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Estimating willingness to pay for water: A Contingent Valuation study on Meki town

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Estimating Willingness to Pay for Water: A Contingent Valuation Study on Meki Town

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ABSTRACT

In this paper, the method of contingent valuation (CV) is employed to assess consumers willingness to pay for an improved water supply service provided through a private connection. The focus group for the study are 264 households who were randomly selected from the small Ethiopian town of Meki.

Though 95.5 percent of the sample use a predominantly piped water source, 54 percent of them consider the existing source to be unsatisfactory. Hence an improved system which also charges higher tariff rate than existing one was welcomed by many of the sample. In fact, a tariff rate of 10 cents per insera, in spite of being almost double the current average price, was found affordable to 89 percent of the sample.

It was also observed that willingness-to-pay bid responses are not just random numbers but sensible expressions of consumers preferences which in fact are partly explained by economic variables such as income and the time cost of fetching water from alternative sources.

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Chapter One

1. Introduction

1.1 Background

Development is invariably one of the few universally desirable objectives that poor nations strive to attain. The attainment of such a multidimensional objective, however, largely remained illusive for most developing countries. Even for some of those who managed to achieve continuous economic growth for relatively longer periods, the lack of improvements in such areas as poverty alleviation and environmental sustainability leave much to be desired.

This, however, in no way discouraged nations from pursuing policies they believe will lead to increased economic growth, reduction of poverty and environmental protection. One such area of emphasis is the development of infrastructure and its services. Under economic infrastructure fall several activities which can be grouped into three main categories: public utilities (power, telecommunication, piped water supply, sanitation and sewerage, etc.), public works (roads, major dams) and other transport sector (urban and interurban railways, urban transport, ports and water ways and airports) (Word Bank, 1994).

Although there is no complete theory that frames the precise link between infrastructure and development, the evidence indicates that there is a high correlation between infrastructure capacity and aggregate output (Word Bank, 1994). Countries with high stock of infrastructure per capita, such as Japan and Norway, tended to be found on the high end of the GDP per capita scale. Similarly, countries with lower GDP per capita like Chad and Mali registered correspondingly lower infrastructure stock per capita. More over, it can be argued that rapid

increase in infrastructural investment, if appropriately transformed to a rapid increase in infrastructure services, can do much to raise productivity and improve living standards.

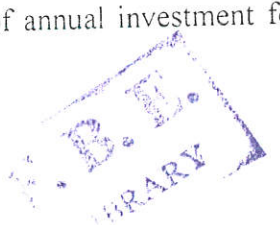
One element of infrastructural services, which will also be the main subject of this study, is the provision of piped water supply. According to Word Bank estimates, in spite of a 50% increase in the number of households with access to clean water world wide in the last fifteen years, there are still one billion people in the developing world who still are unable to access potable water (Word Bank, 1994).

The record is even more revealing when consideration is given to the distribution of access to clean water by income group. A World Bank estimate for the year 1990 shows that not more than 62% of the population in low-income economies obtain clean water while the corresponding figures for middle-income and high-income economies are 74% and more than 95% respectively. A further categorization indicates that most of the countries with 50% or more of their population lacking access to potable water are located in Africa. Further down on the low-coverage end are five African countries (including Ethiopia with just 18% in 1990) that have only 25% or less of their population with access to clean water (World Bank, 1994). The Ethiopian figure of 18% coverage does not tell the whole story since the distribution of the service between urban and rural areas is highly biased in favor of the former. Roughly 70% of the urban population have access compared to only 11% of rural population with similar access to the amenity (MoWR, 1996b).

Thus most Ethiopians lack access to safe water which is strongly believed to have several implications. First is the risk of contracting infectious diseases as a result of consuming

contaminated water. This concern cannot be overemphasized since over 70% of diseases in Ethiopia are attributed to water contamination (MoWR, 1996a). Secondly, the search for safe water by poor households takes a good deal of the time and energy of women and young girls in most rural areas and several urban centers. Since the opportunity cost of time lost in water collection is believed to be significantly positive, the provision of improved-service rendering schemes is potentially welfare improving.

Despite the low coverage in Ethiopia in general, efforts to improve the supply of potable water had been in place for a long time. Government policies in the last few decades strongly supported the urgency of providing safe water to as much population as possible. For instance, in the two decades between 1970 and 1990, the Word Bank estimated that expansion in the service enabled the coverage to increase from 6% to 18% of the total population (World Bank, 1994). This is an indication that a modest growth in the level of annual investment for the provision of improved water services had been undergoing.



The forgoing discussion indicates that efforts by the government to improve the provision of clean water to the public had been on the agenda of public policy for most of the last two decades. The reason for such measures was the belief that providing increased access to the population will directly translate to improved health conditions and reduced time taken to fetch water by households.

However, there was no water sector policy as such, so that such desirable objectives as integrating water supply and sanitation programs is seldom applied. Moreover, even to achieve the observed low water supply coverage in the country, the determining factor for

project formulation had been purely supply side considerations. Tariffs were deliberately set low in the expectation of extending the access to clean water to low income households.

In effect, such a strategy closed any room towards achieving an adequate financial policy. Hence, not only is it difficult to provide timely rehabilitation and expansion to existing schemes, but also the size of actual investment for water supply is limited. And more importantly, from the perspectives of the current study, some of the down sides of past approaches could have been mitigated by adding strong demand side considerations.

Such elements as the effect of user charge paid by households for the improved water services, peoples conception about the quality and desirability of using the new source, the availability of alternative sources, and not least their income and other socioeconomic characteristics are believed to determine their demand for the new services. A more complete picture for guiding government policy regarding new investment directed at the provision of the services would thus require both demand side as well as supply side considerations.

1.2 Statement of the Problem

The basis for most improved water supply service projects has been the premise that people not served by improved water services are mostly the poor because they can not afford to pay. Projects based on such assumptions required the provision of those improved services at prices far lower than if marginal cost pricing was practiced. Such strategies increased unsustainable burden on the limited public resources. The strategy also encourages the provision of low quality services in order to minimize the cost of providing a given level of service.

The result has generally been a failure in many of the services established to render those improved services. The evidence from some studies indicated that a quarter of all those improved systems financed from unreliable government sources do not function at any one time (Brisco *et. al.*, 1990). Further on, the rate of abandoning an existing system is comparable to rate the of commissioning new improved systems.

General conditions regarding improved water supply systems in Ethiopia is no exception to the above generalizations. A comprehensive assessment of past experience with the improved systems shows that most of the targets were underachieved. More importantly, several projects are believed turned to have unsuccessful and unsustainable largely due to the lack of "sufficient involvement from project beneficiaries" (MoWR, 1993).

These observations testify that the formulation of policies for improved systems in developing countries need to incorporate inputs from the potential consumers side. The issue here is to investigate why households in developing countries choose to use an improved water source rather than the existing one. Such investigation will help in avoiding potential resource misuse in the form of overdesigning or underdesigning new improved water service providing schemes.

Therefore, the focus here is to look in to the demand side of improved service rendering water projects. This issue, if appropriately incorporated into the project design stage, is believed to enhance the effectiveness of specific projects and policy at large. More specifically, the main issues to be addressed here are:

1. Information on the needs of the target population regarding their desired improvement to existing water services are seldom available at the design stage of water projects.
2. Once put in place, most improved-water-service-rendering schemes tend to deteriorate fast for lack of timely and adequate maintenance and rehabilitation.
3. If potential consumers' willingness to pay was to be incorporated into the design stage of projects, the degree of success in providing the right type of service required by the target population would improve. But estimating the willingness to pay for public goods is still a challenging task.

1.3 Objective of the study

The **main** objective of the study will be to estimate the willingness to pay for improved water services in Meki town.

Specific objectives of the study are to:

I. Elicit willingness-to-pay responses for improved water services from a hypothetical market scenario for sampled households in Meki town.
II. Analyze the existing water consumption pattern of the population.
III. Analyze the relationship between willingness-to-pay bids and major socioeconomic features of respondents.
IV. Estimate aggregate demand schedule for private connection to the improved water service proposed by this study.
V. Evaluate the extent to which the contingent valuation method can be used to elicit dependable information to construct water demand characteristics of households.
VI. Identify the factors which determine the willingness-to-pay of households for the proposed service.

