Both descriptive (mean, percentage, totals, standard deviation and frequencies) and econometric model analysis were used. In addition, different test statistics, in particular the z-test, p-value and chi X^2 is use to see the statistical significance between the different continuous and dummy variables with WTP. The econometric analysis Heckman two stage sample selection model was used for identifying the determinant of farmer's willingness to pay for the improved irrigation water service.

3.4 Econometrics model

3.4.1 Model Specification

3.4.1.1 Heckman two stage model

If the person is interested willing to pay in the improvement, then what is the maximum amount that they will be willing to pay? But a problem arises if the two decisions are correlated (i.e. the decision that the person is interested in the system and the maximum amount they are willing to pay), separate estimation leads to inconsistent estimates. For example, if the OLS estimation is done to see the factors affecting maximum amount the person is willing to pay, using only those households who are interested in the improved irrigation water system, the result will be inconsistent. This is because selection was made at first in which households who are not interested are taken out in the process. This leads to selective bias and specification error of an omitted variable (Green 1993). Heckman (1979) suggested a two-stage estimation procedures model appropriate to corrects for sample selectivity bias. The first stage of the Heckman two-stage model is a 'willingness to pay, which attempts to capture factors affecting willingness to pay decision. This equation is used to construct a selectivity term known as the 'inverse Mills ratio' (which is added to the second stage 'outcome' equation that explains factors affecting maximum willingness to pay of the farmers). The inverse Mill's ratio is a variable for controlling bias due to sample selection (Heckman, 1979).

Frist stage of Heckman use the probit model to test factor influencing WTP

$WTPi^* = \beta_{1i}X + U_{1i}, \; U_{1i} \sim N(0,1)$

$$WTPi = 1, \text{ if } WTPi^* > 0$$

$$= \{0, if\ WTPi* \leq 0$$

WTPi = the latent dependent variable, which is not observed

Where, WTP_i is a dummy variable which is used to measure whether ith farmer is willing to pay for improved irrigation water service or not .where WTP_i*1= Household willingness to pay for the improvement program and WTPi*=0 is not willing to pay. WTP of equation (1) is observed only when $WTP_i^* = 1$.

X_{1i} = explanatory variables that are assumed to affect the probability of participation decision
β_{1i} = vector of unknown parameter in participation equation,
U_{1i} = residuals that are independently and normally distributed with zero mean and constant variance, and
$WTPi^*$ = Willingness to pay for improvement program

The second stage of heckman model is Lambda is included as an independent variable in the OLS estimates to examine the intensity of willingness to pay OLS specify as follows

Introduce λ, also called the inverse Mill's ratio, Thus it will look like:

$WTP_i^* = \beta x\ i + \theta\ \lambda\ i + \varepsilon I$

Where: θ is the coefficient of the lambda term

λ- Measures bias due to non-random sample selection,

εi -is the error term.

Inverse Mill's ratio that is

$\text{Prob}\ (WTPi * = 1) = \emptyset\ (\alpha\ Zi)$

$\text{Prob}\ (WTPi * = 0) = 1 - \emptyset\ (\alpha\ Zi)$

$E\ [Yi\ /\ WTP\ i *= 1] = \beta x + \rho\sigma\lambda\ (\alpha Zi)$

$\lambda I = \emptyset((\alpha Zi)) / \mathbf{\Phi}(\alpha Zi)$

λi - a selectivity correction term

$\emptyset$ - the standard normal density function.

Φ -the normal distribution function.

σ- The standard deviation.

The lambda (λ) is used as an additional regressor with the view to controlling for selectivity bias. If the coefficient is statistically significant, the null hypothesis of no bias will be rejected.

3.5 Description and Hypothesis of the study Variables

3.5.1 Dependent variables

Based on the intended objective of the study and the theoretical base, in this study there are two dependent variables: The first one is the decision of farmer's willingness to pay for the irrigation service; and the second one showing the intensity of the amount of willingness to pay for the service. For irrigation water service, not only the willingness to pay is crucial; but, also the amount that they are willing to pay for the service is essential. Thus, once the farmer has the decision for willingness to pay, the decision step is on the maximum amount the farmers are willing to pay. The two dependent variables are:

- **Willingness to pay (WTP):** This is the first dependent variable used in the study was willingness to pay, using the response to the for improved irrigation water services. The variable is binary, taking the value 1 if the household was willing to pay and 0, otherwise. This variable is used as a dependent variable in the probit analysis of Heckman's two stage estimation procedure in answering the objective on determinants of willingness to pay for improved irrigation water services in the study areas.

- **Maximum willingness to pay (MWTP):** This is the second dependent variable in the Heckman's two-stage estimation procedure. It indicates maximum willingness to pay for the hypothetical improved irrigation water services. This variable is continuous and measures the intensity of payment.

3.5.2 Independent variables

- **Cultivated land (CULTLAND):** This refers to the total cultivated land size (both irrigated and rain fed) of a household measured in hectare. As the cultivated land size increases provided other associated production factors remain constant, the likelihood that the holder gets more output or benefit is high. Hence farmland is the major input for agricultural production in rural households. Cultivated land should have a positive relationship with willingness to pay of a household.

- **Year of irrigation experience (YOIRREXP):** Irrigation use farm experience enables farmers to diversify and maximize agricultural production, practice multiple cropping, increasing cropping intensity and supplement moisture deficiency in agriculture. Moreover, more irrigation experience household expect more awareness about benefit of irrigation water service. In doing so, it is assumed to have a direct relation with willingness to pay of the household.

