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ADDIS ABABA UNIVERSITY  
SCHOOL OF GRADUATE STUDIES

ESTIMATING WILLINGNESS TO PAY FOR RURAL WATER SUPPLY: THE CASE  
OF ADA'A-LIBEN DISTRICT, CENTRAL ETHIOPIA



by

DUNFA LEMESSA



JUNE 1998

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SUPPLY: THE CASE OF ADA'A-LIBEN DISTRICT, CENTRAL  
ETHIOPIA

A thesis presented to the School of Graduate Studies in  
Partial fulfilment of the Requirements for the Degree of  
Masters of Science in Economics (Economic Policy Analysis)

by

*Dunfa Lemessa*



School of Graduate Studies  
Faculty of Business and Economics  
Department of Economics

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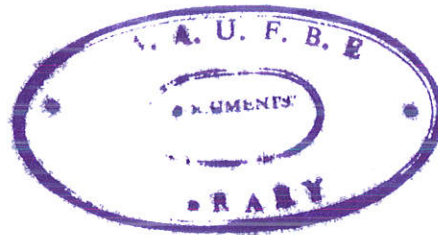


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**ADDIS ABABA UNIVERSITY**  
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*Estimating Willingness to pay for Rural Water Supply:  
The Case of Ada'a-Liben District, Central Ethiopia*




By  
**Dunfa Lemessa Aga**  
Faculty of Business and Economics


Approval by Board of Examiners:



Dr. Alemayehu Seyoum  
Advisor

  
Signature

Ato Getachew Yoseph  
Examiner

  
Signature

Dr. Abdulhamid Bedri K.  
Examiner

  
Signature

Dedicated to my late father

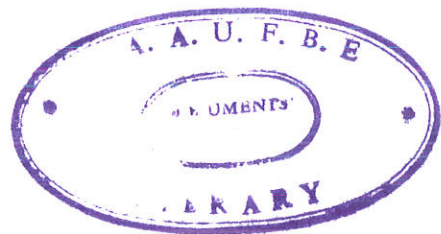
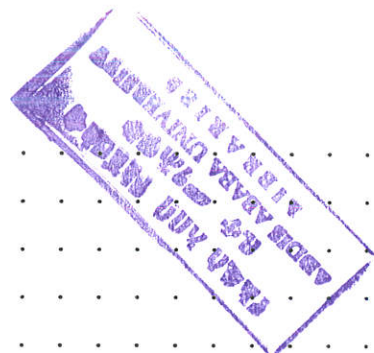


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## Abbreviations

AAU = Addis Ababa University  
AERC = African Economic Research Consortium  
ADADO = Ada'a-Liben District Agricultural Development Office  
BoPEDORS = Bureau of Planning and Economic Development of  
Oromiya Regional State  
CSA = Central Statistical Authority  
GDP = Gross Domestic Product  
ha = hectar  
hr = hour  
Km = Kilometre(s)  
KW = Kilo watt(s)  
m<sup>3</sup> = cubic meter  
MoA = Ministry of Agriculture  
MoH = Ministry of Health  
MoWR = Ministry of Water Resources  
MW = Megawatt(s)  
NGOs = Non Government Organizations  
PAs = Peasant Associations (Administrations)  
WTP = Willingness To Pay



## Abstract

Currently only 26% of Ethiopian population get safe drinking water, which is the lowest access to safe water provision in the world. The coverage of the rural areas is even lower at 19%, while in the urban areas it is 77%.

These facts are indicator of the necessity of a major effort to improve potable water in the country, particularly in the rural areas. Provision and maintenance of safe water supply have to do a lot with the capacity to pay for the services in addition to setting up facilities. A major question is whether users could pay or not. This thesis addresses this issue using contingent valuation method in the absence of directly observable demand for water.

A cross-section data was collected from eight peasant associations and 228 farm households in the Ada'a-Liben district to analyze factors that will determine rural households' willingness to pay for improved rural water provision. Households in this sample survey use different water sources. Among them 63.6% use poor water quality for drinking from river, lake and well while 36.4% use from improved sources (hand pump, electric pump and water vendor).

The results of this study show that income, distance from current water source, quality of water type used and availability of credit are the major determinants of willingness to pay for safe water.

The policy implication of the study is that rural households are willing to pay for improved rural water provision if it is supplied at an affordable price.

Therefore, it may be pragmatic, both in terms of saving resources and sustaining the service, to put a price on safe water.

## Acknowledgment

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## CHAPTER ONE

## I. BACKGROUND AND JUSTIFICATION



## 1. Introduction.

Ethiopia is one of the least developing countries with a population size of 56.4 million that is growing at the rate of approximately 3% annually. The majority of the people (85%) live in the rural areas (World Bank, 1997, CSA, 1996 and MoWR, 1997).

Agriculture dominates the Ethiopian economy, forming 57% of the GDP. Only 10% and 33% come from manufacturing and service sector respectively (World Bank, 1997). Besides, agriculture contributes 90% of foreign exchange earnings and 80% of employment (MoA, 1994, MoWR, 1997 and World Bank, 1997).

Ethiopia has a great potential of water resources in East Africa. It has many rivers, lakes, and ground water sources. The surface water potential is estimated to be 110 billion m<sup>3</sup> and the ground water source is about 2.6 billion m<sup>3</sup>/annum. The major river basins are the *Abbay* (Blue-Nile), the *Tekeze*, the *Baro-Akobo*, the *Omo-Ghibe*, the *Genale-Dawa*, the *Wabi Sheble*, and the *Awash*. The potential irrigable land area of the country is 3.5 million hectares and the hydropower potential is 60 billion KW hr/year. So far only 160,000 hectares are irrigated and 410 MW of hydropower is developed (MoWR, 1997).

According to different sources the percentage of the Ethiopian population that gets safe drinking water is only 26% (MoWR 1997, MoH, 1995 and Fisseha, 1997). This percentage indicates the lowest standard of safe water provision in the world (World Bank, 1994). There is also a great disparity between rural and urban population of the country in getting access to potable drinking water. Studies indicate, urban coverage is 77% while rural coverage is 19% (MoWR, 1997 and MoH, 1995). This clearly shows that safe drinking water provision is biased against the rural population which calls great attention for future improvement.

Lack of potable drinking water causes different water borne diseases such as diarrhoea, typhoid, cholera, worms, hepatitis, etc, that cost human life. For example, in Sub-Saharan Africa contaminated drinking water and poor sanitation contribute to infectious and parasitic diseases that account for more than 62% of all deaths, twice the level found in Latin America and twelve times the level in industrialized countries (World Bank, 1994). The insufficient medical treatment with that of lack of clinics, professional experts and medical equipment exacerbates the problem in rural areas.

According to some reports about 60% - 80% of the diseases that are found in Ethiopia are communicable that could be avoided by improving the environment through provision of safe drinking water and sanitation (MoH, 1997).

Safe water provision is a prominent and determining factor in having a healthy population. An improved water service is a wheel for economic development as long as its existence enables to have healthy and productive population that has a great role in increasing the productivity of the economy.

In developing countries, fetching drinking water is considered to be the normal activity of women and children regardless of their work load (World Bank, 1994). Women are busy on agricultural activities, home management, and child care.

If measures are taken in provision of improved water supply, it will substantially reduce work load of women work in physical terms and time consumption (Churchill, et al., 1987).

As far as the structural nature of water supply of rural Ethiopia is concerned, previously the provision of safe rural water supply was run through the Ministry of Health, National Water Resource Commission (Water Resource Commission) and NGOs. Currently, it is provided by the Ministry of Water Resource at a national level, by bureaus of Mine, Energy and Water Resource at regional level and NGOs, while the Ministry of Health merely deals with supervision and control of sanitation.

Concerning infrastructural activities of water supply, the three parties: namely, government, NGOs, and local community consummate. Both government and NGOs participate in assessing

community's needs and contribute capital, whereas the community contributes labour and locally available materials.

Determining the current status of rural water schemes of the country is very difficult due to lack of sufficient data, which is the result of weak information flow between the Ministry of Water Resource and the Regional States. Nevertheless, a report from the *Oromiya* Regional State indicates that in 1995 there were 2468 rural water schemes in *Oromiya*, of which 497 (20%) were non-functional due to lack of timely maintenance, shortage of spare parts and poor logistic support (BoPEDORS, 1996).

Different factors are responsible to the problem. First, non existence of institution that is technically and organizationally strong to run water services and maintain the installed schemes timely stand out. Second, there is also lack of sufficient finance to expand rural water services.

Taking these problems into consideration, the study will utilize contingent valuation method to estimate the rural households' willingness to pay for improved drinking water provision. Using such method is important since it may indicate ways of alleviating financial constraints which will help to expand improved rural water provision for rural community.

## 2. Statement of the problem

The main problem of the study area is lack of a responsible body that undertakes appropriate study, provides improved rural water supply and maintain the existing improved water supplying schemes.

The Regional Mine, Energy and Water Resource bureau has no structure at the district level which is responsible for rural water supply in *Ada'a-Liben* district. However, urban areas have Water Resource Service Authority under Municipalities that is responsible to provide improved water supply for urban dwellers *ceteris paribus* (such as inefficiency). Therefore, this study is conducted in order to address the problem of the study area to get improved rural water provision.

## 3. Objectives

The overall objective of the study is to examine the problems and the possibilities of improving rural water supply in Ethiopia with a particular emphasis on *Ada'a-Liben* district. Specifically, the study will attempt:

1. to elicit willingness to pay for improved rural water supply<sup>1</sup> from hypothetical market of sampled households;

---

<sup>1</sup> Improved rural water supply implies a clean water that is provided by hand pump, stand point or yard type and accessible for rural households.

2. to analyze factors that determine willingness to pay of rural households for improved water service and
3. to estimate expected revenue from the provision of improved water supply in the study area.

#### 4. Significance of the study

The research will help to explain the current condition of rural water provision in the study area and will suggest alternative solution for the expansion of rural water provision. Hence, the study will initiate potential researchers and policy makers on rural water provision of the country.

#### 5. Scope of the research

Rural water supply includes both safe drinking water and irrigation water provision. This research, however, deals with improved rural drinking water in *Ada'a-Liben* district of central Ethiopia. Thus, rural water supply for irrigation purpose is beyond the scope of the research.

#### 6. Organization of the study

The rest of the thesis is organized as follows: relevant literature is reviewed in chapter two. In chapter three, research methodology is explained followed by chapter four that represents

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result of the study. Finally, concluding remarks and policy implications are given.



## CHAPTER TWO

## II. LITERATURE REVIEW

## 1. Definition

Contingent valuation is a survey technique that attempts to elicit information about preferences for a good or services by asking individuals questions about how much they value a good or service. It uses survey questions to elicit people's preferences for public goods by finding out what they would be willing to pay for specific improvement in them (*Mitchell and Carson, 1989*).

The respondents will be asked different questions on how much they would pay to ensure a welfare gain from a change in provision of environmental commodity or how much they would be willing to accept in compensation to endure a welfare loss from a reduced form of provision (*Bateman and Turner, 1993*).

Contingent Valuation (willingness to pay) studies are simply household surveys in which a member of the household is asked a series of structured questions designed to determine the maximum amount of money the household is willing to pay for a good or services (*Altaf, et al., 1992*).

Contingent valuation method basically asks people what they are willing to pay for a benefit, and/or what they are willing to

receive by way of compensation to tolerate a cost (Pearce, et al., 1994).

## 2. Theoretical Background

Contingent valuation was developed in the past three decades. It was first applied by the economist *Robert K. Davis* in the early 1960s when he used questionnaires to estimate the benefits of outdoor recreation in a *Maine* back-woods area (*Mitchell and Carson, 1989*). Since this time it has been used by different economists and environmental economists to value non-market environmental goods such as water quality, air quality and pollution, hunting and fishing, forest, toxic disposal, value of wild life, value of parks, to value risk reduction in human health, etc.

The theoretical underpinning of contingent valuation method is based upon welfare economics which is part of normative economics. Normative economics is one of the two branches of economics which seeks to make judgments about the desirability of having government undertaken particular policies (*Mitchell and Carson, 1989*).

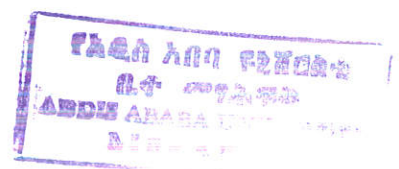
Much of the notion of welfare economics was dominated by social welfare function which is Benthamite Utilitarian in approach. According to this approach welfare economics is defined as the sum of utility of the members of that society for the production

of different combination of goods. Here utility was assumed to be measured in cardinal sense and comparable across individuals. However, late 1930s this notion was rejected in favour of ordinal utility with no comparability across individuals. This severely undermine the theoretical basis of social welfare function.