1.4 Organization of the study

The remaining part of this study is structured as follows. Chapter 2 deals with the theoretical framework for using the contingent valuation method. In this chapter, a section is devoted to survey of the literature on the CV methodology while another section reviews relevant empirical works. Chapter 3 discusses sample results where statistical techniques are employed to test for possible relationship between various economic and social indicators.

In chapter 4, the main findings of the study are presented and discussed. Here, aggregate indicators of willingness to pay are explained and also methodological test results presented. Chapter 5 details the results from a multivariate analysis of WTP bids while the final part, i.e. chapter 6, makes conclusions and forwards policy recommendations from the study.

Chapter Two

2. Review of the literature

2.1 Conceptual Framework

It is useful to note at the outset that to illuminate the rationale for using the Contingent Valuation method, the theoretical formulations used here pursue the argument from a pure public good perspective. This approach does not however limit the methods applicability to the different kinds of goods which can be classified as falling between pure private goods and pure public goods.

In fact the above reminder is very important for the current purpose since valuation in the current study will center on the provision of "improved piped water", which by some definitions can be classified as quasi-private good (Mitchell and Carson, 1989). This definition indicates that the good lacks some of its purities as is found in either pure public goods or pure private goods.

These limitations can arise due to the presence of some rivalry in consumption or due to issues of exclusion or both. In all cases, though, the application of the CV method in studies is targeted at simulating an organized market for goods which are not traded freely. Hence, the method has the advantage of being suitable to measure the benefits of both quasi-private and pure public goods.

Having said this, it will now be easier to discuss the motivation for using the CV method in a broader framework as follows.

The theoretical justification for using the contingent valuation method to estimate willingness to pay measures is based on the subject of welfare economics. The latter is basically one of the two branches of economics referred to as normative economics which seeks to make judgments about the desirability of having governments undertake particular policies (Mitchell and Carson, 1989).

Earlier approaches in applied welfare economics were largely based on the concept of a social welfare function - a notion based on the assumption that individual utilities can be added up to obtain aggregate social utility. This approach is basically Bentamite, and in fact, utility here is taken to be measurable cardinally and hence can be compared across individuals.

Such cardinal utility assumption is not accepted by modern day economists, and thus more acceptable approach for modern welfare economics is to use ordinal comparisons of utility levels. This latter approach allows no comparability of utility across individuals. The welfare criterion used for such purpose is the Pareto criterion. Based on this criterion, the standard for analyzing policy measures is to undertake policy changes which make at least one person better off without making anyone else worse off. And changes with such characteristics are termed Pareto-improving.

To operationalize the Pareto criterion, the next step is to use an appropriate benefit measure such that total benefits accruing to the targeted population from the policy intervention can be correctly assessed. One such measure is the neoclassical concept of consumer surplus. The concept is defined as the difference between the total utility enjoyed by the consumer and what

is paid for a good or service. Total utility for a consumer is thus the combination of the amount paid for the good plus any consumers surplus (Dixon *et. al.*, 1994).

As traditionally used by economists though, the definition of consumers surplus as the area under the ordinary (Marshallian) demand curve and above the price line has a number of problems that limit its applicability for measuring welfare changes arising from a price or quantity change. The basic reason for these problems comes from the recognition that ordinary Marshallian demand curve do not hold the level of utility or satisfaction constant. Rather income is held constant.

To solve this problem, the appropriate measures to use are the Hicksian measures (compensating variation and surplus or equivalent variation and surplus). These measures hold utility constant at either the initial level (compensating measures) or at an alternatively specified level (equivalent measures). Further on, depending on whether the consumer is free to vary his consumption level of the good in consideration or whether he is constrained to consume fixed quantities only, the Hicksian measures can be categorized into either measures of variation or measures of surplus.

The relationship between the Marshallian and the two Hicksian demand curves can be illustrated more clearly using Figure 1 below. Assuming the provision of a certain unpriced public good has been increased from the initial level of Q_0 to Q_1, the consumer surplus associated with this change can be estimated by using three alternative demand curves. The thicker line, D_1, represents the ordinary Marshallian demand curve. Based on it the consumer surplus is the area between the two dotted vertical lines below the D_1 curve, i.e. area (**a** + **b**).

Alternatively, if the Hicksian compensated demand curves are used, two different estimates are possible. If the reference point for the welfare change is the initial utility level, U_0, then the appropriate measure is the area bordered by the two dotted lines from left and right and the H_0 line from above, i.e. area **a**. Finally if the reference point is the final level of utility attained after the change in provision, then consumer surplus is measured by the sum of the three areas, namely (**a** + **b** + **c**).

Policy usually focuses on the potential consumer benefit for a proposed change from the consumers' current or initial level of utility. Further on, if the proposed change is welfare-increasing, as is the subject of this particular study, then the appropriate welfare measure is the compensating surplus. This measure can be interpreted as the "consumer's maximum willingness to pay in order to gain the quantity increase and still maintain his initial level of utility" (Mitchell and Carson, 1989).

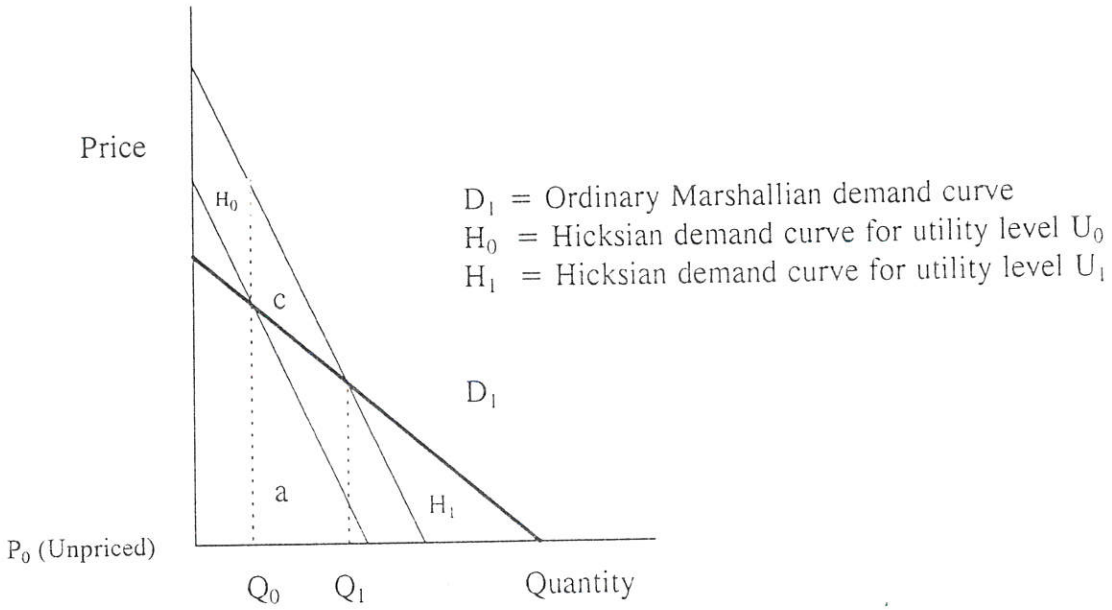
But now, the calculation of benefits by using either of the two appropriate Hicksian demand curves requires the actual construction of the demand curves so that the area under the curve representing the welfare change could be estimated. In reality, though, the task of estimating demand function for environmental goods is very difficult. The difficulty arises, not only from the substantial methodological effort that demand estimation requires, but also from the lack of accurate market data for public goods (Kolstad and Braden, 1991).

At this point, the alternative methodology of using hypothetical market scenarios comes into play. One promising development in the hypothetical market model is the contingent valuation method. The method requires the creation of a market scenario that resembles actual market

situations for goods and services which do not have ordinary markets. By administering the scenarios in a survey model to potential consumers, a maximum willingness to pay data is generated which then is used to construct demand curves. If this procedure is followed, the final point for welfare analyses will then be, to estimate the area under the demand curve for the proposed change in the quantity of provision.