- **Age of the household head (AGE):** age of the household head in years. At old age people lack of labor to use irrigation water properly and they are also the more experience in farming. If irrigation water will be improved it will reduces the amount of labor for them and they want to intensify and diversify their production activities, thus it will be hypothesized that the older people more likely willing to pay. On the other hand, however, it is believed that older people prefer to keep tradition and therefore they are less likely willing to pay.
- **Household income (HHINCOME)**: This variable was measured in Ethiopian Birr and is the amount of income the household generates from various sources and continuous in the model. Economic theory postulates that demand for improved goods increases with increases in income. Thus following the theory, the study hypothesized that income to be positively associated with both WTP for improved irrigation water services. This is mainly because households with higher incomes will demand more improved goods like water services than households with lower incomes, thus willing to pay more.
- **Family size (FASIZE):** This is measured as a continuous variable indicating the number of individuals living in the household. Households with large family size will probably

have more working labor input that can utilize the increased water availability. However, on the other hand, large family size requires relatively large amount of money to feed the family and in such situation the household will be resistant to the idea of paying for the improved irrigation water provision. Thus it is very difficult to determine the sign of this variable a prior+/-.

- **Frequency of development agents (FRQDA):** Frequency of developing agents (DA) visits in a year. It is believed that households who have been frequently visited by the DA are expected to have a higher understanding on the benefits of improved irrigation provision and hence the expected sign of this variable is positive.
- **Gender of the household head (GENDER):** This is a dummy variable, which takes a value of 1 if the household is male and 0 otherwise. Male household heads are expected to have higher income compared to female household heads because of better labor inputs used in male-headed households than the female headed ones. Moreover, with regard to farming experience males are better than the female farmers since it is assumed that male household heads have more exposure and access to information and new interventions than female household heads. Thus, it will be hypothesized that male farm households are willing to pay for the improvement than female farm households.
- **Educational level of the household (EDUC):** this is continuous variable indicating the number of years that the household head had spent in a formal school. More educated people have a better understanding on the benefit of the improved irrigation water provision and are more likely to support the idea. Hence the expected sign of this variable is positive.
- **Total livestock unit (TLU):** Being an owner of the large size of livestock puts the farm household in a better status than households of the small size of livestock. This has its own implications that livestock enables farmers to purchase agricultural food products and livestock also served as a source of food. Thus, farmers are not concerned about the value that they received from agricultural crop production using irrigation water and it was hypothesized that ownership of livestock and WTP for improved irrigation water are inversely related, and the expected sign will be negative.
- **Access to credit (ACREDIT):** In the context of developing country, farmers who have access and those received credit most of the time they failed to invest in irrigation water and other agricultural purposes. This is because, for farm households, of the availability of

immediate needs (i.e. Food) in the household. Therefore, it was hypothesized that access to credit and willingness to pay is inversely related.

- **Initial bid (BID):** this is the initial bids offered to respondents measured in birr and continuous in the model. The initial bid increases the number of respondent farmers who will say yes for the initial bid decreases or they are less willing to accept the improved scenario.

Table 3: Summary of the explanatory variables and expectation sign

Variables	Variables code	Type of variables	Measurement of variables	Expected sign
Size of Cultivated land	LANDCULT	Continuous variable	Measure by hectare or Keda[3]	+
Year irrigation experience	YREXP	Continuous variable	Year of irrigation experience in year	+
Age of the household variable	AGE	Continuous variables	Measure by year	+/-
Family size	FASIZE	Continuous variables	Measure by counting of number of household in the family	+/-
Frequency of Development agent	FRDA	Continuous variable	measure by counting of DA visited in year	+
Gender of the household head	GENDER	Dummy variable	1 male 0 female	+
Educational level of household	EDUC	Continuous variable	Measure by year of schooling	+
Household income	HHINCOME	Continuous variables	Household earned in year Measure by birr	+
Total livestock unit	TLU	Continuous variable	Number of livestock measures in to total livestock unit	-
Access to credit	ACREDIT	Dummy	1=credit accessible 0=otherwise	-
Initial bid	BID	Continuous variable	The offered of bid price to the respondent	-

CHAPTER FOUR
RESULT AND DISSCUTION

In this thesis, the findings of the study obtained from the sample respondents have been presented in three different sections. In the first section socio economic and demographic characteristics of the sample respondents (n=246) are presented. In the second part, analysis of the major determinants that affects household's WTP for the irrigation water services are presented. The last part of thesis discussed the mean and total WTP for improved irrigation water services in which the sample respondents are willing to pay for the services they have been benefited because of the improvements. Means, percentages, standard deviation and frequency were used to summarize the data.

4.1 Descriptive Analysis

4.1.1 Socio-Economic and Demographic Characteristics of Households

The response rate of this study was 100%. A total of 246 sample households were selected and interviewed in the survey to estimate household's willingness to pay for improved irrigation water services in the study area. From the total sample respondents, 70(28.46%) are female headed respondents while the rest 176 (71.54%) are male headed households. The average family size of the total sample household is 6, and ranges from 2 to 11 members with in single household. Data about the age of the respondents shows that 50.82 years is the average age. The maximum is 90 and the minimum is 24 years of age. The education level of the respondent ranges from minimum of not able to read and write to the maximum of college graduate. From the total respondents 138(56.1%) can neither read nor write, 108(43.9%) have completed their formal education include primary education, secondary school and joined higher education.

Data regarding the land holding size of sampled respondents reveals that range from 0.25 to 2.5ha. The average landholding size of the sampled household is 0.6069 hectare of land out of the total of 246 respondents 42(17.07%) have greater than or equal to one hectare of land and the rest of 204(82.92%) of the sampled respondents have less than one hectare of land. Specific to irrigated land, the sample result has shown that size of irrigated land owned by farmer's ranges from 0.1 to 0.5 hectare of land.

The data regarding access to credit indicated that from the total of sample households 206(83.74%) are getting credit from organizations like Amhara credit and saving institutes (ACSI), friends and relatives. Because of higher interest rate, payback period was short, repayment term not favorable and loan was not timely available problem the other 40 (16.67%) reported that they are not getting any form credit.

Table 4: access to credit

Organization	Freq.(n=206)	Percentage
ACSI	174	83
Friends and relatives	32	17
Total	206	100

Source own survey, 2016.