In search for a new welfare criteria, economists turned to pareto criteria which states that policy changes make at least one person better off without making any one worse off is pareto improvement. This pareto improvement occurs from the point in the interior production possibility curve until production possibility frontier is reached. However, pareto improvement is much weaker guideline than social welfare function that specifies a unique optimal point for the economy on the production possibility frontier.

Another applied side of welfare economics is benefit-cost analysis. It operationalize pareto criteria by trying to find ways to place a dollar value on the gain and loss to those affected by change in the level of provision of a public goods. This helps to determine whether a policy change is pareto improvement.

Estimating monetary values of environmental resources concerned with how changes in the provision of environmental goods have impact on the utility of individuals. Traditionally, the welfare gain or loss from such change is approximated by consumer surplus



that is represented by the area under the Marshallian demand curve (Bateman and Turner, 1993).

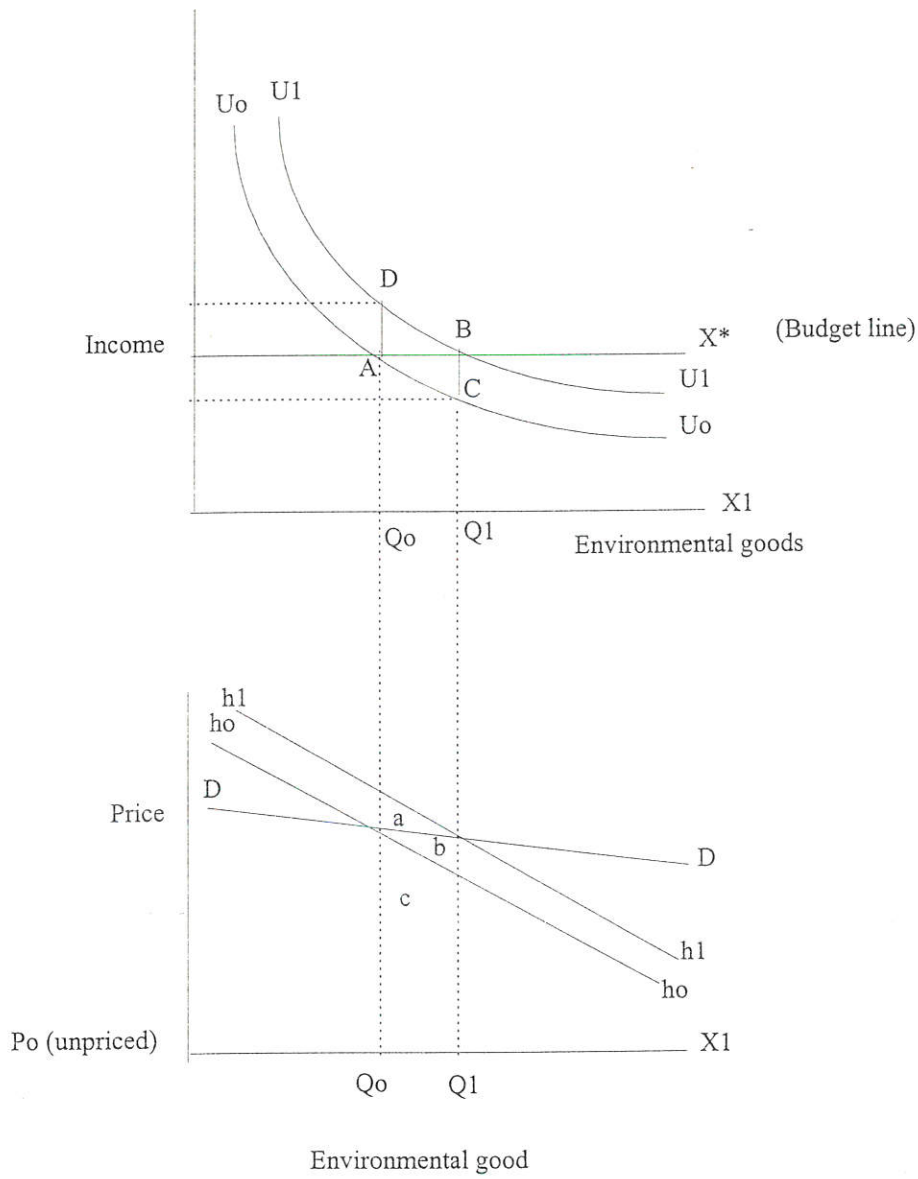
The Marshallian demand curve shows how much the quantity consumed of a normal good increase as its price falls, so that it indicates full price effect. However, it has a practical problem to use for unpriced environmental goods because it keeps income constant.

The theoretical accurate measure of welfare change is therefore, to use Hicksian demand curve because it compensates for the income effects by holding utility constant. Compensating surplus measures can be interpreted as the consumers' maximum willingness to pay in order to gain the quantity increase and still maintain his/her initial level of utility (Mitchell and Carson, 1989).

Contingent valuation measures income compensated (Hicksian) demand curve that represents welfare change as money income adjustment necessary to maintain a constant level of utility before and after the change of provision. The two welfare change measures in this approach are compensating variation and equivalent variation. Compensated variation is the money income adjustment (welfare change) necessary to keep an individual at his initial level of utility ( $U_0$ ) throughout the change of provision, while equivalent variation is the money income adjustment (welfare change) necessary to maintain an individual at his final level of utility ( $U_1$ ) throughout the provision

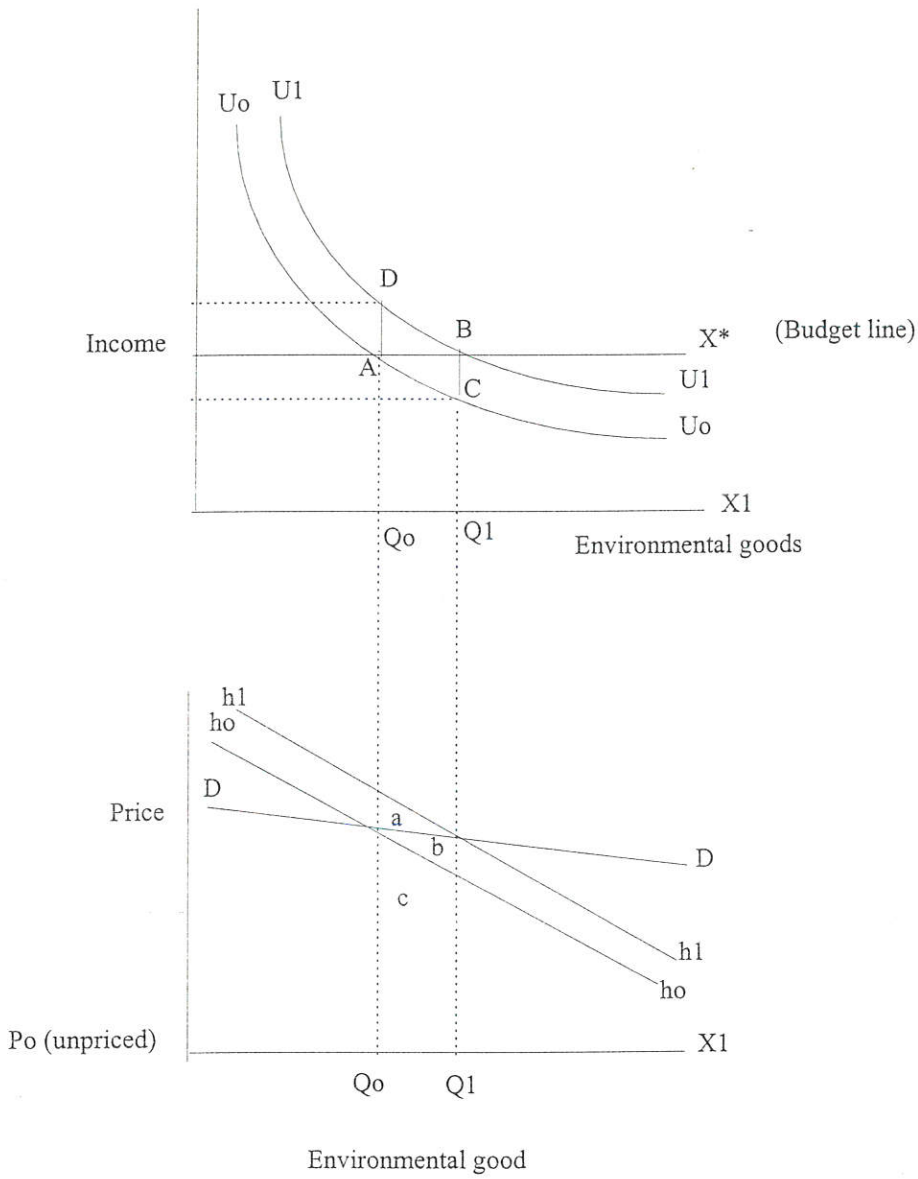
change. Thus, we have two approaches to measure welfare changes. These can be either positive (a welfare gain) or negative (a welfare loss). For a proposed welfare gain the compensated variation measures tell us how much money income the individual would be willing to pay (WTP) to ensure that the change occurs; while the equivalent variation measure tell us how much extra money income would have to be given to an individual (WTA) for the person to attain the final improved utility level in the absence of provision change occurring. The above discussions can be illustrated using graphs on page 13.

Figure 1: Compensated welfare change measures for unpriced quantity constrained good



Source:- Adopted from "Sustainable Environmental Economics and Management," by Bateman and Turner, 1993.

Figure 1: Compensated welfare change measures for unpriced quantity constrained good



Source:- Adopted from "Sustainable Environmental Economics and Management," by Bateman and Turner, 1993.

On the above diagram the horizontal line represents the provision of environmental goods, the vertical line shows income and  $x^*$  represents budget line. The initial consumption level is A at  $Q_0$  on initial utility curve  $U_0$ . Suppose that a welfare gain is proposed, increased in provision of  $X_1$  from  $Q_0$  to  $Q_1$ . This show as a move from point A on  $U_0$  along the budget line to point B on  $U_1$ . This corresponds to the full price effect shown by Marshallian demand curve in the lower panel and the corresponding increase in consumer surplus shown by the area  $b+c$ . Despite  $X_1$  being itself un priced, its increased provision will still have income effect by releasing some of that income previously spent upon priced goods. Consumer surplus is therefore only an approximate measure of the true welfare change. We can compensate for the income effect and obtain a correct welfare change measure by asking how much the individual is willing to pay to insure that the increase in provision does occur. The individual should prepare to give up the amount of income BC which turns him to point C on the initial utility curve  $U_0$  but with the increased provision  $Q_1$ . The corresponding compensated demand curve  $h_0h_0$  is shown in the lower panel and it is the area  $c$  under this curve.

Suppose the proposed welfare gain ( $Q_0$  to  $Q_1$ ) is not implemented. The authorities could still raise the individual's utility from  $U_0$  to  $U_1$  by increasing money income by the amount AD (the equivalent value of extra income which individuals are willing to accept/WTA/ to forgo the welfare gain change in provision). This moves the individual to point D on  $U_1$  and maps out the

compensated demand curve  $h_1h_1$  in the lower panel. The correct welfare measure of this scenario is equivalent surplus ( $ES_{WTA}$ ) that is represented by the area  $a+b+c$  in the lower panel.

### 3. Empirical Studies

In *Laurent*, a village in Southern Haiti, contingent valuation method was used to estimate willingness to pay for water services. The result of contingent valuation method revealed that willingness to pay for improved water supply is positive for households wealth, education level, distance from source, quality of water and female respondents. Thus, contingent valuation study depicted that there is a feasible method of estimating individuals willingness to pay for improved water system (*Whittington et al.*, 1990).

A discrete choice model was used to determine the household water demand decision in *Ukunda*, Kenya. Logit model was employed using data collected by interview method from 69 sample households. The result of the study suggested that households' source of water choice decisions were influenced by the time it takes to collect water from different sources, price of water, and the number of women in the household. However, household income and education level had statistically insignificant effect and the sign of education level was negative (*Mu Xinming, et al.*, 1990).



During 1988 and 1989 study was carried out to determine households willingness to pay for improved water service in rural Punjab, Pakistan. The result of the study revealed that, it is the richer and more educated households that demand and are willing to pay for improved rural water supply (Altaf, et al., 1992).