Figure 1

Choice of benefit measures



Adopted from. "Using surveys to value public goods: The contingent valuation method". by Robert C. Mitchell and Richard T. Carson.

But the advantage of using the contingent valuation method extends more than just generating the data needed to construct the demand curve. In fact, the valuation process can be conducted from the contingent valuation (CV) result without the need to estimate the actual demand curve. This latter point can be emphasized by first considering the relationship between the concept of expenditure functions and Hicksian compensated surplus measures.

Modern consumer theory defines the expenditure function as one of the four equivalent ways to represent the constrained utility maximization problem (Varian, 1984). This function is written as:

$$e(\mathbf{p},\mathbf{q},U) = Y$$

where $\mathbf{p}$ is a vector of prices, and $\mathbf{q}$ is a vector of fixed public goods. U is a level of utility, and Y is the minimum amount of income needed to maintain utility level U given the price and public goods vectors (Mitchell and Carson, 1989).

Now letting $\mathbf{p}_0$, $\mathbf{q}_0$, U_0, Y_0 represent some initial level of those respective arguments and $\mathbf{p}_1$, $\mathbf{q}_1$, U_1, Y_1 represent some subsequent level, the compensating surplus measure can now be represented as the difference between two expenditure functions.

$$CS = [e(\mathbf{p}_0, \mathbf{q}_0, U_0) = Y_0] - [e(\mathbf{p}_0, \mathbf{q}_1, U_0) = Y_1]$$

Hence,

$$CS = Y_0 - Y_1$$

For a proposed welfare gain, i.e. a change in provision which increases utility, the compensated surplus measure tells us how much money income the individual should be willing to give up (WTP) to ensure that the change occurs (Bateman and Turner, 1993). In a contingent valuation method, the proposed increased-provision of the good is presented in a hypothetical market model and then the individual is asked to express his maximum willingness to pay in order to benefit from the consumption of this particular good whose provision level has been raised.

2.2 *The Contingent Valuation Method (CVM)*

The method of contingent valuation (CV) is relatively of a recent development with its first known application to empirical problems dating back to the mid 1960s. Since then, however, investigations into the potential as well as shortcomings of using the method has been conducted.

Some of the detailed studies on the subject ascertains that the method is capable of producing the data required to construct theoretically correct measures of welfare changes such as the Hicksian surplus measures (Mitchell and Carson, 1989, Bateman and Turner, 1993).

In order to do so, however, due emphasis is needed in the designing of the hypothetical market scenario. This stage is particularly expected to depict unambiguously the nature of the public good being valued, the reference level of utility, the conditions for the provision of the good as well as the mode of payment, and the elicitation method (Mitchell and Carson, 1989).

Another area of concern in using the CV method is related to methodological issues which broadly can be classified into validity, reliability and bias issues (Bateman and Turner, 1993). Here again, some of these methodological challenges are considered less threatening than the others. Based on both experiments and theoretical predictions, it is advisable to give emphasis to in-built systems and design modifications that reduce the potential for biased WTP results.

The bottom line is that although CVM has the potential for wide range of application to value environmental goods monetarily, it is also susceptible to several types of biases. However, by a careful designing of the method, the techniques employed can be made to provide valid and accurate valuation results.

2.3 Application of the CV method

The CV method had been employed to diverse areas since its first known application to estimate benefit of outdoor recreation in a Maine backwoods area, in US, by economist Robert K. Davis in the '60s. Some of the areas assessed through the medium of the method include issues on hunting, fishing, air visibility, scenic beauty, water quality, pollution, congestion, accidents, and safety.

Regarding to the CV method's application to value the services form improved water supply projects, few but important empirical works can be cited. The relevance of these studies to the present task cannot be overestimated since almost all of them were conducted on developing countries. However each one of these is not without some distinctive feature of its own. A study by Whittington *et. al.* (1990), for instance largely emphasized on issues of whether one can expect to get reliable WTP estimates from empirical investigations, while others devote greater effort to estimating the WTP for improved service provision (Whittington *et. al.*, 1991; McPhail, 1993).

Still different is the case of studies which were conducted with multiple objectives. One such case is the joint objective to estimate WTP values, test the validity of the result obtained and assess the possible trade-off between social and financial objective of improved water service

rendering schemes (Brisco *et. al.*, 1990). In a similar study conducted in the northern Indian state of Karala in 1988, the CV methodology was employed to assess willingness to pay for improved water services under three water environments, i.e., abundant water, scarce water and saline water (Griffin, *et. al.*, 1995).

All sites selected for the application of the CV method had some peculiar feature regarding their existing water supply facilities. A village in Southern Haiti and one site in Brazil do not have any form of piped water supply system at the time of investigation. On the other hand, the cases of two sites in Brazil, five small cities in Morocco and a big city in Nigeria had all an exiting water supply system in place, although the percentage of population served by the system varied. In the Indian case, the researchers deliberately selected both connected and unconnected families from each water environment so as to capture any variation in WTP responses between the two groups.

Not surprisingly, the WTP bid results, as a percentage of households estimated total income obtained from these studies also showed variations. While some were extraordinarily high - about 18% for Onitsha in, Nigeria- as compared to the World Banks estimate of maximum affordable expenditure for water of 5% of income (Whittington et. al., 1991) - there were also very low WTP bid results. Two such cases are one from rural Haiti where households expressed a WTP of 2.1% for private water connection and the 2.3% average bid value obtained from households in Brazil. (See Table 2.1 below for a summary of the main features and results of studies reviewed in here.)

Tests for various forms of biases in the WTP bid results indicate that the CV method can indeed produce dependably accurate results. On the Nigerian case for instance, no evidence on both strategic bias and starting point bias was observed. Similarly, starting point was not an influencing factor for the Moroccan WTP bid results. The study on Haiti particularly gave greater emphasis on methodological issues by conducting strong statistical tests designed to check the appropriateness of using the CV method itself. Specific tests were conducted to capture possible biases arising from strategic behavior of individuals as well as biases which arise from the starting point of the bidding game.

The data, however, consistently indicated that neither of the two bias categories were significant enough to influence the WTP values obtained in that particular study. The outcome of the starting point bias issue is particularly encouraging for the present study on Ethiopia. This is so because the basic elicitation format to be used will be the bidding game just as the studies reviewed in here have all done. This does not, however, substitute for the need to incorporate a bias testing components in any similar study, including the present one.

To supplement the WTP results obtained from simple statistical analysis, most studies also conduct an accompanying multivariate analysis of the bid values. Although slightly varying econometric models were used, results of the multivariate models employed in these empirical works were largely consistent with what demand theory would predict under similar circumstances. For instance, except for the Nigerian case, income was found to be an explanatory factor of variations in WTP in all the other studies. Further more the direction of relationship between the two variables was definitely positive.

Several of the socioeconomic characteristics of households were also found capable of explaining variations in WTP bids. In Karala, northern India for instance, household features such as use of electricity, number of rooms in a dwelling and ethnic groups of the respondent significantly explain some of the WTP differentials among families.

Results regarding the education variable, on the other hand was mixed. Both in Nigeria and in Morocco, education does not seem to influence households' valuation of improved water services. The study on India found education to be strong enough to affect the probability that households choose to connect to the new system through a yard tap.

On the possibility of having projects which meet social objective while at the same time showing financial viability, the evidence from Brazil answers affirmatively while the Nigerian one emphasizes on finding the trade-off point which produces a desirable combination of the two objectives.

An important addition to such empirical investigations is the evidence on how households behave after the proposed facility are once put in place. Follow up studies geared in this direction are not frequently found. One such case is the result from a 1991 follow up survey to what was conducted in 1988 in India.

The general result affirms that a good proportion of households who claimed they would connect to the system for a given price of the new service did actually hook up to the system when the project was implemented at a later time. More specifically, in the Indian case, the connection rate was found to be very low as predicted by the earlier contingent valuation

study. The main reason for such an outcome is the high initial connection cost demanded of each potential consumer.