One of the variables which were addressed in this study was access of agricultural extension services. Agricultural extension services play a vital role to develop the use of agricultural irrigation technologies in the study area. The main reason for the importance extension services in the study area is because their level of education is very low. This has been already indicated above that the majority of the respondents are illiterate. Agricultural extension services help farmers to understand and aware of the agricultural production problems and make them to use the different opportunities for the enhancement. Hence, the successes of improved agricultural production convey on agricultural extension services given by developing agent at peasant associations or community level. The survey result show that 242(98.37%) are visited and assist by development agents while the rest of 4(1.62%) respondent are not assist by development agents.

The main indicator used to calculate household income was the average household income. Even though, the household sizes can be different, one could argue that the average household income can be misleading. It is important also took account of the household size and calculated per-capita income for each household. However, in this study we used the average income because of lack of getting consistent data. The average yearly income of the survey households 8734.508 birr ranging from minimum of 1160 birr/year and maximum of 36500 birr/year. Off farm -income generating activities is one of the sources of income in addition to farm income. Currently, farmers diversity their income by involving non-farm activities. Out of the sampled households 57.32% involved in off-farm income generating activities to maintain their livelihood. Whereas 42.68% of the respondents reported that they are not involved in income generated activities. The off-farm income generating activities commonly used in the study area include employed daily laborer 36(25.53%), sales of fire wood and pottery and metal work35 (24.82%), 32(22.69%), sales of local drink 20(14.18%), involvement of livestock trading 18(12.76%), respectively.

Table 5: off farm activities of sampled household

Off farm activities	Freq.(n=141)	Percent	Cum.
Daily labored	36	25.53	26.47
Livestock trade	18	12.76	38.24
Pottery, metal works	32	22.69	61.76
Sales of fire work	35	24.82	85.26
Sales of local drinks	20	14.18	100
Total	141	100	

Source own survey 2016.

Asset ownership is considered as a better welfare measure than income because it reflects the household's long term capacity to manage risk and meet its consumption requirements. We considered household livestock assets as a measure of wealth stores by analyzing the proportion of total assets accounted for by livestock. The total livestock unit (TLU) was used to describe livestock numbers across species to produce a single figure that indicates the total amount of livestock owned. Livestock ownership was transformed into TLUs for better comparison since it includes exchange ratios for animals with different body weights. One could argue that is a better measure compared to counting numbers because weights of livestock across species vary greatly. In the study area, the average TLU is 4.62.Minimum and maximum TLU 0 and 14.905 respectively.

Table 6: summery of statistics for key continues and dummy variables

Variables name	Description	Mean	St. Dev.	Minimum	Maximum
Age	Household age in year	50.825	12.97	24	90
Household size	Household size in number	6.1166	2.2647	2	11
Education level	Year of schooling	2.283	3.19	0	15
Land size	Size of cultivated land	0.6069	0.319	0.25	2.5
Frequency of DA	DA number of visit in year	18.2	11.52	0	60
Total household income	Household income in birr	8734.5	5011.94	1160	36500
Year of Irrigation experience	Year of irrigation activity	5.88	0.71	4	7
Initial bid	Initial offered price	42.33	17.7	22	65
Total livestock unit(TLU)	Number of livestock measure in TLU	4.6249	2.7494	0	14.905
Gender of the house hold	Household sex dummy variable(1= male 0 female	0.7167	1.0007	0	1
Access of credit	Household access credit dummy variable 1=access 0= no access of credit	0.916	0.4525	0	1

Source own survey 2016

4.1.2 Household irrigation water use and problems

Awareness about the availability of irrigation water is very essential to elicit households WTP for irrigation water. Moreover, respondent's willingness to pay is highly affected by their years of experience and associated benefits obtained from irrigation. The result showed that 59.17% of the respondents have an experience of using the water resources for irrigation to produce crops and vegetables and reported that the irrigation water received from the dam was inadequate. The reasons attributed to the insufficient availability of irrigation water were population pressure, deforestation, illegal dweller on the forest area, and soil and water degradation. To be more specific, 35% of the respondents frequently mentioned soil erosion as the first environmental problem followed by deforestation 20% and population pressure on the area 4.17%. Suggestions were also elicited from the respondents to overcome the irrigation water problems.

A majority of the respondents suggested that giving training related to proper irrigation water management is important to develop practice of modern irrigation technologies. Moreover, planting and maintaining trees was frequently mentioned protection measure followed by soil and water conservation, punishing illegal dweller and training users. In this regard training was given to different households in the study area to improve the use of irrigation water. The sampled data show that only 40.83% of the respondents did get training related to proper irrigation water management. We were asked sample respondent who give the training about importance irrigation water and management training given by koga irrigation project experts, development agents and district experts however rest respondent 59.17% did not get any training.

Table 7 : summery of scarcity irrigation water problem reasons

	Frequency (n=142)	**Percentage**
Soil erosion	84	59.15%
Deforestation	48	33.80%
Population pressures	10	7.04%
Total	142	100

Source own survey, 2016

4.2Result of the econometric model

In this particular thesis, to identify and analyze the determinants of household's willingness to pay, the Heckman two stage model has been used and analyzed. For the first stage of the Heckman's two stage model i.e. willingness to pay for the improved irrigation water services, probit model were used with ten demographic and socio economic variables such as size of cultivated land, year of irrigation farming experience, age, family size, frequency of development agent visit, gender, education level, household income, total livestock unit and access to credit are entered and analyzed with the help of Stata. For the second stage of the model i.e. outcome equation again eleven demographic and socio economic variables such size of cultivated land, year of irrigation farming experience, age, family size, frequency of development agent visit, gender, education level, household income, total livestock unit, initial bid, access to credit and inverse mills ratio(lambda) are used.