The review summarized by U.S. Agency for International Development (USAID) from about 100 studies of health impact of improvements in water supply and sanitation are a reduction of 22% of diarrhoea, 28% of round worm, 73% schistosomiasis, 76% of guinea worm and a medium reductions of 60% in deaths from diarrhoeal diseases (World Bank, 1992).

The world Bank water Demand Research Team (1993) conducted research between 1987 and 1990 on factors that affect the demand for improved rural water supplies in Latin America (Brazil), Africa (Nigeria and Zimbabwe) and South Asia (Pakistan and India).

The researchers identified two villages in their sample, village A and village B. In village A, households had the option of connecting to a piped water system, some had connected and others had not. In village B, improved water systems were not yet available.



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The researchers identified two villages in their sample, village A and village B. In village A, households had the option of connecting to a piped water system, some had connected and others had not. In village B, improved water systems were not yet available.

In both villages households were asked a series of hypothetical questions what they would choose if improved water supply is available for them at specific price. Then the team used multivariate econometric models to identify factors that affect their preference for improved water supply.

The research team concluded three sets of characteristics jointly influence households' willingness to pay for improved water service. Firstly, the socio-economic and demographic characteristics of the household including education of family members, occupation, size and composition of family, measurement of income, expenditure, and assets. Secondly, the characteristics of the existing or traditional source of water versus those of the improved water supply including the cost, quality and the reliability of the supply. Thirdly, households' attitude towards government supply improved water was observed in African countries such as in Zimbabwe.

In *Onitsha* Nigeria, contingent valuation method was used to estimate willingness to pay for domestic water supply. The bidding game response of the sample household revealed that respondents would pay substantial amounts of money for water from piped distribution system (Which is equivalent to the price of private water vendors). This confirmed survey results on current water use. In addition, the study of water vending indicates that in the dry season 49% of sampled households reported spending 5% or more of their income on water. While during rainy season 25%

of sampled households still spend 5% or more of their income for water (Dixon, et al., 1994).

In 1988 contingent valuation method was used to estimate willingness to pay for improved water service in Karela, India. The study area consists of three types of traditional drinking water environments, abundant water, scarce water and salt-water areas. The sites were categorized into two, site A and site B. Site A had already connected and some non connected. Site B had no piped system but could expect to have one installed soon. Households willingness to pay is asked if reliability of water system is improved. The finding of this study revealed three results. Firstly, decision to connect is positively and strongly affected by income, assets, and schooling of household. Secondly, people in scarce water areas are much more likely to connect than abundant areas. Thirdly, reliability did not affect the probability that non connectors would decide to connect to the system, but the already connected individuals would be willing to pay substantial amount of money for more-reliable service.

In the period following the 1988 contingent valuation study, improved water services were made available in the scarce and saline-water areas. Site B households in these two areas have to decide whether to connect to the improved system. The original site B families in these two water environments were resurveyed in 1991 to determine whether they had connected.

The survey result showed that; (1) the majority of the household did not connect due to low income factor as was predicated in 1988 contingent valuation survey. (2) Reliability did not affect the probability of connecting improved water system for water scarce areas of households in the survey area.

Thus, the second survey result of 1991 was similar to that of the 1988 survey which indicated that contingent valuation method gives a reliable prediction (*Griffin, et al., 1995*)

*Fisseha Aberra* (1997) also used contingent valuation to assess the willingness to pay of households for improved water service in *Maki town, Ethiopia*. The sample size of the study was 264 and 95.5% of them already use piped water source. The result of the study showed that households willingness to pay for improved water service is affected by income and time cost spent to collect water from the source. But factors such as households' education level, occupation, price of water, number of domestic animals owned have insignificant impact on household willingness to pay for improved water services in the study area. Among the sample households 54% of them revealed that the existing source is not satisfactory and many of them preferred the provision of improved water supply at a higher charge which is greater than the current water price.

## CHAPTER THREE

## III. METHODOLOGY

## 1. Sampling techniques and data collection

The data source of the research is a primary data that was collected from *Oromiya* Regional State, *East Shewa* Zone *Ada'a-Liben* district of central Ethiopia from February 5 to 27, 1998.

The data includes;

1. socioeconomic and demographic characteristics of the respondent such as asset, income, expenditure, education level, sex, family size, race, religion, etc.
2. respondents current source of water and their status and
3. the response of households for improved rural water provision.

A two stage random sampling procedure were adopted to select the desired sample. At the first stage 8 peasant associations (*Kebele* administrations) were randomly selected which are called sampling area or Primary Sampling Units (PSUs). At the second stage, households were selected. Accordingly, 228 households were randomly selected from eight peasant administrations for the study. The sample size may represent the district for the purpose of the study. World Bank takes 16 households in each designated Primary Sampling Unit (*Grosh* and *Munoz*, 1996). Similarly, CSA takes 25 households per Enumeration Area(EA) in Ethiopia in



Agricultural sample survey where one EA is less than or equal to one peasant association (CSA, 1995, 1996).

## 2. Analytical models specification

This study utilizes different models. These are descriptive statistics such as average, percentage, maximum, minimum, etc. and ordered probit model.

### 2.1. The ordered probit model

The ordered probit model is based on following specification

$$y^* = \beta'x + \epsilon \text{ ----- (3.1)}$$

where  $y^*$  represents households willingness to pay for improved rural water supply,  $x$  is a vector of households characteristics such as income, age, education, attributes of the current water sources, etc.  $\beta$ 's are parameters of the model, and  $\epsilon$  is a random term. Since  $y^*$  is not observable from the bidding game, equation (3.1) can not be estimated. What we observe is:

$$\begin{aligned} y &= 0 \text{ if } y^* \leq 0 \\ &= 1 \text{ if } 0 < y^* \leq \mu_1 \\ &= 2 \text{ if } \mu_1 < y^* \leq \mu_2 \text{ ----- (3.2)} \\ &\cdot \\ &\cdot \\ &\cdot \\ &= J \text{ if } \mu_{J-1} \leq y^* \end{aligned}$$

$\mu$ 's are unknown parameter to be estimated with  $\beta$ .  $\epsilon$  is assumed to be normally distributed across observations with zero and one (Green, 1993).

Substituting for  $y^*$  from equation (3.1), rearranging and assuming that  $\epsilon$  is normal distribution we have the following probabilities:

$$\begin{aligned} \text{prob}(y = 0) &= \Phi(-\beta'x), \\ \text{prob}(y = 1) &= \Phi(\mu_1 - \beta'x) - \Phi(-\beta'x), \\ \text{prob}(y = 2) &= \Phi(\mu_2 - \beta'x) - \Phi(\mu_1 - \beta'x), \\ &\cdot \\ &\cdot \\ &\cdot \\ \text{prob}(y = J) &= 1 - \Phi(\mu_{J-1} - \beta'x). \end{aligned} \tag{3.3}$$

Estimates are obtained by maximum likelihood. The probabilities which enter the log likelihood function are:

$$\text{prob}[Y_i = j] = \text{prob}[Y_i^* \text{ is in the } j^{\text{th}} \text{ range}] \tag{3.4}$$

The independent variables used in this model includes households socioeconomic factors, demographic factors and current status of water sources of the respondent. These variables are designed to explain variation in household's decision making in choosing improved water source. These explanatory variables are described in the following section.

### 3. Description of variables used in the analysis

The farm households' behaviour in terms of willingness to pay for hypothetical choices for improved rural water supply response would be affected by a set of independent variables. These includes households socioeconomic factors, demographic factors and current status of water sources.

Therefore, the following variables are considered to determine the willingness to pay of households' for improved rural water provision in the study area.

1. **INCOME (lTEXPR)**: Rural households are expected to get income from different sources, namely, on-farm, off-farm and non-farm income. Most of the time rural households do not tell their income correctly for enumerators since they attach income with tax and other payments. Besides, estimation of rural households income is generally very difficult due to seasonal variations and non cash component ( i.e own production). Due to these reasons we used expenditure as a proxy for household income. Moreover, using expenditure rather than income to show welfare has got theoretical underpinning. In this study it is hypothesized that those households that have more income (whose expenditures are high) are more likely willing to pay for improved water services.

2. **LEVEL OF EDUCATION (EDUCA)**: Household's and family members education level has a positive relationship with improved water

supply. One expects that, those families with increased education level will know health benefits of improved water supply. Thus educated households are more likely to pay for improved water supply than illiterate households.

**Dummy variable** ; 1 if the household is literate 0 other wise

**3. AGE (AGEHH):** Age of household head is also considered as one of the influencing factor for willingness to pay of the households.

**4. TOTAL FAMILY SIZE (TFSIZE):** The size of the household determines the amount of water daily consumed by the household. Households having larger family size are likely to consume more water daily. It is hypothesized that those households having larger family size are more likely to pay for improved water supply at their community.

**5. NUMBER OF WOMEN (NW) AND CHILDREN IN THE FAMILY (NCHL):** In Ethiopia, in general, women as well as children fetch water for the family from a distant areas. Due to this, it is hypothesized that those households having more women and children in their family are not likely to pay for improved water supply.

**Dummy variable;** 1 if the household has > 1 female whose age is more than 15; 0 other wise

1 if the household has a child/children whose age is/are less than or equal to 15; 0 other wise

**6. WEALTH (CORISH):** Estimating households' wealth accurately is a top difficult one. However, in this study household wealth is represented using a proxy. Thus, households having a house with a corrugated iron sheet roofs are considered richer than households that have a house with thatch roofed in the rural areas.

**Dummy variable;**

1 if the household has a house with corrugated iron sheet roof; 0 other wise

**7. FEMALE HOUSEHOLD HEAD (FHH):** Fetching water relays on women for the family. Thus, it is hypothesized that female household heads are more likely to pay for improved water supply than male household heads.

**Dummy variable;** 1 if household head is a female, 0 other wise.

**8. DISTANCE TO COLLECT WATER (LDIST):** The amount of time it takes to fetch water from the source is taken as proxy for the distance of the water source. Thus, the more time it takes to



fetch water from its source, the more the respondent is likely to pay for improved water supply.

9. **CREDIT (CRED)**: Credit for agricultural inputs is indispensable in rural areas to boost production which will enhance their income. Thus, it is hypothesized that those households who got credit in 1997/98 crop year are more willing to pay for improved water supply.

**Dummy variable**; 1 if the household gets credit for agricultural inputs, 0 other wise.

10. **QUALITY OF WATER (QUAL)**: Generally it is said that surface water is low in quality. Most of the sample households use surface water which is low in quality. Thus, it is hypothesized that those households using surface water (i.e river and lake) are more likely to pay for improved water supply.

**Dummy variable**; 1 if the water source of the household is river or lake, 0 other wise.

11. **ALTERNATIVE WATER SOURCE (AWS)**: In rural areas supply of water declines during dry season and some times streams and ponds dry up. Even during rainy season there is a problem regarding its quality. Thus households face problem of water for home and livestock consumption during dry season. Due to this, it is hypothesized that if there is alternative water supply such as

well water around the respondents' residence the willingness to pay of the household for safe water provision will decline.

**Dummy variable;** 1 if there is alternative water source at the surrounding of the respondent, 0 other wise.

**12. NUMBER OF DOMESTIC ANIMALS (1TLU):** Households are expected to use improved water supplies at their community for their domestic animals consumption. Thus, it is hypothesized that those households having more domestic animals are more likely willing to pay for improved water supply.

## CHAPTER FOUR

## IV. RESULTS AND DISCUSSION

## 4.1. Over view of the study area

*Ada'a-Liben* district is found in *Oromiya* Regional State, *East Shewa* Zone, central Ethiopia. It is 45 kilometres away from *Addis Ababa* in Eastern direction on the way to *Adama (Nazeret)* town. The capital city of the district is *Bushoftu (Debrezeyit)*.

The total area of the district is estimated to be about 1,610.6 square kilometres. The altitude of the district is 1800 meters above sea level. The average rain fall of the district is 800 mm. Its highest temperature during dry season (*bega*) is 26°C while the lowest temperature during rainy season (*kiremt*) is 12°C (ADADO, 1997).

According to the 1994 population census of the country the total population of the district is 234,614. The rural population accounts 65.9 % while 34.1 % of the population live in the urban areas (CSA, 1996).

The main seasons of the district are two; namely rain season (*kiremt*) and dry season (*bega*). The farmers of the district are growing different types of cereal crops such as *teff*, wheat, chick pea, horse bean, field pea, barely, Vetch, etc. Among these

crops *teff* is the main cash crop that earns the highest income for the farmers. Besides, farmers rear different types of livestock and poultry such as ox, cow, bull, heifer, calf, sheep, goat, donkey, mule, horse and hen.