Another concern is the benefit-transfer issue. Benefit-transfer basically involves the objective of extrapolating CV results obtained from information gathered from one group to predict actual behavior of a similar group. In spite of the close similarity between the two sites analyzed in Karala, India, predictions based on benefit-transfer were found to be wrong for about half of the sample.

In conclusion, the demand for water should be one of the basis for initiating and implementing projects which provide improved water services. In so doing, it is not income alone which determines households' demand, rather it is the joint effect of three major factors: (a) socioeconomic and demographic characteristics of the households, (b) current water sources' characteristics in comparison to proposed water sources, and (c) households attitudes towards government policy in the water sector (Word Bank, 1993).

To analyze the effect of such variables on households WTP, a proper use of simple statistical techniques as well as behavioral models can generate consistently accurate predictions. Extrapolating these information to other similar groups could however lead to seriously erroneous results.

Table 2.1: Summary of main features and results from studies reviewed above.

Authors	Country of study	Year of study	No. of House-holds surveyed	Mean WTP obtained	Model used	Tests conducted for	Major explanatory variables used
Whittington *et. al.*	Haiti	1986	170	2.1% PC[1] 1.7% PT[2]	Probit	Strategic, starting and hypotheti cal biases	Wealth , education, quality, and distance from source
McPhail	Morocco	1990	460	7 - 10% PC	OLS	Simple reliability tests	Household expenditure education, no of rooms
Brisco *et. al.*	Brazil	1987	1164	2.3% PC	Probit, Tobit	Strategic bias	Income, education, appliance ownership
Singh *et. al.*	India	1988	1150		Probit		Income, education, occupation, distance from water source
Griffin *et. al.*	India	1991	161			benefit transfer, benefit revelation	
Whittington et. al	Nigeria	1987	235	18% PC	OLS, Probit	reliability tests	Income, education, water storage

PC[1] = Private Connection PT[2] = Public Tap

Chapter Three

3. The sample set

3.1 Household characteristics

The data used in this study was generated through a probability sampling procedure conducted in Meki town in early January 1997 in which 264 households were selected as a sample. (For details on data collection method as well as field procedures, see appendix 2 below). It was discovered that a total of 1643 people reside in the selected sample households thereby making up roughly 7.5 percent of the town's population. The household size of this sample ranges from one person per household to 17 persons per household, while the mean value is 6.22 persons.

In conformity to normal expectations, a larger share (i.e. 62.9 percent) of the households were found to be male headed (Table 3.1), with the remaining 37.1 percent constituting the female headed portion. Even then, the observed proportion of female headed families is considered to be on the high side. The latter type of families are mostly engaged in home-based businesses such as preparing local beer and other harder liquors. A simple correlation analysis on the relationship between engagement in small businesses and the head of the households indicates that 79 percent of female headed households are involved in at least one type of small commercial activity. For male headed families the corresponding figure is 55 percent.

Sixty percent of surveyed families reported a family head who has no exposure to formal education, while 40 percent are headed by one who has at least elementary school level

education. Another feature of the sample households is that some of them are engaged in agricultural activity (including animal husbandry). This activity is undertaken either as a major source of income or as a supplementary one.

Table 3.1: Some indicators on household characteristics, education and occupation of sample households

Mean household size	6.22
Percentage of households headed by male	62.9
Percentage of households having a household heads with at least elementary school level education	40.5
Percentage of households with some members engaged in agriculture	38.3
Percentage of households with some members engaged in commerce	63.6

Source: Computed from survey data

Some 20 percent of the sample households, for instance, are engaged in both home-based businesses and agriculture simultaneously. It is also noted that a proportionately higher percentage of those who are engaged in agriculture do also have high average monthly income, although the level of association of the two variables is not so strong. (A chi-square test for independence of the two indicators becomes significant at 17.1 percent level of probability).

A similar exercise to identify the main features of households who undertake small home-based business and/or retailing activities shows that 56 percent of these families have a monthly income not exceeding 150 Birr. A comparison of the proportion of households who conduct business across different income groups however reveals the ratio falling with increase in the

income category. Standard statistical test, though, discloses the correlation to be not so strong (significance = 0.143).

3.2 Water consumption practices

Most of the households surveyed in Meki town use piped water for all their daily needs. It is only about 4.5 percent who reported using predominantly non-piped water sources for most of their daily activities (Table 3.2). Some of the latter group obtain their water from wells located in their compound while others depend for a source on a river which passes through the center of the town. The remaining 95.5 percent of the households use piped water throughout the year.

Such a high level of demand by households for piped water would normally be expected to correspond to a wide and developed water supply network. However, the proportion of households who enjoy private piped connection to the town's water supply network constitutes only 17.4 percent of the sample.

Even more surprising, only 6.4 percent of the surveyed families depend on public water taps for their major source of water. Schemes such as public water tap facility are supposed to serve populations with very low income. In such circumstances, proportionately higher percentage of households in small rural towns would be expected to use the facilities.

Table 3. 2: Major sources of water for sampled households

Source	Frequency	Percent	Cumulative percent
Water vendor	189	71.6	71.6
Own connection	46	17.4	89.0
Public water tap	17	6.4	95.4
Wells and rivers	12	4.5	100.0

Source: Computed from survey data

During the survey, it was learnt that there are nine public water tap stands within the town boundary, although only seven of these were functioning. Since most of these stands had at least four taps each, several households could use the facilities at a time. The problem, however, is that the working hours of the public water taps is very short. In fact, at the time of the survey, no two public tap stands were observed operating at the same time. To aggravate the problem even further, only one person from the town's Water Supply and Sewerage Services Office is responsible for operating all the public water points in the town.

This situation restricts households from meeting their water demand from this particular source and hence forces families to resort to other sources. The alternative is to buy water from vendors. Vendors are households and other small commercial units who have a private piped connection to the system and use the water not only for themselves but to retail at profit to other households. In the sample, the later group constituted 71.6 percent of all households.

While the price of water at public taps is currently 2.5 cents per *insera*, most households who buy water from vendors are charged five cents or more for the same amount of water (Table 3.3). Consequently, most households have to pay higher prices to obtain water from water

vendors, which they could have obtained at a lower rate had they been able to use public taps or even their own private connection to the system.

Table 3. 3: Mean, minimum and maximum values of selected water use indicators for sample households

	Mean	Minimum	Maximum
Households' daily water consumption (in *insera*/ a 20 liters capacity container)	5.72	1	20
Monthly expenditure on water (in Birr)	10.50	0	70
Average price of water (cents per *insera*)	5.5	0	20
Price of water by source(cents per *insera*)			
Water vendor	6.8	3.3	20
Public water tap	2.5	2.5	2.5
Private connection	2	2	2
Time taken to fetch water (in minutes)	24.93	0	300

Source: Computed from survey data

The sampled households pay an average price of 5.5 cents per *insera*, although some families face prices as high as 20 cents for approximately the same amount of water. Except for cases where households solely depend on the public tap system, or have their own private connection, the minimum price charged for one *insera* of water never falls below 5 cents. As a result, 44 percent of the sampled households are forced to pay 5 cents per *insera*. Some families however obtain their water freely from a private well, river or in some cases from piped connections owned by governmental offices.

The mean daily water consumption level is 5.72 *inseras* per household. If one transforms this indicator into its consumption per capita equivalent, an average per capita value 1.025 *inseras*

is obtained. Approximating the capacity of each *insera* by 20 liters, it becomes apparent that each individual consumes about 20 liters of water per day. This estimate is based on the fact that water fetched from all sources has been included in the survey. It should also be noted that water used for all purposes (such as drinking, cooking, clothes washing, house cleaning, bathing, garden tending, animal feeding, etc.) is taken care of.

Water consumption data obtained from this survey was further analyzed with respect to other socioeconomic indicators. Forty-four percent of those households with monthly income exceeding 400 Birr consumes more than 9 *inseras* of water per day while the corresponding figure for low income families (i.e. with income less than 150 Birr) is 11.5 percent only. A chi-square test for independence of the two supports the above observation ($\chi^2 = 16.468$, d.f. = 1).