4.3 Estimation procedures

Before the estimation of the parameters of the model, the data have been tested for multicollinearity and heteroscedasticity problems using different STATA commands. Multicollinearity problem arises when at least one of the independent variables is a linear combination of the others. If there is multicollinearity problem: standard errors are inflated (creates very large standard errors), sign of the estimated regression coefficients may be opposite of hypothesized direction, smaller t-ratios that might lead to wrong conclusions Maddala (1992). Thus, the existence of serious problem of multicollinearity among the variables is examined by the help of Variance inflation factor (VIF) for the continuous variables and the values of contingency coefficient (CC) for the dummy variables. For the continuous variables the VIF greater than ten reveals strong correlation and measures inflation in variance in due to multicollinearity and the value of contingency coefficient is a chi-square based measure of association where a value of 0.75 and above shows the existence of strong multicollinearity problem. Based on the results of VIF, the data had no serious problem of multicollinearity. This is because, for all continuous explanatory variables, the values of VIF are by far less than 10 (appendix II). Therefore, these continuous explanatory variables were included in the model. Similarly, the contingency coefficient (CC) results showed absence of strong association between different hypothesized discrete explanatory variables, since the respective coefficients were very low (less than 0.75) as given on appendix III. Therefore, the dummy variables were included in the model. For this reason, all of the explanatory variables were included in the final analysis. In Heckman's selection model the homoscedasticity of the error term should hold. Hence, these assumptions required to be tested. We tested heteroscedasticity for outcome equation for the different regression outcomes. We used Breusch-Pagan heteroscedasticity test to check existence of heteroscedasticity problem for errors. The homoscedasticity for the outcome equation for both the WTP and outcome equation of the models are not rejected.

4.3.1 Analysis of Determinants of WTP

4.3.1.1 Results of Probit Model for the Determinants of improved irrigation water service willingness to pay Decision of the Sample Households

In this section determinants of WTP for improved irrigation water for households who are using irrigation water are analyzed. The Heckman selection model has two parts, which are presented separately (probit and OLS). Estimation results of the Heckman two stage model are reported based on the theoretical model that has already been developed in the methodology section. The first stage is probit model used to estimate and infer the parameters of the determinants of households' willingness to pay for irrigation services decision and its effect.

As shown in Table 8, out of the total ten explanatory variables, output for the probit equation shows that five variables, were found to be significantly creating variation on the probability of households' willingness to pay for the improved irrigation water services.

Table 8: Heckman's Two Stage Econometric Model-Probit Model Results

Variables	Coefficient	Std.err	Z-value	Marginal effects
AGE	.0031903	.0027524	1.16	.0031903
GENDER	.0788193	.0768403	1.03	.0788193
EDUCLEVEL	.0278017	.0101018	2.75	.0278017
FSIZE	.0278282	.0154842	1.80	.0278282
ACREDIT	.0190325	.0284959	0.67	.0190325
TLU	.011158	.0135405	0.82	.011158
FREVISIT	-.001925	.0026295	-0.73	-.001925
CULTLAND	.2883593	.1060177	2.72	.2883593
YOIEPERR	-.0149966	.0437525	-0.34	-.0149966
HINCOME	9.94e-06	7.58e-06	1.31	9.94e-06
CONST	.4522654	.3012044	1.50	
Dependent variable	WTP			
Number of observations	246			
Log likelihood	106.08			
Wald chi 2(10)	0.000			

Source own survey 2016.

*** At 1% significance level

** At 5% significance level

*At 10 % significance level

As indicated in Table8 of the probit estimate, out of the total 10 explanatory variables hypothesized, 3 explanatory variables have significant effects on probably of respondents accepting the bid and significant effect to the log likelihood of the probit model. On the other hand the rest explanatory variables were found to be not significant at 1%, 5% and 10% probability level. In the determinants of willingness to pay estimation of the probit model, the non- significant explanatory variables were less important in explaining the variability in the willingness to pay. Thus, in this study only the significant explanatory variables were discussed below. However, it is noticed that, the non-significant variables have also contributed to the log likelihood function of the probit model.

Education level of the household head (EDUC): This variable took the expected sign and its coefficient was significant at 1% probability level. It had a positive and strong relationship with the dependent variable showing that as the education level of the household head increases, willingness to pay for improved irrigation service increases. This could be possibly because, education increases awareness and value for goods and services such as improved irrigation. result show that for each additional increment of education The probability of the willingness of the household to pay for soil conservation practices will increase by 2.78%, ceteris paribus at less than 1% probability level. One possible reason could be that more educated individuals have better understanding on the benefit of improved irrigation water provision.

The size of cultivated land (CULTLAND): was one of the hypothesized variables in the probit model and it was hypothesized, and obtained positive and significant at 5% level of significance and positive relationship with WTP. The significant result indicated that households who have higher cultivated land were more likely to pay for the improved service than the respondents with small cultivated land. The marginal analysis on the total farm size showed that households having higher farm size are less likely to pay for irrigation water. The result revealed that keeping the influences of other factors constant, a one unit increase in the farm size increase the probability of WTP by 28.83%.

Family size of the household (FASIZE): The coefficient of this variable supports the proposed hypothesis and it was found to be significant at 5% probability level. Households with higher family size are expected to pay more than those who have less family size because the proposed project was impressive to increase production and productivity to feed their large family size. Hence households with large family size may tend to pay more for the improved services. The implication of the positive sign is that an increase in household family size increases the probability of a respondent to support the proposed improved irrigation services. The implication of the positive sign is that an increase in household family size increases the probability of a respondent to support the proposed improved irrigation services. Keeping the influence of other factors constant, a 1 person increase in the total family size increases the probability of willingness to pay by 2.78%.Other studies found this result like (Chandrasekaran *et al* .2009).

4.3.1.2 Second stage of OLS estimation

The second stage of heckman model is estimating maximum willingness to pay of the households by using OLS.

Table 9: Heckman second stage OLS result

Variables	Coff.	Std.Err	Z-value
AGE	-.0481995	.01500	-3.21***
GENDER	1.861072	.53070	3.51***
EDUCLEVEL	.1649088	.14373	1.15
FSIZE	.3424562	.13775	2.49**
ACREDIT	-.606164	.24790	-2.45**
BID1	-.0277293	.01258	-2.20**
TLU	.3004031	.16661	1.80*
FREVISIT	.1114387	.03113	3.58***
CULTLAND	1.268291	.96581	1.31
YOIEPERR	.0299846	.25229	0.12
HINCOME	.0002197	.00009	2.56**
LABMDA	-0.4769	-3.72	0.000***
Constant	-.6730754	1.7913	-0.38
Dependent Variable	Maximum willingness to pay		
Number of observation	246		
Prob>F	0.0000		
R –square	0.5323		
Adjusted .R	0.5089		

Source own survey, 2016.