*Ada'a-Liben* district has 42 peasant administrations (PAs). For this study 228 households were randomly selected from 8 randomly selected Peasant Administrations. The peasant Administrations that are included in this sample are *Bakeljo, Dhankaka, Dire-1, Hidi, Kaliti, Udlea, Wadofi dhibayu and Wajitudibdibe*.

## 2. Household characteristics

The sample consists of 88.6% male household heads and 11.4% female household heads that have totally 1507 family members. One household has a minimum of 2 and the maximum of 14 members. The average family size of the sample area is 6.61.

Table 1: Sample households and their family members by peasant administration

No	Name of PAs	Household heads			Household members			Total family members		
		M	F	T	M	F	T	M	F	T
1	<i>Bakeljo</i>	26	2	28	69	86	155	95	88	193
2	<i>Dhankaka</i>	24	4	28	57	81	138	81	85	166
3	<i>Dire-1</i>	26	2	28	84	91	175	110	93	203
4	<i>Hidi</i>	26	4	30	83	89	173	109	93	202
5	<i>Kaliti</i>	22	6	28	62	92	154	84	98	182
6	<i>Wajitudibdibe</i>	24	6	30	62	75	137	86	81	167
7	<i>Wedofi dhibayu</i>	25	1	26	81	96	177	106	97	203
8	<i>Udiea</i>	29	1	30	90	81	171	119	82	201
Total		202	26	228	588	691	1279	790	717	1507
Average					2.6	3.0	5.6	3.5	3.1	6.61
%		88.6	11.4	100	46	54	100	52.4	47.6	100

NB PAs = Peasant administrations (associations)

M = Male, F = Female, T = Total

Source : Summary of the sample survey

85.5% of the sample households are *Oromos* and the rest 14.5% are *Amharas*. Among these 97.4% are Orthodox christians while 2.6% are Protestant christians.

Concerning education level, from the total household heads 23.7% have no schooling, 39% are participated in adult literacy program, 18.4% are from grade 1 to 6, 6.6% are from grade 7 to 8 and 12.3% are from grade 9 to 12. From the household members (i.e whose age reached for education) 78.1% are literate while 21.9% are illiterate. Generally, from the sample area 76.3%

of the family heads and 78.1% of the family members are literate.

The sample households are engaged in mixed farming (crop production and livestock production). Their main source of income is on-farm income. Besides to on-farm income, some the households get non-farm income from such as crop trading, a local beer (*tella* and *katicala*) preparing and selling.

From the sample households 92.5% use kerosene lamp (*kuraz*) light, 5.7% use lantern, and 1.8% use electric light. And their energy source for cooking are cow dung cake, fire wood and crop residues. Further more, 52.6% of the households live in houses with corrugated iron sheet roofs while 47.4% live in thatch roofed houses.

The sample households have 499 oxen, 211 cows, 104 bulls, 103 heifers, 128 calves, 227 sheep, 89 goats, 325 donkeys, 5 horses, and 4 mules. The average holding of livestock is 2.2 oxen , 1.4 donkey and 1 sheep while below zero for the rest.

Ox plays a significant role in agricultural production in the study area since it is the basic traction power. However, all households in the sample area do not have ox. As the survey data indicates from sample households 13.6% have no ox, 13.2% have 1 ox, 45.2% have 2 oxen and 28% have more than 2 oxen.



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Table 2: Land holding and livestock owned by the sample households

No	Name of PAs	Total land (ha.)	Number of livestock									
			ox	cow	bul l	heif er	cal f	she ep	goa t	don key	hors e	mule
1	Bakeljo	69.25	54	27	11	12	11	16	20	34	1	-
2	Dhankaka	52.5	51	15	5	6	11	19	2	37	-	-
3	Dire-1	56.13	62	29	15	24	24	44	31	40	1	-
4	Hidi	52.25	84	40	16	17	25	31	18	48	1	3
5	Kaliti	54	52	18	9	10	8	28	2	40	-	1
6	Wajitudibd.	55	49	9	1	6	6	28	2	38	1	-
7	Wedofidh.	45.75	59	35	24	15	18	38	14	43	-	1
8	Udiea	68.2	88	38	23	13	25	23	-	45	-	-
Total		453.08	499	211	104	103	128	227	89	325	4	5
Average		1.99	2.2	0.9	0.5	0.5	0.6	1	0.4	1.4	0.02	0.02

Source: Summary of the sample survey

The sample households have 453.08 hectares of land. 46.1% of them have less than 2 hectares, 44.3% have from 2 to 3 hectares and the remain 9.6% have above 3 hectares. Generally, the maximum land that one household has is 4.75 hectares, the minimum land holding is 0.25 hectares and the average is 1.99 hectares. Among these households 95.6% cultivate their own land while 4.4% contract-out and share cropped-out due to lack of oxen and labour.

However, due to shortage of land 35.9% of the sample households have contracted-in land and 11.8% have share cropped-in land from other farmers.

In the rural areas of *Ada'a-Liben* district, farmers have an acute problem in accessing drinking water. 86.8% of the farmers travel more than 1 hour to fetch water for consumption. The maximum time daily spent on collecting water is 5 hours, the minimum is 10 minutes for those who have well water and the average is 3.20 hours. Due to this 77.2% of the households use donkey to carry pair jerrycan of water for family consumption, where one jerrycan contains from 25 to 30 litres of water. The rest 22.8% collect water carrying on the back of women.

Concerning water consumption pattern, the sample data shows that from sample households 14% consume less than 50 litres, 74% consume from 50 to 100 litres and 12% consume above 100 litres daily depending on their family size. The average daily water consumption per capita of the sample area is 10 litres. This amount of water consumption includes food preparation, washing cloth, bath, drinking, etc.

In the sample area there are six types of water sources. These are river, well, lake, hand pump, electric pump, and water vendor. There are four rivers (*Mojo, Wadecha, Kolbe and Dukem*), 1 lake (*Hora kilole*), 16 wells, 3 hand pumps and 2 electric pumps that give service currently for the population.

Among the sample households 63.6% use water with poor quality from river, lake and well while 36.4% use from hand pumps, electric pumps and water vendors. Specifically, from the total sample households 37.7% use river, 4.4% use lake, 21.5% use well, 18% use electric pump, 3.5% use hand pump and 14.9% use water vendors. The households from *Hidi* PA use both *Mojo* river and *Hora kilole* lake. Households from *Kaliti* PA use *Mojo* and *Wadecha* rivers in addition to 2 wells. Households from *Bakeljo* entirely depend on *Kolbe* river. *Udiea* PA use water from 10 wells. *Dire-1* PA gets water from 1 electric pump currently installed by Catholic mission. *Wajitudibdibe* PA gets water from 1 electric pump, water vendor and *Dukem* river. *Dhankaka* PA gets water from 4 wells, 2 hand pumps and *Mojo* river. *Wedofi dhibayu* PA entirely depend on water vendor (i.e *Kebele 01* of *Bushoftu* town). Households in this PA also buy water for their cattle during dry season and some times take their cattle to *Chalakilak* lake after a long journey for drinking.

Table 3: Current water source of the sample households

No	Name of PAs	River	Lake	Well	Hand pump	Electric pump	Water vendor	Total household
1	Bakeljo	28	-	-	-	-	-	28
2	Dhankaka	9	-	11	8	-	-	28
3	Dire-1	-	-	-	-	28	-	28
4	Hidi	20	10	-	-	-	-	30
5	Kaliti	20	-	8	-	-	-	28
6	Wajitudibdib	9	-	-	-	12	9	30
7	Wadofi dh.	-	-	-	-	-	26	26
8	Udiea	-	-	30	-	-	-	30
Total		86	10	49	8	41	34	228
%		37.7	4.4	21.5	3.5	18	14.9	100

Source: Summary of the survey result

In this sample area there are 19 improved water supplying schemes (i.e 1 solar pump, 16 hand pumps and 2 electric pumps). However, only 3 hand pumps and 2 electric pumps are functioning. This means 26.3 % of the installed schemes are giving service while 73.7 % are non functional due to lack of maintenance. The distribution of the schemes are described on table 4.



Table 4: Improved water schemes found in the sample area

No	Name of PAs	Solar pump		Hand pump		Electric pump		Total		
		F	NF	F	NF	F	NF	Total	F	NF
1	<i>Udiea</i>	-	1	1	6	-	-	8	1	7
2	<i>Dire-1</i>	-	-	-	-	1	-	1	1	-
3	<i>Dhankaka</i>	-	-	2	5	-	-	7	2	5
4	<i>Wajitudibdib</i>	-	-	-	1	1	-	2	1	1
5	<i>Bakeljo</i>	-	-	-	1	-	-	1	-	1
Total			1	3	13	2	-	19	5	14
%									26.3	73.7

F = Function, NF = Not function

Source: Summary result of the sample survey

Payment for water service varies from one peasant association to another. For instance, it is 3 birr per year per household in *Dhankaka* (for hand pump guards' salary), 0.15 birr per jerry can in *Dire-1* and 0.25 birr per jerry can from water vendors in *Wedofi dhibayu* and *Wajitudibdibe* peasant associations. Normally, they use a jerry can that contains from 25 to 30 litres of water. In the sample area 12 households from *Wajitudibdibe* peasant Association use water by electric pump from East African Trading Private Limited Company with out any service charge.

Among the total households 31.1% pay for water services while the rest 68.9% of the households do not pay for water service. Daily water cost of the households range from 0 birr to 1.25 birr and the average is 0.26 birr. This implies that average monthly water cost of a household is 7.80 birr.

Table 5: Descriptive statistics of major variables used in the analysis

Variables	Mean	std.dev	Minimum	Maximum
AGHH	43.9	12.67	24	80
DIST (hours)	3.20	0.80	0.17	5
TFSIZE	6.61	2.56	2	14
TEXPR (birr)	484.80	241.06	30.00	1158.80
TLU	5.45	4.0	0	23.2

Source ; Computed from sample survey

As indicated on the above table the average age of the sample household is 43.9. This is due to the fact that 51.2% of the sample households are above 40 years old. The average distance between the residence of the sample households and their water sources, average monthly income (proxied by expenditure), average livestock owned and average family size are 3.20, 484.80, 5.45, and 6.61 respectively.

### 3. Test of contingent valuation results

In this study we attempt to test the existence of two basic biases in contingent valuation survey response, namely, strategic bias and starting point bias.

### 3.1. Strategic bias

Strategic bias may arise when an individual thinks he/she may influence an investment or policy decision by giving a false answer in a contingent interview. Free-riding and strategic behaviours are the problems that encountered in contingent valuation studies.

An individual will understate his true willingness to pay for public good on the assumption that, others will pay for its provision which he/she will then enjoy; i.e free-riding.

*Varian* (1984) notes that such behaviour in contingent valuation studies will depend upon both the respondent's perceived payment obligation and his expectation about the payments for the good. If an individual feels that the payments of others will be sufficient to ensure provision of a good, then he has an incentive to free-ride by lowering his willingness to pay bid below his true valuation. However, if an individual is particularly keen upon a good and calculates that the decision regarding provision depend upon the mean valuation of the sample, he/she may behave strategically and over state his/her true willingness to pay to ensure provision i.e, strategic over-bidding.

The optimal strategy for an individual who values the good is to pledge to pay the highest credible amount in the hope that policy makers will be encouraged to provide more of the good.

In most well designed contingent valuation surveys there is low level of strategic bias. The results of survey done in *Southern Haiti* by *Wittington, et al.*, (1990) and *Fisseha* (1997) fail to support the hypothesis that individuals will act strategically in answering contingent valuation questions.

In this research, strategic bias was tested by comparing the mean willingness to pay bid response for improved rural water supply from two different household water users. The first group consists of households using poor water quality (traditional water users) from river and lake and still there is no promise to provide improved water supply for them. The second group is formed by households with access to a clean water supply since electric pump and hand pump water supplies are available for them.

Here we test whether the two groups mean willingness to pay for improved rural water provision are significantly different from each other using t-statistics.

The formula for calculating two tailed t-test comparing the hypothesis  $H_0: X_1 = X_2$  against the hypothesis  $H_1: X_1 \neq X_2$  is given by:

$$T = (X_1 - X_2) / (S_p \sqrt{1/N_1 + 1/N_2})$$

$$\text{and } S_p^2 = (N_1 - 1) S_1^2 + (N_2 - 1) S_2^2 / (N_1 + N_2 - 2) \text{----- (4.1)}$$

(*Mitchell and Carson 1989*).

where  $X_1$  = the mean wtp of traditional water users

$N_1$  = number of observation of traditional water users

$S_1$  = standard deviation of traditional water users

$X_2$  = the mean wtp of modern water users

$S_2$  = standard deviation of modern water users

$N_2$  = number of observation of modern water users

From the survey result the first group has 96 number of observations, 0.14 mean willingness to pay and 0.09 standard deviation. Similarly, the second group has 83 number of observations with 0.12 and 0.09 mean willingness to pay and standard deviation respectively.