One also observes that proportionately larger percentage of families who consume at least 9 *inseras* per day have a household head with higher level of education compared to those with daily consumption of less than five *inseras* thereby suggesting some association. Statistical tests though prove the association to be insignificant (significance = 0.408). A comparison of educational indicators with household data on per capita water consumption also supports the above observation. Similarly, no noticeable difference was observed in water consumption levels between those who have their own private pipe and those who purchase piped water from secondary markets (significance = 0.774).

The sample households spend an average of Birr 10.50 per month for all their water needs. Since most families depend for their water needs on the piped system, and also that most non-piped sources are obtained free of charge, the total expenditure goes to purchase piped water.

For those who actually spend money for water, the range of expenditures extends from around 1.50 Birr to as high as 70 Birr per month.

As one would expect, those who claim to spend more than 15 Birr per month for water constitute a good proportion (i.e. 48 percent) of those households whose daily consumption exceeds 9 *inseras* of water. Correspondingly, only 12.5 percent of households who spend 15 Birr or more per month for water reported a daily water consumption in the order of 9 *inseras*.

The sample result indicates that both water-vendor users as well as those with private connections have similar proportion of households who pay more than 20 Birr per month for water. This, as supported by $\chi^2 = 1.657$, was taken as an indication of no significant correlation between expenditure for water and the mode of piped service used. As is to be expected, none of the households who use the public tap services fall in this category.

Another indicator considered here in order to assess the existing water supply and demand system was the time households take to fetch water from their main water source. On the average households claim to spend 25 minutes to fetch water just once. Some families (20 percent of the sample) do not spend substantial time for water collection while few reported taking two hours or more of their time to get just 20 liters of water. Average collection time does not, however, seem to influence water consumption significantly.

3.3 Monthly income and asset ownership

Acknowledging the sensitivity of posing questions that deal with household income levels, some care was taken during the interview to convince households that the income data will be used for academic purposes and will never be used for other objectives. Not forgetting the possibility that some households could still report underestimated income, the observed response rate of 96 percent is believed to be solidly high.

Surveyed families reported average monthly income of 237 Birr (Table 4.4). Since the sample' average household size is 6.22 persons, the observed monthly income figure amounts to a per capita income of 38 Birr. This estimate seems reasonable considering that roughly 64 percent of the sample households are engaged in very small retail activities.

As an instrument to assess the dependability of the data on reported monthly income levels, the income variable was cross tabulated with some presumably related indicators. Seventy-seven percent of the households whose income falls in the low income range use water vendors as their main source of water while all of those in the high income range have their own private water connection. In as much as the latter type of service required a minimum of 200 Birr initial investment, it seems reasonable that those who have the service are the relatively well-off households. This observation is supported by a statistical test, where by a hypothesis of independence between the two becomes significant at 0.040 level.

Table 3.4: Mean values of income and assets for sampled households

	Mean	Minimum	Maximum
Monthly household income (in Birr)	237.11	12	1500
Number of livestock heads owned by the households	2.65	0	25
Number of electrical/electronic appliances owned by the household	0.47	0	3

Source: Computed from survey data

In another effort to assess households wealth in the surveyed area, each family was asked whether it owns domestic animals and if so how many. The results show that 53.8 percent of the sample have at least one domestic animal (the animals considered here include cattle, sheep, goats, donkeys, mules, horses, but not poultry). The extent of ownership in this respect is so substantial that households have an average of 2.65 heads of domestic animals.

The ownership of cattle or other domestic animals by households also seems to have marked relationship with monthly income figures ($\chi^2 = 11.876$). More than 80 percent of households with incomes above 500 Birr own at least one domestic animal in comparison to only 45 percent of those with incomes less than 150 Birr.

A strong relationship is revealed from a simple correlation analysis between domestic animal ownership and total daily water consumption such that a hypothesis of independence can be rejected at any acceptable significance level. Sixty percent of households who consume less than five *insera* of water per day do not own any kind of domestic animals. On the other hand,

62.5 percent of those whose daily consumption ranges from 5 *inseras* to 9 *inseras* do have at least one domestic animal at the time of the survey. The proportion is even higher for those families with daily consumption range between 10 and 20 *inseras*.

The percentage of sample households who pay more than 15 Birr for water per month also depicts a close association, $\chi^2 = 24.050$, with the number of domestic animals that households own. For families who own five or less domestic animals, the ratio does not exceed 14 percent while for those who own more than 10 heads of domestic animals, the proportion rises to more than 23 percent.

To help assess household-assets level, data on ownership of electronic and/or electrical appliances was collected during the survey. Items surveyed under this category include radios, tape recorders, televisions, refrigerators, stoves, *metads*, and others. The results show that 43.9 percent of the sample own at least one of these items. Moreover, a higher proportion (62.5 percent) of households who reported a monthly income of 500 Birr or more have at least one electronic or electrical appliance compared to those with income of less than 150 Birr per month. A chi-square test also attests to the presence of strong association ($\chi^2 = 16.129$).

3.4 Housing characteristics

Only five households of the sampled 264 households have their residence made up of bricks or other durable construction materials. The bulk of the sampled houses, on the other hand, are made up from low quality construction materials such as mud or wood. These houses are

generally small in size with the average number of rooms per household not exceeding 2.22 rooms.

Roughly two thirds of households own the houses they live with the rest being tenants. A preliminary analysis of water consumption differentials between owners and tenants reveal that households who live in their own house tend to have high per capita water consumption than those who dwell in rented houses. The relationship between the two is, however, not very strong ($\chi^2 = 1.450$).

Table 3. 5: Indicators on housing characteristics of sampled households

Percentage of households who own the house they live in	63.6
Percentage of households who use electricity	94.3
Percentage of households who own a garden	20.5

Source: Computed from survey data

A good deal of the households who own the house they live in were also found to raise some domestic animals compared to those who live in rented houses ($\chi^2 = 20.998$). High income households also have high percentage of house owners than low income families. On the other hand, the correlation between the tenancy condition and the educational level of household heads is observed to be insignificant ($\chi^2 = 0.2957$).

Another household feature considered by the survey was whether families use electricity or not. The use of electric energy is practically one of the most universal features that households in Meki can be characterized with. More than 94 percent of sampled households use electricity (Table 3.5). Since the ownership of electrical appliances by households is largely limited to the radio, the use of electricity is largely for lighting purposes.

Moreover, families who have high monthly income are also invariably electric users while the proportion of users falls with a reduction in the income category. This relationship is however not very strong (significance = 0.114). In the lowest income category for instance, only 92 percent are electric users compared to 100 percent of the highest income group.

Related to the electric issue is households monthly expenditure on electricity. Average expenditures incurred by the sample households range from as low as 1.50 Birr to as much as 60 Birr per month, while the mean monthly expenditure is 7.90 Birr. The expenditure data correlates positively with households monthly income data ($\chi^2 = 13.580$).

For instance, for those in the high income group, 16 percent of them were also categorized in the high monthly expenditure category. For those in the low income group however, only six percent of them fall in the high-expenditure-for-electricity category.

Families with highly educated household head also displayed a high probability of being at the same time in the high-expenditure-for-electricity category compared to those with less educated family head (significance = 0.01628). The is also have a high proportion (87.5 percent) of house owners among those who pay 15 Birr and above for electricity per month,

than the proportion (57.6 percent) for those who pay less than 7.50 Birr per month, (χ^2 = 8.932).

Finally, households were asked whether they own any kind of garden around their houses. To this question 20.5 percent of the sample responded affirmatively. Further on, a preliminary analysis was conducted to see whether household water consumption levels correlate with the ownership of a garden by the household. The result indicates that there is no significant relationship between the data for the two variables, χ^2 = 0.336. Neither is there strong relationship between garden ownership and the income level of households.

Chapter Four

4. Results of the contingent valuation surveys

The main objective of this section, is to determine the willingness-to-pay (WTP) of households for the provision of improved water services. For these purposes, potential consumers were presented with carefully worded scenario depicting the commodity being offered for sale as well as the modality of payments for consuming it. (For a sample of the questionnaire used in the survey, see appendix 1). This scenario was then followed by a set of structured bidding format questions asking whether households are willing to pay specified prices for the proposed services under certain circumstances.