***At 1% significance level
** At 5% significance level
*At 10 % significance level

Twelve explanatory variables, including LAMBDA were entered in the model to determine coefficients statistical significance for the second dependent variable (MWTP). Initial bid was included as an explanatory variable for MWTP for households who decided to pay for the irrigation water service. Of these, eight were found to be statistically significant at 1 %, 5 % and 10 %significance levels influencing the extent of maximum willingness to pay for the improved irrigation water service. The variables are: age and education level of households, initial bid, frequency of visit, household income, total livestock unit, family size and correct selectivity bias (LAMBDA). The rest of the variables are not statistically significant, implying that they are less important in influencing MWTP pay for improved irrigation water service.

The R^2 for the estimated equation is 0.5323. According to Mitchell and Carson (1993), if a CV study failed to show an R^2 Less than 0.15 the result is open to question. So we can see that our model has passed this criterion. This indicates that the linear regression model explains about 53.23% of the variation in the maximum amount of price the farmers' are willing to pay.

Gender of the household head (GENDER): Gender of the household head was found to have a positive effect to willingness to pay for improved irrigation water. The result of the model revealed that male headed household heads were found to be willing to pay more for improved irrigation water than female headed households. The sign of gender turned out to be consistent with the prior expectation and it was positively and significantly related with the dependent variable at 1% level of significance. This is mainly because; female headed households have less resources possession endowment as well as some cultural constraints than male headed households and female have less access to information about the technology due to cultural constraint than male headed household, then due to the case of sex difference of household head has influence in the maximum willingness to pay in improved irrigation water service.

Age of respondent (AGE): significant variable at 1% probability level and negative relationship with MWTP. This means older people are less willing to pay than the younger. This because of the probability that older people prefer to keep tradition way and people of a relatively old age may have a shorter planning horizon than younger people and they may become more conservative with regard to spending money. Thus, they will stick to the traditional irrigation water supply system and the probability of willing to pay for the initial bid became less.

Family size of the household (FASIZE): The coefficient of this variable supports the proposed hypothesis and it was found to be significant at 5% probability level. Households with higher family size are expected to pay more than those who have less family size because the proposed project was impressive to increase production and productivity to feed their large family size. Hence households with large family size may tend to pay more for the improved services. The implication of the positive sign is that an increase in household family size increases the probability of a respondent to support the proposed improved irrigation services. (Gebrelebanos, 2013) and (Paulos, 2002)

Bid offered (BID): Bid offered has been found to be negative and significantly related at 5 % significance level with willingness to pay for irrigation water services. This implies, the probability of a positive response to the initial bid increases with decrease in the offered bid which indicates that the likelihood of accepting an offered bid amount increases as the bid amount goes down and vice versa which is consistent with the economic theory.

Access to credit (ACREDIT): access to credit has been significant at 5% significance level and unexpectedly positive relationship with MWTP**.** This implies households who get credit access is maximum willingness to pay .this because of farmers who have access and those who have received credit mostly failed to invest in irrigation water and other agricultural purposes

Total livestock unit (TLU): TLU has an expected positive effect related to likelihood of willingness to pay. The coefficient of this variable was significant at 10% probability level which shows TLU possession increases MWTP. Livestock is considered as a measure of wealth and increased availability of capital which make MWTP in irrigation water more feasible. This is consistent with the fact that TLU is one of the wealth indicators and should have a positive contribution to MWTP.

Frequency of development agent visit (FVISIT): this variable is statistically significant at 5% level of significance and has the expected positive sign. The positive relationship may indicate that in the study area, those households who get technical advice, training or those who participated on field demonstrations are well aware of the advantage of agricultural technologies and willing to adopt new technologies and produce more, thereby improving the household level of income.

Household income (HHINCOME): as expected, income (total annual income) is positive and significant 5%level of significance. Implying that those farm households who obtained higher yields benefit more from an improved water irrigation system, and therefore state a higher MWTP. This positive effect indicated that respondents with higher annual income were more willing to pay than households with lower income.

Inverse Mill's Ratio (LAMBDA): The inverse Mill's Ratio is related to the intensity of MWTP and found to be statistically significant on the basis of the regression analysis result indicating the presence of selectivity bias. This implies that there are other unmeasured factors that determine the intensity of payment for the product other than those variables which are included in the model.

4.3.1.3 Mean willingness to pay

Mean willingness to pay calculated by using the following formula mean WTP=-α/β Where α = a coefficient for the constant term or the intercept of the model and β = slope coefficient of bid values that will be offered to the respondents. Mean WTP= from appendix 2 we get coefficient of bid price and value -16.597/-0.3789=43.8 birr /0.25 ha of land If we multiply the value of the mean willingness to pay 43.8birr/0.25 ha by 4 we get the mean willingness to pay value per hectare. The estimated value was 175 birr /ha of land. To compare this value with the actual cost of the project incurred on operation, maintenance and removal of over accumulation of sediment from the dam it was difficult to get the update data in the project area. However, a project and consultancy report by DWWSES (Desta Worecha Water Supply Engineering Service, 2008), reported that it costs on average about 2200 Ethiopian birr/ ha/year. When we compare the cost incurred with the results of farmers Mean WTP, the WTP of farmers covers only the fraction of the cost incurred.

4.4 Estimating Total willingness to pay

An important issue related to the measurement of welfare using WTP is aggregation of benefit. There are four important issues to be considered regarding sample design and execution in order to have a valid aggregation of total benefits: population choice biases, sampling frame bias, sample none response bias and sample selection bias. Random sampling method was used in this study using a list of households. A face to face interview method is used and Protest zero responses were excluded from the analysis and possibility of Protest zeros was accounted in the estimation of the aggregate benefit. Hence, the result indicated that none of the above biases was expected in the analysis. Thus, one of the objectives of this study was estimating the total households' willingness to pay for the improved irrigated water service and the potential revenue that accrue due to irrigation pricing. However, there is a difficulty in defining the population over which the aggregation will take place when the commodity in question is irrigation. In other contingent valuation studies like improved urban drinking water supply, one can use the total population of the town in which the study is conducted to obtain the aggregate demand and revenue. This is not possible in this study since not every household in the survey Woreda have access to irrigation. Due to natural and technical factors some households do not have access to irrigation water.