Performing this calculation yields a value of  $T = 1.483$  and  $t$  critical at  $N_1 + N_2 - 2$  degrees of freedom is 1.645. Thus,  $t$  calculated value is less than the critical point. This shows that the difference between the two means is not significantly different from zero. This result implies that there is no strategic bias. The test for strategic bias is summarized on table 6 below.

Table 6: Test for strategic bias

WTP for improved rural water supply	Traditional water users <sup>2</sup>	Improved water users <sup>3</sup>
Number of observations	96	83
Mean wtp bid( <i>birr</i> )	0.14	0.12
Standard deviation	0.09	0.09
Over all mean( <i>birr</i> )	0.13	
Standard deviation	0.09	
t-statistics	1.483	

Source: Computed from survey data

### 3.2. Starting point bias

In the bidding-game question format, the enumerator starts questioning the respondent at an initial price. Concerning such type of questioning there are different suggestions in contingent valuation studies. As noted by *Betman and Turner* (1993) the initial starting point in bidding game can significantly influence the final bid, i.e, the choice of high or low starting point may lead to a high or low mean willingness to pay. On the other hand *Mitchell and Carson* (1989) described that the use of starting points may reduce non-response and variance which may result from open-ended questions.

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<sup>2</sup> Traditional water users are those households that use water from river and lake.

<sup>3</sup> Modern water users are those households that use water from electric pump and hand pump.

In this study one group of respondents were asked a higher 0.15 birr starting point of payment per jerrycan improved water supply and the second group of respondents were asked a lower 0.10 birr starting point of payment per jerrycan of improved water supply. These prices were taken based on actual prices that the sample households are currently paying for improved water service in the study area. The difference between the mean willingness to pay of the two groups were tested using formula (4.1).

Applying this formula (4.1)  $t$ -calculated value is 0.839 while the  $t$ -value of critical level at  $N_1 + N_2 - 2$  is 1.645. This shows that the difference between the mean willingness to pay of the two starting point bids is zero. This test result implies that we can not reject the null hypothesis that there is no starting point bias. The result of this test is summarized on table 7.

Table 7: Test for starting point bias

Willingness to pay for improved water supply	Starting point	
	0.15 birr	0.10 birr
Number of observations	116	112
Mean WTP bid(birr)	0.13	0.12
Standard deviation	0.09	0.09
Over all mean(birr)	0.13	
Standard deviation	0.09	
t_statistics	0.839	

Source: Computed from survey data

The result of both strategic bias and starting point bias tests of this thesis are consistent with previous studies done by *Wittington* (1990) and *Fisseha* (1997). Therefore, contingent valuation is a convenient method to utilize in willingness to pay survey for public goods.

#### **4. SUMMARY OF HOUSEHOLDS WILLINGNESS TO PAY FOR IMPROVED RURAL WATER SUPPLY**

Households in the sample survey gave different responses for survey questions for a jerrycan of improved rural water provision. In this study one jerrycan is assumed to contain from 25 to 30 litres of water. For one jerrycan of improved rural water provision 14.9% of the households were willing to pay from 0.01 to 0.05 *birr*, 18% were willing to pay from 0.06 to 0.10 *birr*, 15.8% were willing to pay from 0.11 to 0.15 *birr*, 14.9% were willing to pay from 0.16 to 0.20 *birr* 13.2% were willing to pay from 0.21 to 0.25 *birr* and 10% were willing to pay from 0.26 to 0.30 *birr*. The frequency distribution of households willing to pay response is summarized on Table 8.

Table 8: Frequency distribution of willingness to pay

WTP in birr per jerry can of water	Frequency distribution	Percentage
0	30	13.2%
0.01 - 0.05	34	14.9%
0.06 - 0.10	41	18%
0.11 - 0.15	36	15.8%
0.16 - 0.20	34	14.9%
0.21 - 0.25	30	13.2%
0.26 - 0.30	23	10%
Total	228	100%

Source: Summary of survey result

Generally, from the sample survey result 86.8% of the rural households are willing to pay for water service. The rest 13.2% of the households are not willing to pay for improved rural water supply. The basic reasons are;

(1) existence of alternative water source: Among households that gave zero response for improved rural water provision 26.7% of them have alternative water source at their surrounding. Most of these households use well water at their compound.

Even though, the quality of well water is less than public stand point or yard type, sample households that have alternative water sources such as well water in their compound do not want to pay for improved rural water provision.

(2) low level of income: Households that have low level of income responded a zero willingness to pay for improved rural water provision. These households represent 73.3% of the households among that gave zero response for improved rural water provision. This implies that income is one of the basic constraining factors to get improved water provision in rural areas. For the later computation purposes table 8 can be rearranged as table 9 below where willingness to pay (wtp) mid point represents the mean willingness to pay of sample households.

Table 9: Willingness to pay mid-point and their frequencies

WTP in birr per jerrykan of water	WTP mid point (birr)	Frequency	Percentage
0 - 0.05	0.03	64	28%
0.06 - 0.10	0.08	41	18%
0.11 - 0.15	0.13	36	16%
0.16 - 0.20	0.18	34	15%
0.21 - 0.25	0.23	30	13%
0.26 - 0.30	0.28	23	10%
Total		228	100%

Source: Summary of survey result

5. Maximum likelihood estimation results of factors influencing improved rural water provision: ordered probit analysis

The explanatory variables that influence households willingness to pay for improved rural water supply used in this study are analyzed by ordered probit model specified under methodology section. The estimates are obtained by maximum likelihood. The independent variables, the estimates of coefficient and their t-ratios are described on table 10 next page.

Table 10: Maximum likelihood estimation results of factors influencing improved rural water provision: ordered probit analysis

Variables	Coefficients	t-ratios
constant	-3.537	-2.320*
lTEXPR	0.3417	2.042*
EDUCA	0.0464	0.232
AGHH	-0.0067	-0.877
NW	-0.1486	-0.676
NCHL	0.0124	0.035
CORISH	0.0905	0.523
lDIST	0.2131	2.278**
FHH	0.2343	0.768
QUAL	0.6817	3.928*
AWS	-0.206	-0.751
lTLU	-0.00015	-0.390
CRED	0.5077	2.389*
TFSIZE	0.0539	1.130
Log likelihood function	-262.8600	
Restricted log likelihood	-287.9973	
Chi-squared	50.27454	
Significance level	0.2674110E-05	
Degrees of freedom	13	

\* significant at 1% and \*\* significant at 5%.

Source: Computed from sample survey data

## 6. The likelihood ratio test of the model

The likelihood ratio test is a test procedure that compares the value of the log likelihood function evaluated at the maximum likelihood estimator ( $\beta$ ) with respect to all parameters,  $\alpha$ ,  $\beta_1$ ,  $\beta_2 \dots \beta_n$  to the restricted maximum likelihood estimator ( $\beta^*$ ) when

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maximized with respect to  $\alpha$  only (setting all the  $\beta$ 's equal to zero).

Likelihood ratio test statistics is used to test the hypothesis of the research and it is given by;

$$\lambda_{LR} = 2(\ln l(\beta) - \ln l(\beta^*))$$

has a  $\chi^2_{(J)}$  distribution if the joint null hypothesis is true (Griffiths, 1993). If the data do not support the null hypothesis, then the value of the test statistics become large, and the null hypothesis is rejected if  $\lambda_{LR} \geq \chi^2_{(J)}$ .

Where  $J$  represents number of independent restrictions (explanatory variables),  $\ln l(\beta^*)$  is the value of the restricted log likelihood function and  $\ln l(\beta)$  is the value of unrestricted log likelihood function.

From the above table 10 the value of restricted log likelihood is -283.9973 and the value of unrestricted log likelihood is -262.86. Therefore, the value of the log likelihood ratio test statistics of the model is then;

$$\begin{aligned} \lambda_{LR} &= 2(\ln l(\beta) - \ln l(\beta^*)) \\ &= 2(-262.8600 - (-287.9973)) \\ &= \underline{25.1373} \end{aligned}$$

At the  $\alpha = 0.05$  level of significance the test critical value is  $\chi^2_{(13)} = 22.3621$ . Thus, we do not accept the null hypothesis which describes that households willingness to pay for improved rural water supply is not significantly different from zero. This hypothesis test shows that rural households are willing to pay for improved rural drinking water provision.

#### 7. Analysis of factors affecting willingness to pay for improved rural water supply

In maximum likelihood estimation result of ordered probit model (table 10), thirteen explanatory variables are used for the estimation of willingness to pay for improved rural water provision. This estimation result is obtained using LIMDEP Version 7. The estimation results of maximum likelihood of ordered probit analysis is discussed as follows.

1. **Income (lTEXPR):** Income of the households proxied by expenditure (changed to logarithm), showed positive and statistically significant relation with willingness to pay for improved rural water provision (a t-ratio of 2.042). This implies that the higher the income of households, the higher probability of the households' willingness to pay for improved rural water supply.

2. **Distance from current water source (LDIST):** The distance between current water source and residence of the household proxied by the amount of time it takes to fetch water (changed in to logarithm) showed positive and statistically significant with willingness to pay of the household for improved rural water provision (a t-ratio of 2.278). This implies that the more the households' far away from current water source, the greater the probability of the households' willingness to pay for improved water supply at the community since it saves time to fetch water. This result is consistent with survey data, because 86.8% of the household use water from a distant place that takes more than 1 hour journey.

3. **Quality of current water source (QUAL):** The estimation result of current water source quality for willingness to pay of the household is positive, and statistically significant (a t-ratio of 3.928). This may be due to the fact that 42.1% of the sample households use poor water quality (river and lake), so that they respond positively for willingness to pay for improved rural water provision.

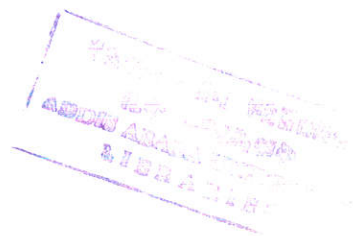
4. **Alternative water source (AWS):** The maximum likelihood estimation result of those households who have alternative water source at their surrounding showed negative and statistically insignificant (a t-ratio of -0.751). This implies that the probability of willingness to pay for improved rural water supply by households having alternative water source will decline. This

may be due to the fact that 21.5% of the sample households use well water in their compound. This result is consistent with actual fact that is expected from households that have other source of water at their surrounding.

5. Age (AGHH): Age of household head is considered as one of explanatory variable in households willingness to pay for improved rural water provision. The study result showed that age of household has a negative relationship with households' willingness to pay for improved rural water provision and statistically insignificant (a t-ratio of -0.877). This negative relationship may be due to the fact that old aged households are conservative to use improved rural water provision on charge base.

6. Education (EDUCA): Households' education level shows a positive relationship with willingness to pay for improved rural water supply. But the probability of literate households' willingness to pay for improved water provision is statistically insignificant ( a t-ratio of 0.232). This may be due to illiterate households also willing to pay for improved rural water since lack of improved water equally affects both literate and illiterate households in the study area.

7. Corrugated iron sheet roofed house (COIRSH): Corrugated iron sheet roofed house is used as a proxy for wealth in rural areas since wealthy households mostly have corrugated iron sheet roofed



houses in the sample area. The maximum likelihood estimation result showed that there is a positive relationship between wealth and willingness to pay for improved rural water provision in the study area. This implies that wealthy households have a greater probability to pay for improved drinking water. However, its estimate is statistically insignificant (a t-ratio of 0.523).

**8. Number of Women (NW) and children (NCHL):** The result of maximum likelihood estimation for number of women is negative. This implies that as the number of women increases in the family the probability willingness to pay of the household for improved water provision will decline. This may be due to households prefer to fetch water from river since they have abundant labour force. This result is consistent with actual behaviour of rural households. However, the estimate is statistically insignificant (a t-ratio of -0.676).

On the other hand, the estimate of the number of children and willingness to pay of household for improved rural water supply is positive. This result indicates that as the number of children increases the consumption of improved water rises, so that the probability of households' willingness to pay for improved rural water provision also increases. This result is opposite to the hypothesis that as the number of children increases the households' willingness to pay for improved water supply will decrease. This may be due to the fact that the sample households use donkey to carry (transport) pair jerrycan of water

(one jerrycan is assumed to contain from 25 to 30 litres of water) for family consumption. This shows that the need of child labour for fetching water is low by sample households in the study area. But the estimate is statistically insignificant (a t-ratio of 0.035).