The basic questioning format is to present a proposed tariff rate that consumers will be charged if they choose to connect to the new urban water scheme. To this, each respondent has to answer by saying either yes or no. The price refers to the proposed tariff rate that consumers will be charged if they choose to connect to the new urban water scheme. Recognizing the fact that high initial connection cost is one of the major reasons that prohibited households from accessing services already in place, the families interviewed were told that no initial investment in the form of connection cost was required of them. Rather, this cost will be covered by the water authorities, but then it will be spread over long period so that it could be paid back in the form of water price.

Most respondents found the proposed scheme very attractive that, every household surveyed willingly answered all WTP bid question part. It was also observed that respondents, in most cases, gave considered answers to questions pertaining to the proposed price of water. Some

respondents even took the extra effort to ask for further clarification before answering certain questions. These situations indicate the degree of concern given by households to the whole question and answer session and hence were encouraging for the whole survey process. Before presenting the basic results of the research as well as their implications for future water supply planning, we first test the CV methodology itself as follows.

4.1 Testing the CV Method

A common concern of researchers who use the contingent valuation method as well as those who are end users of CV results is the validity of the research outcome. This issue of validity refers to the degree to which valuation outcomes from the CV method indicate true values of the assets being investigated. In this regard, the literature identifies few categories of methodological issues which could in fact reduce the validity of CV results.

One of these is the loss of validity arising from biased results generated by the CV method. The potential for several sources of biases to enter CV results is considered a real threat to the whole effort of valuing environmental goods. This section is hence devoted to investigating the issue in the context of the valuation process conducted for improved water services.

Two major potential sources of biases are identified here. First is the consideration whether WTP responses derived from a contingent valuation study could somehow be influenced by agent's strategic behavior. The issue here is that, although a well designed questionnaire coupled with an appropriate questionnaire administration can present the desired hypothetical market to potential buyers, households may not reveal their true valuation of the service in the expectation of getting the service for lower price than they actually think it is worth.

Alternatively, households could overestimate their valuation if they think the provision of the proposed service would not materialize unless they offer higher WTP.

To assess for the possible existence of such biases in the WTP response, the hypothetical market scenario used during the study was presented in two formats. The basic difference between the two is that the first is intended to capture any strategic behavior. The second one, on the other hand, includes a statement which is specifically designed to discourage respondents from incorporating any strategic element in their valuation of the service. The latter one explicitly states that respondents' answers to the bidding game question will not affect the price setting process of the proposed improved service. These two scenario formats were then distributed almost equally among the questionnaire. Strategic-bias-encouraging questionnaires constituted 47 percent while the rest 53 percent discourage such biases.

Once the data is gathered and tabulated appropriately, a test was conducted to determine whether there is a significant difference between the average WTP values of the two sub-samples. The results of the test are reproduced in Table 4.1.

Observations under scenario 1 represent the sub-sample who were presented with a hypothetical market description that includes a statement discouraging strategic behavior. The mean WTP bid of this group is 15.71 cents per *insera*. On the other hand the 120 families who were confronted with a market scenario which is open for potential strategic manipulation produced a mean value of 16.13 cents per *insera*.

Table 4.1: Test for strategic bias

	Scenario 1	Scenario 2
Observations in each group	106	120
Mean WTP bid (in cents)	15.71	16.13
Standard deviation	7.22	7.35
Mean of the full sample	15.93	
Standard deviation	7.27	
t - statistic	0.43	

Source: Computed from survey data

The latter outcome is to be expected. Since one of the scenarios basically allows for strategic behavior, a higher average WTP for respondents under scenario 2 compared to those under scenario 1 is not surprising. The important point, though, is that the difference between the two means is not statistically significant. As evidenced by the t-statistic, the null hypothesis that the two samples were drawn from the same population cannot be rejected at the 95 percent confidence level.

The preceding results build our confidence in the appropriateness of the methodology used to elicit the WTP bids in the improved water provision scheme. In fact, the WTP bid results are good approximations of households valuations, such that summary measures produced from the sample can legitimately be used to predict demand for connections under alternative tariff options.

The second major test conducted by the study is to investigate whether bid starting points has been a source of bias. To facilitate the ground for an appropriate test, the questionnaire was

designed to accommodate two different bid starting points. The first starts the bid at 10 cents per *insera* while the second version opens the bidding by demanding of respondents whether they can afford to pay 15 cents per *insera*.

Just as in the case for strategic bias test, almost half of the questionnaires carried high starting point bidding game questions while the other half carried the low starting point version. In addition to this, to avoid unnecessary complications, the proportion of questionnaires with each different starting point category was evenly distributed among the two versions of hypothetical market scenarios.

In the actual administration of the questionnaires, one observes that 53 percent of households surveyed received the high starting point version, while 47 percent took the low starting point bidding game. Here again, the basic hypothesis is that the mean of the two sub-samples will not display significant difference. To check for this hypothesis, comparison is made between the means of the two sub-samples assuming that each sub-sample is independent of the other.

Table 4.2 presents the results of the test. Few observations can be made right away. As expected, the mean of the sub-sample who responded to high-starting point questions is slightly higher than the other subgroup. Further on, one notices that the mean of the two sub-samples are not significantly different from each other. In fact, as indicated by the low t-statistic, the null hypothesis that the two sub-samples came from the same population cannot be rejected at any acceptable significance level.

Table 4.2 Test for starting-point bias

	High starting point		Low starting point
Observations in each group	120		106
Mean WTP bid (in cents)	16.01		15.85
Standard deviation	7.57		7.02
Mean of the full sample		15.93	
Standard deviation		7.27	
t - statistic		0.16	

Source: Computed from survey data

The implication of the above results is again very clear. WTP bid results obtained from the survey are actual manifestations of consumers preferences. They can be used to construct demand for improved water services in the town. The latter will then serve in the preparation of sound investment projects which provide the service at least cost on a sustainable basis.

So far, the argument centered on the point of whether there is any kind of bias or not, based on explicit indicators of the issue incorporated in the survey process. The investigation could, however, be pursued further by considering other features as well. First in this regard is the attitude and response rate of respondents to the WTP questions. None of the sampled households refused to respond to the WTP questions. The slightest problem faced was on areas where respondents had to reveal their monthly income.

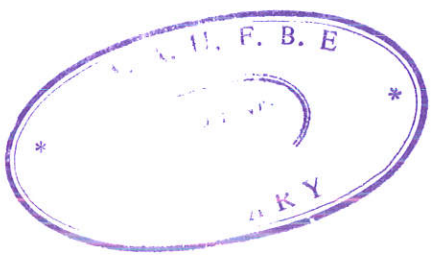
Although most households understood the intentions of the survey, and hence were willing to give an estimate of their income, some complained about those particular questions. In general

though, the emphasis area of the study, i.e. WTP bid for improved water services, was answered with full cooperation of households and hence no protest-zero was recorded.

Next, a comparison was made between what households already pay monthly for water and the level of monthly expenditure on water as predicted by the WTP responses. To execute this comparison, a few simplifying assumptions are needed. First, households daily water consumption level is assumed to stay the same under the improved system as it is now. Secondly, all households demands under the improved system, for all those who choose to connect to it , will be met from the piped system only.

Under such circumstances, the mean value of monthly expenditure for water as a percentage of households monthly income is calculated. On the average, households can be expected to spend about 19 percent of their income to use the improved service. This percentage obviously looks on the high side and hence one may question whether households have really considered their budget constraint properly.

A close scrutiny would, however, reveal that these households are already paying an average of 7.2 percent of their income for their water needs under the current status of service. This estimate compares well with a 1988 study in Addis Ababa where the urban poor were observed spending up to 9 percent of their income on water (Linn, 1989). Given that the current water source as well as service is considered unsatisfactory (by 54 percent of the population) and inadequate (by 40 percent of the population), a highly improved system such as the proposed one would be expected to obtain higher valuation.