Table 10: aggregate WTP and revenue (in birr) from the improved irrigated water service

WTP class interval in birr/0.25ha	Mid or class Mark for WTP	No of sampled HHs &cumulative of the HHs		Total No of Households	Total revenue
(1)	(2)	(3)	(5) %	(6)	(7)
0-20	10	63	25.61	6838	68380
21-40	30.5	44	17.89	4776	145668
41-60	50.5	42	17.07	4559	230229.5
61-80	70.5	38	15.45	4125	290812.5
81-100	90.5	41	16.67	4450	402725
101-120	110.5	2	0.81	217	23978.5
121-140	131.5	12	4.88	1302	171213
141-	151.5	4	1.63	434	65751
Total		246	100	26701	1398758

Source own survey 2016.

From table 10,the class interval of willingness to pay is given in column (1) and the midpoints of each interval are shown in the column (2) and column (4) show the number and percentages of the sampled households whose maximum willingness to pay within the given boundaries. Total number of households, which obtained by multiplying total number households in the irrigation command area by the proportion of households falling in each interval, indicates in column (5).In column (6) total revenue willingness to pay per 0.25 hectare of land .

4.4.1 Estimating of aggregate revenue of WTP

The maximum revenue that will collect at each price level which is indicated in column 7 is, obtained by multiplying of total households of the command area by midpoint of WTP .This implies that we obtained 1398758 birr per 0.25 ha of land and. If we multiply the value by four we get 5,595,032birr/yr. As we can see table 10 the highest potential revenue is 402725birrper year this indicates 90.5birr/0.25ha in year at this price 38 sampled households are willing to pay and the lowest potential revenue is 65751birr/year this indicates 151.5birr/0.25ha at this price 4 household are willing to pay .From this we conclude at the price increase potential of willing to pay is decrease.

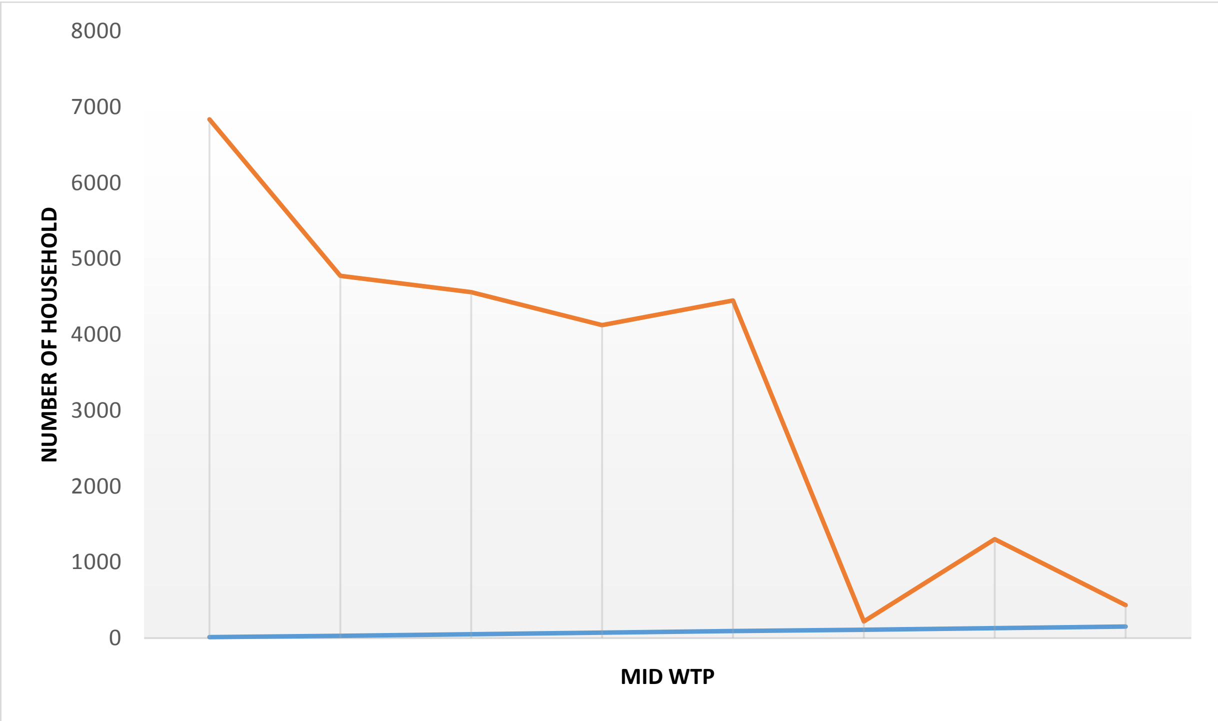

Figure 3: Relationship between number of household and willingness to pay of different price level.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The major objectives of this study were to identify determinants of WTP, to calculate mean willingness to pay and to estimate the total WTP estimate of household in koga irrigation project Mecha district Amhara regional state Ethiopia .To achieve these objectives ,contingent valuation methods (CVM) was used in order to elicit households WTP for the improved irrigation water service to specify single bounded dichotomous question followed by open ended follow up question were used .The data used for this study were both primary and secondary sources. The primary data obtained from face to face interview of 246 sampled households. The secondary data was obtained from published and unpublished documents.

The data was analyzed using descriptive and econometric statistical methods. Socio economic and demographic characteristics of the sampled households were described using the descriptive statistical data analysis techniques.. However, the determinants that affect households' willing to pay for the improvement service, maximum willingness to pay (MWTP), and the mean willingness to pay for improved irrigation water service was determined using the Heckman two stage sample selection model. The data was analyzed using STATA version 13.0 statistical software.