9. **Credit (CRED):** Those households who got credit for agricultural inputs last year showed a positive and statistically significant willingness to pay for improved rural water supply (a t-ratio of 2.389). This may be due to the fact that 71.5% of the households that got credit for agricultural inputs last year had improved their income, so that their probability of willingness to pay for improved rural water provision increased.

10. **Number of domestic livestock (TLU):** The number of domestic animals that the sample households have (converted into tropical livestock unit /TLU<sup>4</sup> changed in to logarithm) showed negative relationship with households willingness to pay for improved rural water supply. This may be due to the fact that as the households' number of livestock increases they may prefer river as well as lake water for their livestock consumption since the total service charge of improved water for livestock may rises. However, the result of the estimate is statistically insignificant (a t-ratio of -0.390).

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<sup>4</sup> For detail see Gittinger, J. Price, 1983, Economic Analysis of Agricultural Projects, 2<sup>nd</sup> ed., pp. 174 - 175 concerning Tropical Livestock Unit (TLU) conversion.

11. **Female household head (FHH)**: The maximum likelihood estimate of female household heads' willingness to pay for improved rural water provision showed positive but statistically insignificant (a t-ratio of 0.768). This may be due to the fact that the problem caused by lack of improved rural water supply is also perceived similarly by male households in the sample area.

12. **Total family size (TFSIZE)**: The result of maximum likelihood estimate indicates that the total family size has positive relationship with households' willingness to pay for improved rural water provision. This implies that the higher family size of the household, the higher probability of the households' willingness to pay for rural water supply. However, this relationship is not statistically significant (a t-ratio of 1.130).

#### 8. Time saving

Access to a convenient source of clean water helps rural households to save time and reduce work load for women and children. In the sample area the average time that rural women use on work is 15 hours. From these on average 3.20 hours are use for daily water collection. This represents 21% of the total working hours.

If improved rural water is provided for rural households rural women will use almost 20 minutes for water collection and save

on average 3 hours daily. This means they can save weekly 21 hours (7 days x 3 hours), monthly 90 hours (30 days x 3 hours) and yearly 1095 hours (365 days x 3 hours) or 45 days. If improved water is provided for rural households, rural women will save these time to raise their households income through such as petty trading, home based business works or through increasing labour in agriculture (for example, growing more food crops and rearing livestock). In addition to these, it will help them to get more time for child care and home management. This clearly shows that provision of rural water supply is important since it saves time for income generation and has health benefit for rural communities.

#### 9. Calculating the benefits of improved rural water supply

Financial constraint is the basic problem that hinders the expansion of improved rural water provision. This problem will be minimized when rural households pay for improved water supply in rural areas.

From the hypothetical rural water market bid of sample survey the frequency distribution of households willingness to pay bid can be used to estimate the total willingness to pay and to roughly estimate revenue expected from providing water service at specific price. This revenue will be used for further extending improved water supply in rural areas.

### 9.1. Estimating total willingness to pay

From the sample data we can estimate total rural households of the district that will pay for improved water supply. The total willingness to pay of the rural households of the district for improved water provision can be calculated by multiplying the frequency distribution of the sample by the total household<sup>5</sup> of the district to get estimated household in each willingness to pay interval (table 11 column 2). Since the midpoint of each interval is the mean willingness to pay (column 3), the total rural households can be multiplied by the mean willingness to pay of the household to estimate the total willingness to pay (column 4). The total willingness to pay of the rural household if they consume one jerry can per household is birr 3,006.90. Graphically this can be represented by figure 2.

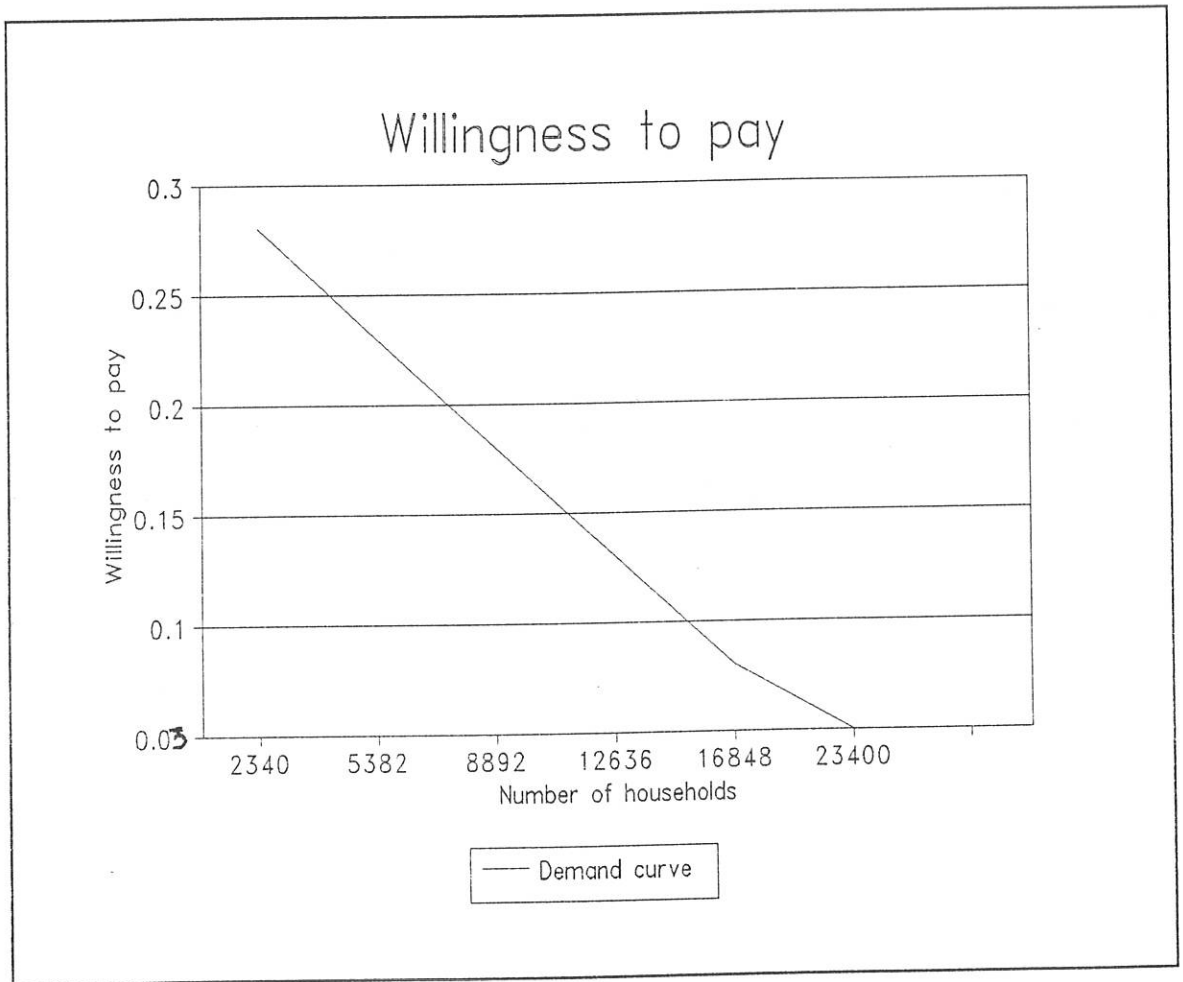
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<sup>5</sup> The total rural population of the district is 154,683 and their family size is 6.61. Thus, the total rural household of the district is 23,400.

Table 11:- Total willingness to pay (TWTP) for improved rural water supply from the consumption of one jerry can of water by each household

(1) Frequency distribution (From table 8)	(2) Total household of the district	(3) WTP midpoint (in birr)	(4) TWTP for one jerry can of water used by each household (in birr)
28%	65527	0.03	196.56
18%	4212	0.08	336.96
16%	3744	0.13	486.72
15%	3510	0.18	631.80
13%	3042	0.23	699.66
10%	2340	0.28	655.20
100%	23,400		3,006.90

Figure 2:- Graphical representation of total willingness to pay (demand schedule for improved rural water supply) at different price level.



## 9.2. Estimating Expected Revenue

The frequency distribution of willingness to pay bids can be used to provide rough estimates of the revenue that might be expected from providing improved rural water service at specific price. This is done by first predicting the total number of household that would be willing to pay for improved rural water provision at specific price and then multiplying this by the price.

In this study estimating total revenue is indispensable since it allows water utility to determine how many households can afford the provision of improved rural water on charge base. From table 12 if each household consumes one jerrycan of improved water we can estimate the total households that can afford the service charge for improved water service and expected revenue from the service. Thus, when the price of water service per jerrycan is 0.03 birr 23,400 households will afford the service charge and expected revenue is birr 702.00. When price of water service per jerrycan becomes 0.08 birr 16,848 households can afford service charge and expected revenue of improved water service is birr 1,347.84. When price of improved water service becomes 0.13 birr per jerrycan 12,636 households can afford the service charge and expected revenue is birr 1,642.68. When service charge of improved water per jerrycan becomes 0.18 birr 8892 households can afford the service charge and expected revenue is birr 1,600.56. When a price of water per jerrycan becomes 0.23 birr 5,382 households can afford the service charge in order to get improved

rural water service and expected revenue is birr 1,237.86. When price of improved water per jerrycan is 0.28 birr 2,340 households can afford the service charge and expected revenue falls to birr 655.20. The graphical representation of the analysis is presented on figure 3.

From this simple analysis the maximum revenue of birr 1,642.68 is achieved at a price of 0.13 birr per jerrycan of improved rural water service. Therefore, 0.13 birr will be the average price for a jerrycan of improved rural water provision for the study area.

This price is half of the price that 14.9% of the sample households are currently paying for water vendors and relatively similar to *Dire-1* sample households that are paying 0.15 birr for a jerrycan of water.

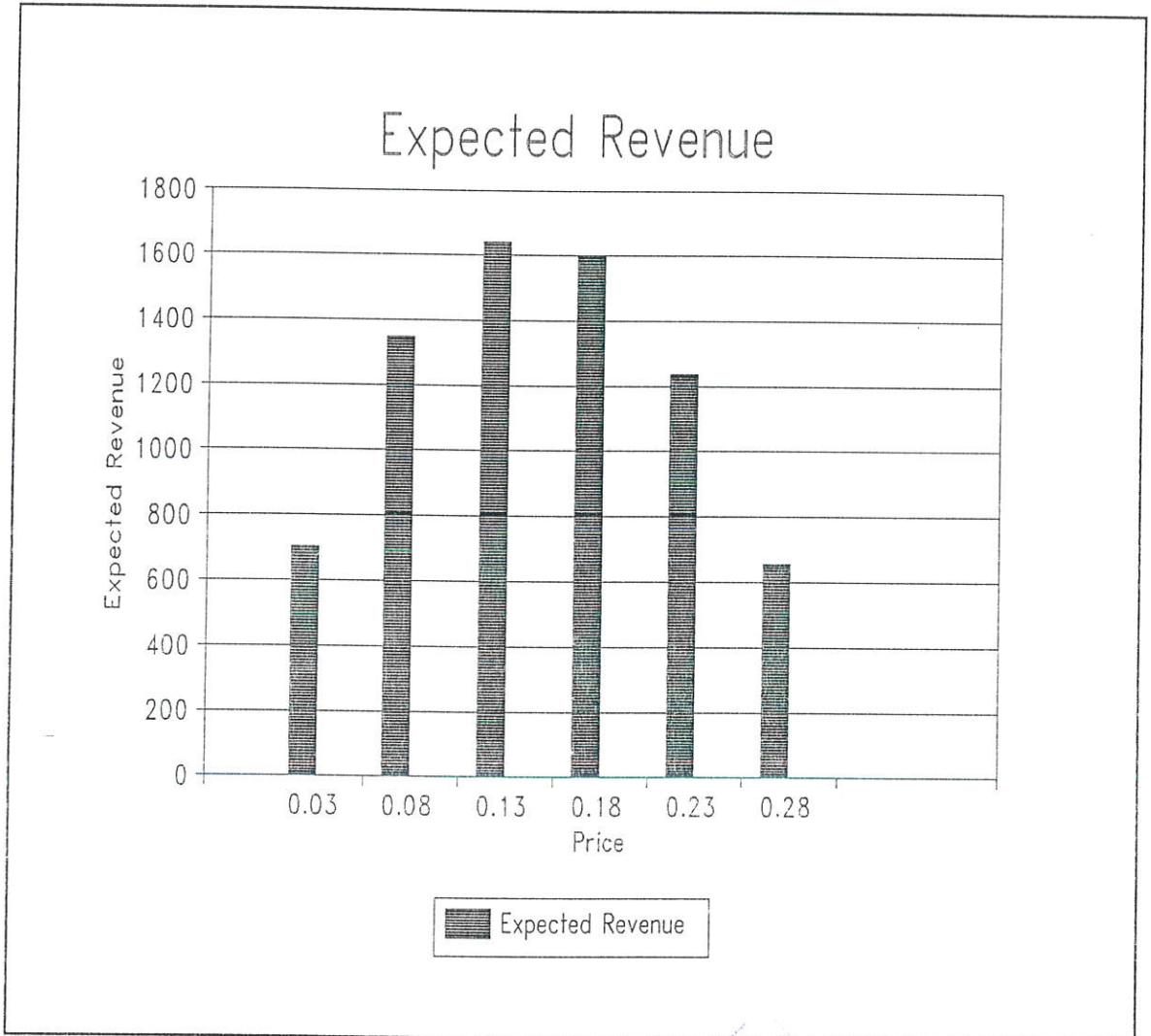
We can understand from this analysis that if improved rural water service increased in *Ada'a-Liben* district about 54% of the households will afford to get the service. This may improve the number of households that are currently getting improved rural water provision in the study area by 48.3%. Besides, it may increase source of revenue to expand improved rural water provision of the district.