Further, it is not difficult to recognize that all the current expenditure quoted by households covers just the cost of obtaining water. The predicted expenditure, on the other hand, will definitely include not only the commodity charge, but also repayment of the financed connection cost. Since households will also consider in their valuation such non-financial cost items as the time and labor costs of drawing water, the inconvenience of entering into different contracts with neighbors in order to buy water, etc., the valuation of the improved facility is expected to be higher than the current. Finally it is useful to note that WTP of such magnitude is not with out parallel. A similar investigation conducted in 1987 in Onitsha, Nigeria, reported WTP of 18 percent of income (Whittington, *et. al.*, 1991.).

4.2 Willingness-to-pay for improved water services

From the specific results of the WTP study, one observes that 66.4 percent of surveyed households are willing to pay 15 cents and more for an *insera* of water delivered to them through the new scheme (Table 4.3). As a result the mean WTP for the proposed service is calculated at about 16 cents per *insera*, which is three times greater than the average price that families pay currently.

The implication is that, the good being offered for sale as well as the mode of its delivery is valued so highly by the towns residents that they are willing to incur costs which considerably deviate from what they pay already. More importantly though, is the fact that 92.9 percent of the sample are offering to pay at least five cents for an *insera* of water under the new scheme This rate is more than double of the existing rate that consumers pay for the towns WSSA both for private connection and the public tap service.

On the other hand 7.1 percent of the sample expressed unwillingness-to-pay any amount for the proposed new service. Most of these respondents were asked a follow-up question querying why they value the service at zero. Several of them answered either by saying they cannot afford or they are satisfied with the existing water sources.

It is believed that these group of respondents have genuinely expressed their attitudes towards the proposed service. Two reasons can be suggested. First, some agents have low monthly income and this is expected to have restricted them in their choice to low quality services. Secondly, the daily consumption level of these households is so low that they may not feel much discomfort from the services they get presently. Hence, the welfare gain they expect to get from hooking to the new scheme can be insignificant owing to their low daily water demand.

Table 4.3: Frequency distribution of the WTP bids

Bid Value (Birr per *insera*)	Frequency	Percentage	Cumulative percentage
0	16	7.1	7.1
0.05	9	4.0	11.1
0.10	51	22.6	33.6
0.15	38	16.8	50.4
0.20	65	28.8	79.2
0.25	47	20.8	100.0

Source: Computed from survey data

In fact, 85 percent of families who claimed they cannot afford more than 5 cents per *insera* for water delivered to them through the proposed scheme have a monthly income of 150 Birr or

less. Since 64 percent of these households actually gave zero WTP response, it is not difficult to suspect the role of income in consumers valuation of the service. For comparison purposes, one might note that just 43 percent of households who willingly claim to be able to pay 20 cents or more for one *insera* of water reported a monthly income of less than 150 Birr.

A similar exercise to identify the degree of association between extremely low willingness-to-pay bids and daily water consumption levels also supports the above findings. Here again, low WTP bids are more associated with low daily water consumption than are high WTP bids. The result is not, however, clear cut when it comes to per capita water consumption indicators.

On the other hand, significant proportion of the sample (i.e. 89 percent) find it worthy to pay 10 cents or more for one *insera* of water delivered to them through the proposed scheme. This rate is five times greater than the existing rate that families with private connections are paying for the same amount of water presently. The divergence is also very high for consumers who mainly use the public tap system since this group pays 2.5 cents for the same quantity.

During the survey, it was recognized that water vendors have the largest role in the water supply process and hence the significance of the WTP bids will largely be determined by the response of households who use vendors as their major source. This group constitutes roughly 72 percent of the sample and hence represent the bulk of the town's population. Households who buy water from vendors are those with no private connection but at the same time are unable to get their daily water requirements from the public tap system.

The expectation is that, these group face the greatest inconvenience in their effort to satisfy their daily demand and therefore will tend to place a higher value on the service than do other groups. The evidence obtained supports the above assertions strongly. Those who value an *insera* of water at 20 cents and above constitute 51 percent of all those who depend on water vendors. Correspondingly, only 10 percent of water-vendor users price the same quantity of water at 5 cents or less.

Next elicited WTP bid values were analyzed in relation to some of the main features of households. Table 4.4 depicts some of the evident relationships observed between WTP bids and household features. Regarding water-fetching time, for instance, approximately 68 percent of families who bid 5 cents or less do not take more than 15 minutes on average to fetch water. On the other hand, out of the families who expressed a WTP of 20 cents or more, only 46 percent claimed they spend less than 15 minutes for the same routine.

Table 4.4: Relationship between WTP bids and some selected household characteristics

WTP bid range (in Birr)	Percentage of households **in each WTP bid range** who				
	spend less than 15 minutes to fetch water	claim they are getting enough water from existing source	pay 5 cents or less for one *insera* of water currently	conduct home-based commercial activity	own the house they live in
0 - 0.05	68.0	72.0	88.0	68.0	56.0
0.10 - 0.15	49.4	59.1	65.2	64.0	59.6
0.20 - 0.25	46.4	55.4	67.8	58.0	65.2

Source: Computed from survey data

Similarly, consumers dissatisfaction with the existing way of getting water is seen correlated with WTP bid results. Proportionately higher percentage of those who are satisfied with current services (such as getting enough water) constitute a higher proportion of the group offering lower value for the improved service. The share of these group of households decreases with an increase in the WTP bid offered.

One also observes that the percentage of households who pay 5 cents or less for an *insera* of water bidding zero to 5 cents is high compared to those who valued the service at 20 to 25 cents. A clear pattern also emerges from an analysis of WTP bid ranges with respect to the probability of households in each group undertaking any home-based commercial activity From those who claimed WTP of 20-25 cents, for instance, 58 percent have at least one member of their family engaged in such activity. On the contrary, the proportion is higher for the sub-sample representing WTP range of 0 - 5 cents.

So is the relationship between home ownership and the probability of these families bidding higher. More than 65 percent of families who dwell in their own house bid at least 20 cents for an *insera* of water. On the contrary, the proportion of households who value the proposed service at 5 cents or less constitute about 56 percent of the home-owners group.

The above considerations are just few of the many factors which could have influenced households valuation of the proposed service. The important point though, is that, willingness-to-pay bid results are not just random numbers. These values correlate systematically with the major socioeconomic characteristics of the targeted households. Hence, the mean bid value of

16 cents per *insera* obtained for the sample is believed to represent the true average valuation of the improved water service proposed by the study.

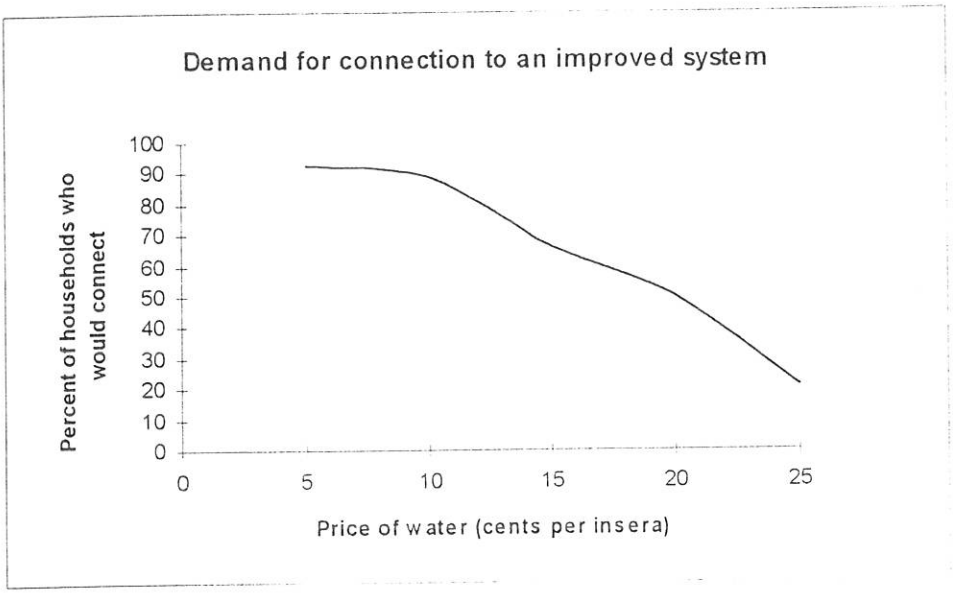
4.3 Demand for improved services

If the WTP bid results are genuine expressions of individuals preferences, we may now need to aggregate results over households and try to construct a demand curve. The basic approach here is to determine the percentage of households who would choose to connect to the proposed system if different prices were charged (Figure 2).