The first stage model output shows that, out of the 10 hypothesized variables three of them significantly affect households' WTP for irrigation water services., education level, Family size and household income are positively affects WTP of the households; this implies that each of the variables increase WTP of improved irrigation water household also increase.

In the second stage of the Heckman model, twelve explanatory variables including Start bid and invers Mill's ratio (Lambda) were used to find out the major determinant of MWTP. Out of twelve explanatory variable nine of them significantly affected MWTP. Namely age, access of credit and initial bid price negatively affects MWTP. The other gender, family size, total livestock unit, frequency of development agent visit and income positively affects MWTP. It is, therefore, important for policy and water managers to address the water problem in these areas having taken into consideration these important characteristics affecting MWTP. From the contingent valuation method (Hypothetical market scenario) indicates that sampled households mean willingness to pay 175 birr/ha/year and the total willingness to pay of the four sampled kebeles is 1,398,758 birr/year. In the study area the secondary information indicated that there are no strong and accountable institutions that strongly assist farmers. Thus, the government should strengthen strong and accountable water users associations that convey information to farmers, buying farm inputs on behalf of farmers and marketing of crops. Moreover, there is a need to reinforce the existing agricultural extension system to provide training on the use of irrigation water management, the selection of profitable crops and arrangement of proper storage for perishable products. In this concern, it is also necessary to highlight the importance of private investor's involvement and establishing of public private partnership in the irrigation area.

5.2 Recommendations

- Farmer's willingness to pay has shown that there is opportunity for policies or projects aimed at improving irrigation water using irrigation water price system that can be used for both improving the management of the irrigation water and the cost recovery mechanisms. This is important particularly because of the water use completion as a result of high demand water by the farmers. Households in the study areas showed that they are capable of paying an amount of up to 175 birr/ha/year. The implication of this is that partial recovery on investment costs and operating costs required for sustainability of the irrigation water can be achieved through the introduction irrigation water tariffs.

- The results from the study showed that family size positively affects the MWTP. This shows the extent of how irrigation water is crucial to feed the large number of family size in the study areas hence government should look into it that the proposed improved irrigation water project is implemented. This improved irrigation water scenario project has the potential to uplift rural livelihoods in the sense that with improved irrigation water, households can use the water efficiently for non-domestic purposes like backyard garden irrigation, livestock rearing, traditional beer production, etc., which can enhance households" income thus reduce poverty.

- Furthermore, the results of the study also reveal that variables such as total livestock holdings, and frequency of visit by the developing agents have a positive effect to WTP for improved irrigation water in the study area. This implies that for successful management of natural resources such as improving irrigation water should target the poor so that they would be able to pay. And, awareness creation using development agents improve the thinking of households about the use of improved irrigation water and their willingness to pay for the improved services.

- Evidence from the study support that, age, gender, family size, income, education, frequency of visit by developing agent and total livestock units are significant factors that explain households' WTP. The mean WTP is found to be 175 Birr per year with an aggregate benefit of 1,398,758birr per year. Therefore, actions to be made towards these socio-economic aspects that significantly influenced households WTP is a first step to improve irrigation water and sustain irrigation water use to enhance Agricultural production. Policy thrust should focus on enhancing income through income improving mechanisms among others.

- Finally, given the proposed improved irrigation water project in the study area, the study used CVM in estimating willingness to pay. However, as future research area, one can use other estimations techniques like travel cost method (TCM), Choice Modelling (CM) and averting behavior method (ABM) can further be used to compare and validate the values of WTP. This would further probably give more scope on WTP and on the setting of a socially acceptable irrigation water price. Moreover, one can do further research on labor as a payment vehicle than money because such knowledge can enhance planning processes while also diverting government expenditures to other national priorities.

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APPENDIXES

Appendix I

A formal survey questionnaire designed for thesis proposal entitled on DETERMINATS OF FARMERS' WILLINGNESS TO PAY FOR IRRIGATION WATER IN KOGA DAM IRRIGATION SCHEME, AHMARA NATIONAL REGIONAL STATE, ETHIOPIA The thesis is designed to estimates the determinants of willingness to pay for irrigation water services that farmer attaches and to identify the major factors influencing farmer's willingness to pay. This study, first it will assist the Government of Ethiopia to implement the cost recovery principle in the rehabilitation of old schemes and construction of new schemes. Second, it has paramount importance to ensure the availability of efficient and effective water services that satisfy the basic requirements of farmers.

Part I: General Household Information (socio-economic status of HH)

1. Age of respondent _______________ years
2. Gender of the respondent 1. Male 2. Female
3. Level of education of the respondent

1. Illiterate 2. Primary school 3. Secondary school 4.Others (specify)____

4. Total family size of the household?______________ (number of family members)
5. If you have farm experience, how many years of farm experience do you have since started farming? _________________years

Part II. Credit, market and agricultural extension services

6. Do you have access to formal or informal credit services whenever you need to borrow?
   1. Yes 2. No
7. What are the different sources of credit (multiple answers possible)
   1.Friends and relatives 2. Small rural micro finance institutions (ACSI[4]) 3. Banks 4. Others (specify)________________
8. If you have received any type of credit in 2007 E.C. how much money have you borrowed? __________________ birr
9. If you did not borrowed money, what were the reasons why you did not receive a credit (multiple answer is possible)
   1. Loan was not timely available 2. Repayment term was not favorable

3. Payback period was short 4. Higher interest rate

5. No formal or informal institution in the area 6. Others (specify) _________

10. Have you received any type of extension services in 2007 E.C 1. Yes 2. No

11. If yes, to question 10, frequency of visit by development experts _______ Days/year

Part III. Land resource, land use and tenure system

12 Do you have your own farm land? 1. Yes 2. No

13 If yes, to question 12, how large is the total size of your land ___________in hectares/ (Kada[5])

14 How many hectares (Kada) of land did you cultivate in 2007 E.C?

1. Owned__________ 2. Rented in _____________ hectares/(Kada)

Part IV: Rain-fed and Irrigation Agriculture

15 Do you have an irrigable land?

1. Yes 2. No

16 If yes, to question 15, what is the total size of your irrigable land?

1. Owned _________ 2. Rented in _____________hectares/ (Kada)

17 Do you have irrigation farming practical experience?

1. Yes 2. No

18 If yes, to question 17, how many years of experience do you have?_ Years

19 Have you get any practical training in the use of irrigation farming management?

1. Yes 2. No

20 If yes, to question 19, by whom (multiple answer possible)?

1. Bureau of Agriculture development agent
2. District experts
3. Others (specify)_________

21 Did you encounter irrigation water scarcity problems

1. Yes 2. No

[5]Kada is a local unit, 1kada =0.25ha

22 If yes, to question 21, what do you think was the reasons for scarcity or insufficient availability of irrigation water?