Table 12: Expected Revenue from improved rural water supply

Frequency	% of households that can use	Number of households that can use at different price	WTP mid-points (in birr)	Expected Revenue (in birr)
28%	100%	23,400	0.03	702.00
18%	72%	16,848	0.08	1,347.84
16%	54%	12,636	0.13	1,642.68
15%	38%	8892	0.18	1,600.56
13%	23%	5382	0.23	1,237.86
10%	10%	2340	0.28	655.20

Source: Computed from the survey data

Figure 3: graphical representation of expected revenue at different price level



فصل ثالث  
مادة المحاسبة  
جامعة سبأ  
SABAA UNIVERSITY  
SABAA

## CHAPTER FIVE

## V. CONCLUSION AND POLICY IMPLICATION

This study employs contingent valuation method to elicit the willingness to pay of rural households for improved rural water provision in *Ada'a-Liben* district, Central Ethiopia.

The research was conducted in this district for the following purposes. (1) to investigate problems of rural households in getting improved rural water supply and to suggest alternative solution for them; (2) to produce evidence on improved rural water provision of the country in general and the study area in particular that is useful to potential researchers and policy makers.

In this study the researcher does not come across starting point bias and strategic bias problems. The study result of the research suggests that peasant households' willingness to pay for improved rural water provision is positively influenced by income of the household, distance (time it takes to fetch water), quality of current water source and credit. Factors such as education, family size, wealth and the gender of the household head (female) have positive relationship with households' willingness to pay for improved rural water provision, but their estimators are statistically insignificant.

On the other hand, age of household head, number of women in the family and number of domestic animals owned have negative relationship with households' willingness to pay for improved rural water supply. Furthermore, number of children in the family and willingness to pay for improved rural water supply have positive relationship. This result may be surprising since one expects that as the number of children increases the willingness to pay of the rural households for improved water supply may decrease since rural households may prefer to use child labour

to fetch water from distant areas rather than pay for improved water services. This result may be due to the fact that most of the rural farmers of the sample area use donkeys to carry (transport) a pair jerrycans of water and the need of child labour to fetch water is low.

The sign of coefficients and t-ratios of the explanatory variables, namely; income, time (distance) and number of livestock owned of this study are similar with that of *Fisseha Aberra's* study. But the sign of the coefficients of education level of the household is positive in this study while it is negative (for high school) in *Fisseha Aberras'* study. Besides, variables such as households age, number of children, number of women, wealth, female household head, quality of water, alternative water source, credit and total family size that are considered in this study are not used in *Fisseha Aberra's* study.

The average price per jerrycan of water that the sample households are willing to pay is 0.13 birr. This payment for improved rural water service has many advantages. On one hand it will raise revenue that could be used to expand rural water services and on the other hand it may reduce burden of government budget. Supply of improved water for rural households will also reduce work load of rural women and children. Besides, rural women may save time for income generating activities such as petty trading, home based business and labour in agriculture for crop production and rearing livestock.

#### **POLICY IMPLICATION**

1. The basic problem of rural water provision in the study area is that, there is lack of responsible body (institution) that can identify the need of the society and provide improved water service as well as maintain the already installed improved water supplying schemes. In order to solve the

problem of improved rural water provision of the study area the government has to give attention to establish a responsible body at the district level that can make follow up about the problem of rural areas and give immediate solution.

2. Based on households' demand, provision of improved rural water service at affordable price is important since it will reduce financial burden on the government budget, increase revenue of the government and enhance sustainable improved rural water service for the community.

3. Concerning improved rural water provision attention has to be given for rural households that are far away from water sources and to those households that use low water quality such as rivers, lakes and wells as sources of water.

4. Encouraging grass-root organizations in rural water provision (such as water users association) is important at a village level. Members of such organizations may contribute their own money for improved water supply which will help to encourage cost sharing, ownership and management.

5. Materials (equipments) needed for rural water supply has to be maintained easily at local level by the community. Producing such materials locally has many advantages. The advantages are; (a) to reduce import of expensive materials and (b) to encourage local enterprises that produce such materials.

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## APPENDIX

## APPENDIX 1: QUESTIONNAIRE FOR THE STUDY ON IMPROVED RURAL WATER PROVISION (January 1998).

The information generated by using this questionnaire will be used only for academic purpose. All household level information will be confidential.

## PART I: GENERAL INFORMATION

1. Region \_\_\_\_\_ Zone \_\_\_\_\_ District \_\_\_\_\_
2. Peasant association (PA) \_\_\_\_\_
3. Name of household head \_\_\_\_\_ sex \_\_\_\_\_  
Race \_\_\_\_\_ Religion \_\_\_\_\_
4. Interviewer \_\_\_\_\_ Date of interview \_\_\_\_\_
5. Supervisor \_\_\_\_\_
6. List of all household members with their age, sex and education level

Name	sex	age	education					
			NSC	ALPP	grade 1 to 6	grade 7 to 8	grade 9 to 12	CAA

NB

NSC = No schooling, ALPP = Adult literacy program participation,  
CAA = Collage and above

7. Would you list your alternative water sources?

- |    |    |    |
|----|----|----|
| 1. | 3. | 5. |
| 2. | 4. | 6. |

8. What is your current source of water?

- (1) community electric pump (2) community solar pump  
 (3) community hand pump (4) spring developed (5) water vendor  
 (6) others (spring, river, well, pond)

If (1), (2), (3), or (4) go to question number (9)

If (5) go to question number (27)

If (6) go to question number (34)

**1. COMMUNITY ELECTRIC PUMP, SOLAR PUMP, HAND PUMP OR  
 SPRING DEVELOPED**

9. What is the distance between your house and your current water source?

- (1)  $\leq 1$  km (2) 1 km to 3 km (3) 3 km to 5 km (4)  $> 5$  km

If more than 5 km specify \_\_\_\_\_

10. How many times do you fetch water from this source daily?

- (1) once (2) twice (3) three times (4) four times

(5) five times (6)  $\geq 6$  (specify) \_\_\_\_\_

11. Time spent on water collection by women relative to other works;

11.1. How much time do you spend to fetch water during one journey? \_\_\_\_\_ hours and \_\_\_\_\_ minutes

11.2. How much time do you spend on other works on average daily? \_\_\_\_\_ hours and \_\_\_\_\_ minutes

12. Is there queue? (1) yes (2) no

If yes how much time do you spend? \_\_\_\_\_ hours \_\_\_\_\_ minutes

13. How many persons go to fetch water at once for the household? \_\_\_\_\_ person/s

14. Who fetch water for the household? (1) girls (2) boys

(3) women (4) men (5) girls & boys (6) girls & women

(7) girls & men (8) boys & women (9) boys and men

(10) women and men (11) girls, boys and women

(12) girls, boys, women & men

15. Number of those who fetch water according to their age group; (1) whose age < 15 male \_\_\_\_\_ female \_\_\_\_\_  
(2) whose age  $\geq$  15 male \_\_\_\_\_ female \_\_\_\_\_
16. How many taps does it have? (1) 1 (2) 2 (3) 3 (4) 4 (5) 5  
(6)  $\geq$  6 (specify) \_\_\_\_\_
17. How much taps function most of the time?  
(1) 1 (2) 2 (3) 3 (4) 4 (5) 5
18. How much water do you collect from this source at once?  
\_\_\_\_\_ insira/jerrycan
19. How do you fetch water? (1) on a back of donkey  
(2) on the back of women (3) on a head load (4) by hand
20. List alternative use of donkey (1) \_\_\_\_\_  
(2) \_\_\_\_\_ (3) \_\_\_\_\_ (4) \_\_\_\_\_
21. Do you pay for the water service you get? (1) yes (2) no
- 21.1. If yes how much cents do you pay for one  
insira/jerrycan? \_\_\_\_\_ cents.
- 21.2. If yes for which do you pay? (1) service charge  
(2) operating and maintenance cost  
(3) others (specify) \_\_\_\_\_
- 21.3. When do you use this source? (1) during dry season  
for \_\_\_\_\_ month (2) during rainy season for \_\_\_\_\_ month  
(3) throughout the year
- 21.4. If no why?  
(1) it gives free service for the whole community  
(2) there is no agreement of payment from the beginning  
(3) it has no management that is responsible to collect  
service charge (4) I can not afford the charge  
(5) others (specify) \_\_\_\_\_
22. Does it give enough service always? (1) yes (2) no  
If no when do you prefer? (1) in the morning  
(2) at mid day  
(3) after noon (4) during evening
23. What is the current status of its service? In terms of:  
(a) quality; (1) good (2) very good (3) excellent (4) bad  
(5) worse (6) the worst

- (b) Quantity; (1) good (2) very good (3) excellent (4) bad  
(5) worse (6) the worst
- (c) Convenience of service hours in relation to working hours; (1) good (2) very good (3) excellent (4) bad  
(5) worse (6) the worst
24. Why do you collect water from this source?  
(1) for drinking and household work (2) for washing cloth  
(3) for livestock (4) for home based business (*tella, katikala, etc.*)  
(5) watering vegetables and other garden plants  
(6) for drinking, household work & washing cloth  
(7) for drinking, household work & home based business  
(8) for drinking, household work, washing cloth, home based business, livestock and garden plants.
25. Does its management efficient? (1) yes (2) no  
If no which type of ownership do you prefer? (1) private  
(2) contract (3) others (specify \_\_\_\_\_)
26. Do you have a practice of harvesting rain water for drinking? (1) yes (2) no  
If yes from where? (1) iron sheet roof (2) collection of run off flood (3) others (specify \_\_\_\_\_)

## 2. WATER VENDOR

27. From whom do you buy water? (1) from well owners  
(2) from hand pump owner (3) from pipe line owners  
(4) others (specify) \_\_\_\_\_
28. How much do you buy daily? \_\_\_\_\_ insira/ jerry can
29. How much do you pay per *insira/* jerry can of water?  
\_\_\_\_\_ cents.
30. When do you buy water? (1) during dry season for \_\_\_ month  
(2) during rainy season for \_\_\_ month (3) throughout the year
31. Do you buy water for livestock? (1) yes (2) no  
If yes \_\_\_\_\_ jerry can per day for \_\_\_\_\_ months
32. Do you get enough water from water vendor? (1) yes (2) no

33. How much time do you spend fetching water from water vendor at once? \_\_\_\_ hours \_\_\_\_ minutes

**3. OTHERS (spring, river, pond, well)**

34. What is your current source of water?

(1) spring (2) river (3) well (4) pond

(5) others ( specify) \_\_\_\_\_

35. What is the distance between your house and your current water source?

(1)  $\leq 1$  km (2) 1 km to 3 km (3) 3 km to 5 km (4)  $> 5$  km

If more than 5 km specify \_\_\_\_\_

36. How many times on average do you fetch water from this source daily? (1) once (2) twice (3) three times

(4) four times (5) five times

(6) If  $\geq 6$  times (specify) \_\_\_\_\_

37. Time spent on water collection by women relative to other works;

37.1. How much time do they spend to fetch water during one journey? \_\_\_\_ hours and \_\_\_\_ minutes

37.2. How much time do they spend on other works on average daily? \_\_\_\_ hours and \_\_\_\_ minutes.

38. Is there queue? (1) yes (2) no

If yes how much time do they spend? \_\_\_\_ hours \_\_\_\_ minutes

39. How many persons go to fetch water at once for the household? \_\_\_\_ person/s

40. Who fetch water for the household?

(1) girls (2) boys (3) women (4) men

(5) girls & boys (6) girls & women (7) girls & men

(8) boys & women (9) boys and men (10) women and men

(11) girls, boys and women (12) girls, boys, women & men

41. Number of those who fetch water according to their age group; (1) whose age  $< 15$  male \_\_\_\_\_ female \_\_\_\_\_

(2) whose age  $\geq 15$  male \_\_\_\_\_ female \_\_\_\_\_

42. How much water do you collect from this source at once?

\_\_\_\_\_ insira/jerrycan.

43. Do you fetch enough water from this source? (1) yes (2) no  
 If no why? \_\_\_\_\_  
 If no when do you prefer? (1) in the morning  
 (2) at mid day (3) after noon (4) during evening
44. What is the current status of its service? In terms of:  
 (a) quality; (1) good (2) very good (3) excellent (4) bad  
 (5) worse (6) the worst  
 (b) Quantity; (1) good (2) very good (3) excellent (4) bad  
 (5) worse (6) the worst
45. Why do you collect water from this source?  
 (1) for drinking and household work (2) for washing cloth  
 (3) for livestock (4) for home based business  
 (tella, katikala, etc.)  
 (5) for watering vegetables and other garden plants  
 (6) for drinking, household work & washing cloth  
 (7) for drinking, household work & home based business  
 (8) for drinking, household work, washing cloth,  
 home based business, livestock and garden plants

## PART II: QUESTIONNAIRE ON WILLINGNESS TO PAY

Suppose there is improved water service by government or private enterprises in your community. This water service will be established at a convenient place for the community or yard type. The water service is reliable and sufficient for your family as well as for your community throughout the year. And it will be metered for the service it gives.

Regarding to the investment cost of water service, the cost of installation will be distributed over the service year and you are required to pay per *insira* or jerrycan you may collect. The charge may depend on initial investment and operation cost. Therefore, you may get improved water service at your community. So that, you may save time for agricultural works, other income generating activities and child care.

Giving these information I would like to ask you some questions to know your demand for improved water service in your community. Therefore, I would like if you answer the following questions based upon your own preference.

### A BIDDING GAME

#### A high starting point of bidding game

46. If the charge for improved water service is 0.15 birr per jerrycan (where one jerrycan is assumed to contain from 25 to 30 litres of water) are you willing to pay for improved water service?  
 (1) yes (2) no  
 If yes go to question number (47)  
 If no go to question number (50)
47. If the charge for improved water service per jerrycan is from 0.16 to 0.20 birr, are you willing to pay for improved water service at your community? (1) yes (2) no  
 If yes go to question (48)
48. If the charge for improved water service per jerrycan is from 0.21 to 0.25 birr, are you willing to pay for improved water service at your community? (1) yes (2) no  
 If yes go to question (49)
49. If the maximum charge per jerrycan is 0.30 birr, are you willing to pay for improved water service at your community?  
 (1) yes (2) no
50. If the price of improved water service per jerrycan is from 0.11 birr to 0.15 birr, are you willing to pay for improved water service? (1) yes (2) no  
 If no go to question (51)
51. If the price of improved water service per jerrycan is from 0.06 to 0.10 birr, are you willing to pay for improved water service? (1) yes (2) no.  
 If no go to question number (52)

52. If the price of improved water service per jerrycan is from 0.01 to 0.05 birr, are you willing to pay for improved water service? (1) yes (2) no.  
If no go to question number (53)
53. If you are not willing to pay for improved water service at all (i.e if the response is "zero"), would you tell me the reason?

**PART III: RESPONDENTS' ASSET, INCOME AND EXPENDITURE.**

54. Did you get extension service? (1) yes (2) no
55. Did you get credit for agricultural inputs last year?  
(1) yes (2) no
56. Did you use improved seed and/or fertilizer last year?  
(1) yes (2) no  
If yes which one did you use?  
(1) selected seed (2) fertilizer (3) both
57. Do you have a corrugated iron sheet roofed house?  
(1) yes (2) no
- 57.1. If yes its value in birr \_\_\_\_\_  
If yes do you have thatch roofed house in addition?  
(1) yes (2) no
- 57.2. If no is it thatch roofed house? (1) yes (2) no
58. From what does your house is made of? (1) wood and mud  
(2) others (specify) \_\_\_\_\_
59. What do you use for lighting? (1) lantern (2) kerosene lamp  
(kuraz) (3) fire-wood (4) cow dung  
(5) other (specify) \_\_\_\_\_
60. What type of energy source do you use for cooking?  
(1) Kerosene (2) fire-wood (3) cow dung (4) crop residues  
(5) kerosene and fire wood (6) Kerosene and cow dung  
(7) kerosene and crop residues (8) fire wood and cow dung  
(9) fire wood and crop residues (10) cow dung and  
crop residues (11) kerosene, fire wood and cow dung  
(12) kerosene, fire wood, cow dung and crop residues  
(13) others (specify \_\_\_\_\_)

61. What is your average weekly expense for light and/ or energy sources? \_\_\_\_\_ birr and \_\_\_\_\_ cents
62. How many hectares of land do you have totally? \_\_\_\_\_ hectares
63. Land quality and tenure status (in 1989/90 EC);
- 63.1. Land quality; (1) fertile (2) medium (3) not fertile
- 63.2. Land tenure status; (1) self cultivated  
(2) share cropped-out (3) rented-out (4) contract-out
- 63.3. rent-in land (1) yes (2) no If yes \_\_\_\_\_ hectares
- 63.4. share cropped-in (1) yes (2) no If yes \_\_\_\_\_ hectares
- 63.5. contract-in (1) yes (2) no If yes \_\_\_\_\_ hectares
64. Do you have radio/tape recorder? (1) yes (2) no  
If yes value in birr \_\_\_\_\_
65. Do you have domestic animals? (1) yes (2) no  
If yes specify their number, value and age

no.	value	age	no.	value	age
	in birr			in birr	
ox	_____		sheep	_____	
cow	_____		goat	_____	
bull	_____		donkey	_____	
heifer	_____		mule	_____	
calf	_____		horse	_____	
			camel	_____	

66. Types of crops grown (1) annual (2) perennial  
(3) Vegetables

67. Actual yield of 1997(1989 E.C) and 1998 (1990 E.C);

Type of crop	1997 (1989 E.C)		1998 (1990 E.C)	
	amount in hectares	yield in qt.	amount in hectares	yield qt.

White teff	_____	_____	_____	_____
Black teff	_____	_____	_____	_____
Wheat	_____	_____	_____	_____
Barley	_____	_____	_____	_____
Maize	_____	_____	_____	_____
sorghum	_____	_____	_____	_____
Chick pea	_____	_____	_____	_____
horse bean	_____	_____	_____	_____
Haricot bean	_____	_____	_____	_____
Field pea	_____	_____	_____	_____
Lentils	_____	_____	_____	_____
flax	_____	_____	_____	_____
Neug	_____	_____	_____	_____
rape seed	_____	_____	_____	_____
Vetch	_____	_____	_____	_____
Others	_____	_____	_____	_____

68. Off-farm income: did you or any other member of the household have off-farm income from weaving, tannery, pottery, smith, hired-out of labour, trading, traditional healing, hiring packed animals, etc?

(1) yes (2) no

If yes specify the average monthly income you got from them here under.

- a. weaving birr\_\_\_\_\_
- b. tanning birr\_\_\_\_\_
- c. pottery birr\_\_\_\_\_
- d. smith birr\_\_\_\_\_
- e. hired-out labour birr\_\_\_\_\_
- f. trading(crop, livestock,etc.) birr\_\_\_\_\_
- g. traditional healing birr\_\_\_\_\_
- h. hire of packed animals (transport) birr\_\_\_\_\_
- i. sewing birr\_\_\_\_\_
- j. remittance birr\_\_\_\_\_
- k. Others (specify) \_\_\_\_\_

69. Did you hire-out ox/oxen? (1) yes (2) no

If yes how much income did you get in 1989/90 EC ?

\_\_\_\_\_birr and \_\_\_\_\_qt. of grain (specify its name)\_\_\_\_\_

70. Did you hired-in ox/oxen? (1) yes (2) no

If yes how much was your expense in 1989/90 EC?

\_\_\_\_\_birr and \_\_\_\_\_qt. of grain (specify its name)\_\_\_\_\_

71. Did your family get income from such as tella, katikala, etc.? (1) yes

(2) no

If yes average weekly income\_\_\_\_\_birr.

72. How much did you sale from your yield?

		In 1989 EC			In 1990 EC
types of	amount	in birr	amount	in birr	
crop sold	in qt.		in qt.		

- a. \_\_\_\_\_
- b. \_\_\_\_\_
- c. \_\_\_\_\_
- d. \_\_\_\_\_

73. Income from livestock sales and livestock by-products during;

	<u>1989 EC</u>	<u>1990 EC</u>
cow/ox	___ birr	___ birr
heifer/bull	___ birr	___ birr
calf	___ birr	___ birr
sheep/goat	___ birr	___ birr
horse	___ birr	___ birr
Donkey	___ birr	___ birr
mule	___ birr	___ birr
hen	___ birr	___ birr
milk	___ birr	___ birr
hide and skin	___ birr	___ birr
honey	___ birr	___ birr
egg	___ birr	___ birr
cow dung	___ birr	___ birr

74. Do you save money? (1) yes (2) no

If yes, I save (1) in bank \_\_\_ birr/month

(2) Eqube \_\_\_\_\_ birr/month

(3) hoard \_\_\_\_\_ birr/month

(4) others (specify) \_\_\_\_\_

75. Amount used for seed in 1989 EC for main crops

Types of crop                      amount  
in kg.

- a. \_\_\_\_\_
- b. \_\_\_\_\_
- c. \_\_\_\_\_
- d. \_\_\_\_\_
- e. \_\_\_\_\_
- f. \_\_\_\_\_
- g. \_\_\_\_\_
- h. \_\_\_\_\_
- i. \_\_\_\_\_

76. Did you purchase food crops for family consumption in 1989/90 EC? (1) yes (2) no

If yes mention types of crop purchased and their amount

Type of crop	1987 EC		1990 EC	
	amount	price	amount	price

White teff \_\_\_\_\_

Black teff \_\_\_\_\_

Wheat \_\_\_\_\_

Barley \_\_\_\_\_

Maize \_\_\_\_\_

Sorghum \_\_\_\_\_

Chick pea \_\_\_\_\_

horse bean \_\_\_\_\_

Haricot bean \_\_\_\_\_

Field pea \_\_\_\_\_

Lentils \_\_\_\_\_

flax \_\_\_\_\_

Others \_\_\_\_\_

77. Total expenditure for agricultural inputs (fertilizer, selected seed, labour, pesticides, herbicides, animal health, hoe, maresha, wegel, etc) of 1989/90 EC  
\_\_\_\_\_ birr

78. Land tax \_\_\_\_\_ birr

79. Other yearly expense of the family (in birr)

a. clothing \_\_\_\_\_

b. health care \_\_\_\_\_

c. education \_\_\_\_\_

d. mahber \_\_\_\_\_

e. edir \_\_\_\_\_

f. ceremony \_\_\_\_\_

g. Others (specify) \_\_\_\_\_

80. What was daily wage rate for the following categories of labour during this year?

(1) < 15 years of age male \_\_\_\_\_ female \_\_\_\_\_

(2) ≥ 15 years of age male \_\_\_\_\_ female \_\_\_\_\_

81. What is your household average weekly expense for the following items?

a. salt *birr*\_\_\_\_\_

b. coffee *birr*\_\_\_\_\_

c. edible oil *birr*\_\_\_\_\_

d. spices *birr*\_\_\_\_\_

e. soap *birr*\_\_\_\_\_

f. others (specify)\_\_\_\_\_

82. Is there healthy education at your community?

(1) yes (2) no

If yes did you participate? (1) yes (2) no

If no why?

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
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## Declaration

I the undersigned, declare that this thesis is my work and that all sources of materials used for the thesis have been dully acknowledged.

Name:- Dunfa Lemessa

Signature:-  \_\_\_\_\_

Place and date of submission

Graduate School, June, 1998