1. Population pressure   2. Deforestation   3. Illegal Dwellers
4. Soil erosions   5. Others (specify)______________________

Part V: The Contingent Valuation (CV) Scenario and Willingness to Pay (WTP) questions

You might have perceived and noticed that the government of Ethiopia has constructed the Koga irrigation dam project using a fund from international donor organizations. The dam will support farmers to produce crops of different types three times a year by providing adequate irrigation water, water for livestock's and for domestic supply. This aims at improving peoples' food security and self-sufficiency. However, irrigation water services must be maintained and improved through time in order to ensure the long and short term benefits from irrigation water and to achieve the stated objectives of the irrigation project. Therefore, to get water throughout the whole year, there is a need to improve the irrigation water services. The improvement plan includes, for example, maintaining the technical stability of the dam and its irrigation channels, replacing old irrigation weirs by new once for ensuring a proper flow of water control, and constructing and maintaining channels and drainage ways to get proper irrigation water. Since these measures are costly, money is required for implementing the improvement plan. The Ethiopian government intends to finance improvement measures through beneficiary farmers in the command area. A practical consequence could be that you will be charged a yearly irrigation water fee through water use associations based on the hectares or "Kada" of irrigation land.

23 Do you have an irrigable land? 1. Yes   2.no

If the answer yes for question 23 go to the next

24 So, if the irrigated water service is provide, are you willingness to pay the irrigated water service? 1. Yes   2. no

25 If the answer is yes, would you willingness to pay _______________birr/yr/ha for the improved irrigated water service?

26 What is the maximum amount you want to pay per hectar of land _________________birr/yr/ha

27 If you are not willing to pay, what are your reasons (multiple answers possible)?

1. I do not trust the improvement
2. I cannot afford to pay
3. I am indifferent
4. Irrigation water should be provided free of charge
5. The existing irrigation water service is satisfactory
6. The government is responsible to finance
7. Others (Specify)____________________

Part VI: Income source and wealth indicators

28 Do you or any of your family members engaged in any other business other than agriculture (like off-farm activity)? 1. Yes 2. No

29 If yes, to question 28, which type of business? (multiple choice possible)

1. Weaving 2. Milling 3. Livestock trade 4. Pottery, metal works

5. Sale of local drinks 6. Sell of firewood and grass 7. Daily labourer

8. Others (specify)_______________

30 How much money do you earn from the off-farm activity per year? ______ Birr

31 What is the amount of annual income? ________________ Birr.

32 Do you have your own livestock? 1. Yes 2. No

33 If yes, to question 35, list down the type of animal and numbers.

Livestock Type	Numbers
Ox	
Cow	
Calve	
Heifer	
Horses	
Mules	
Donkey	
Goats	
Sheep	
Chicken	
Others (specify)	

APPENDIX 2

OLS Result

variables	Coef. Std.	Err.	t value
AGE	-.1739768	.1552563	-1.12
GENDER	8.143047	4.526321	1.80
EDUCLEVEL	1.653377	.6601789	2.50
FSIZE	7.642053	.914148	8.36
ACREDIT	.5895538	1.869289	0.32
BID1	.3789314	.1023232	3.70
TLU	1.676007	.8709878	1.92
FREVISIT	-.0324697	.1606501	-0.20
CULTLAND	17.1757	6.865528	2.50
YOIEPERR	-1.164784	2.581969	-0.45
HINCOME	.0017055	.0004808	3.55
_cons	-16.59775	18.87274	-0.88

Appendix 3

VIF

Variable	VIF	1/VIF
HINCOME	1.91	0.522492
TLU	1.90	0.526442
CULTLAND	1.59	0.627332
EDUCLEVEL	1.52	0.659601
FSIZE	1.44	0.696369
GENDER	1.41	0.711026
AGE	1.35	0.739991
ACREDIT	1.14	0.875871
YOIEPERR	1.13	0.885517
FREVISIT	1.13	0.886432
BID1	1.10	0.906275
Mean VIF	1.42	

Appendix 4 Correlation coefficient between independent variables

	AGE	GENDER	EDUCLEVEL	FSIZE	ACREDIT	BID	TLU	FREVISIT	CULTLAND	YOIEPERR	HINCOME
AGE	1										
GENDER	0.0002	1									
EDUCLEVEL	-0.4091	0.2779	1								
FSIZE	0.0347	0.2188	-0.0489	1							
ACREDIT	-0.0792	0.1127	-0.0257	0.1463	1						
BID	0.0100	0.0261	-0.1344	0.0900	-0.1016	1					
TLU	-0.0745	0.3764	0.1799	0.4512	0.1246	0.1303	1				
FREVISIT	-0.0020	0.0597	0.0638	0.2337	0.1974	0.0054	0.1880	1			
CULTLAND	0.2177	0.2555	0.0284	0.3540	-0.0337	-0.0387	0.3803	0.0371	1		
YOIEPERR	0.0255	-0.2193	-0.0023	-0.0385	0.1261	-0.1400	0.0097	-0.0307	-0.0751	1	
HINCOME	-0.1101	0.3593	0.3437	0.2312	0.0964	-0.0245	0.5674	0.1619	0.4600	0.0010	1