Examining Figure 2, one notices that if the price charged for an *insera* of water from the new scheme does not exceed 10 cents, 89 percent of the towns population can be expected to willingly connect to the system. A tariff rate of say 15 cents would however reduce the percentage of households who would willingly connect to the new scheme to 66 percent. Another increment of 5 cents on the tariff brings down the connection rate to just half of the targeted population.

The general result would thus be interpreted as showing an inelastic demand for connections where the price range is between zero and 10 cents per *insera*. For higher price ranges, proportionately higher percentage of the population would be unable to benefit from the new system. Obviously then, for the higher price ranges (i.e. those between 10 and 25 cents) demand becomes more elastic.

Figure 2



Source: Survey data

4.4 The implications

Under the current system, only 500 private connections exist in the town. Some of these purely serve medium sized commercial activities only. There are also few connections which are used by governmental and non-governmental organizations. Even if all the 500 were to serve households in the town, the overall connection rate can be seen to be very low. For instance, taking the average household size obtained from the survey, one calculates that the existing private connections would serve not more than 3200 persons. This is roughly 14 percent of the town's population (forecast based on the 1994 population census results). In reality though, 89 percent of the population depend on those few connections. To make

matters worse, the towns water supply department estimates that an average of 10 percent of the existing connections do not function at any given time.

Scheme such as the proposed one would, however, bring about a marked change to the level of coverage in private piped-connection. Assuming, for instance, that the tariff rate for the new service is set at 10 cents per *insera*, few overall indicators can be assessed. First, the connection rate will jump from the current 14 percent to almost 90 percent. Second, such a tariff rate would also contribute positively towards creating a financially sustainable water supply system since the utility authority's revenue will increase correspondingly.

Finally, an observation can be made about the expected contribution of increased utility revenue towards achieving financially sustainable project in the Meki case. A recent study by the Ministry of Water Resources on upgrading the existing water supply system in Meki town, for instance, conducted several simulation under various financing options. The result indicates that assuming the funds for an upgrading-project are obtained at no interest, a water tariff rate of 1.3 Birr per meter cube for private connection coupled with 1.5 Birr per month of meter rent and 100 Birr charge for new connection would create a sustainable financial position (MoNEP, 1994).

The bottom line is that marginal cost of water for the study area is estimated at around 1.474 Birr/m^3 which is about 2.9 cents per *insera*, and hence schemes such as the one proposed by the study can be implemented at a reasonable increment to the existing tariff rate and still achieve socially desirable objectives such as high private connection rate.

Chapter Five

5. Determinants of WTP

The purpose of this chapter is to extend the analysis of willingness-to-pay bid responses started in chapter 4 above. A major shift in methodology here will be the use of a multivariate econometric model to evaluate the WTP bids. This practice is commonly followed by contingent valuation studies and has also been found important to incorporate in this particular study.

Households are usually the observation units of most contingent valuation (CV) studies. These units, in spite of how closely settled one might find them, are likely to have some distinctive characteristics of their own. Dissimilarities could arise out of household size, composition and age; whether the household head is male or female; how educated household members are; income level of the family; the degree of assets ownership and other factors.

These dissimilarities, in general, are hypothesized to form part of the reason that cause valuation differentials among consumers for similar goods presented under identical market conditions. The starting point for using a multivariate technique in empirical CV studies is thus, the hypothesis that WTP outcomes from such investigations do correlate with variables suggested by economic theory, as well as some of the major socioeconomic features of households. If this is true, using an appropriate model would serve at least two main purposes. First, major socioeconomic characteristics suggested by economic theory as well as other household characteristics can be used to explain the variations in WTP bids.

Secondly, if the model does really explain the variations in WTP responses, then it could serve for prediction purposes. The latter involves determining how changes in some of the household features and characteristics affect the demand for the service being offered. For the problem at hand, the issue then becomes modeling WTP bids for improved water services on the major economic and social indicators of households.

When it comes to model selection, the nature of the dependent variable (WTP) makes it inappropriate to use the Ordinary Least Squares (OLS) method. The reason being that WTP responses obtained from a bidding game format such as the one conducted for this study are not free variables which can take any value. Rather, they are limited to few specific values. As a result, the observed dependent variable is not the maximum amount the household would be willing to pay. It is an interval within which the actual WTP falls. In such circumstances, applying OLS would be contradictory to one of the model's specifications. Namely the assumption that the error term is normally distributed will be violated.

This non-continuous nature of the observed dependent variable then requires a variant of the non-linear econometric models classified as qualitative response models. A specific variant which was found appropriate for the problem at hand is the multinomial ordered probit model. The model is basically an extension of the binomial probabilistic model where the dependent variable takes either of two values. Unlike it, however, the multinomial model allows for more than two values for the dependent variable.

More importantly though, the latter model recognizes that a single decision is being made among several alternatives and that these alternatives do have an ordered sequence which can

easily be ranked. Hence, a household bidding say 25 cents for an *insera* of water is recognized as offering a higher value to the proposed service than is the one bidding 15 cents or even 20 cents for the same amount.

5.1 Specification

The multinomial ordered probit model is based on the presumption of the existence of an underlying, latent regression model of the form

$$Z_h = \alpha + \beta X_h + \varepsilon_h \qquad (1)$$

$$\varepsilon_h \sim N(0,1)$$

where it is assumed that the error terms are independent of each other (Greene, 1993). Z_h is the unobservable variable, and is here taken to represent households maximum willingness to pay for the improved service. This variable is hypothesized to be a function of households socioeconomic characteristics as well as the attributes of the existing and the proposed water service. The latter are represented by the vector X_h while α and β are the model's parameters.

The unobservable nature of Z_h precludes the possibility of estimating equation (1) directly. However, we know from the WTP bid responses the ranges within which Z_h will fall. Now , let G_1, G_2,..., Gn be the **n** prices which divide the range of WTP space into **n+1** categories. If we now create a categorical variable, Y_h , such that

$$Y_h = 1 \quad \text{if} \quad Z_h < G_1,$$

$$= 2 \quad \text{if} \quad G_1 < Z_h < G_2,$$

$$= \quad 3 \quad \text{if} \quad G_2 < Z_h < G_3, \qquad (2)$$

...

...

...

$$= \quad n+1 \quad \text{if} \quad Z_h > G_n .$$

Then substituting from equation (1) into equation (2) for i = 1, 2, . . ., n+1 , we get,

$$Y_h = i, \quad \text{if}$$

$$G_{i-1} < Z_h < G_i \qquad (3)$$

which equals to

$$G_{i-1} < \alpha + X_h\beta + \varepsilon_h < G_i \qquad (4)$$

$$G_{i-1} - \alpha - X_h\beta < \varepsilon_h < G_i - \alpha - X_h\beta \qquad (5)$$

The above is also equal to

$$(G_{i-1} - \alpha - X_h\beta)/\sigma_h < \varepsilon_h/\sigma_h < (G_i - \alpha - X_h\beta)/\sigma_h \qquad (6)$$

where σ_h is individual specific standard deviation and has been incorporated here to take care of possible hetroskedasticity problem.

Assuming now that ε_h follows a standard normal distribution, we can specify the following probabilities.

$$P(Y_h = i) = P(G_{i-1} < Z_h < G_i) \quad (7a)$$

$$= P(G_{i-1} < \alpha + X_h\beta + \varepsilon_h < G_i) \quad (7b)$$

Now, let $\mu_i = G_i - \alpha$, and $\mu_{i-1} = G_{i-1} - \alpha$,

then,

$$P(Y_h = i) = P(\mu_{i-1} - X_h\beta < \varepsilon_h < \mu_i - X_h\beta) \quad (8)$$

$$= F(\mu_i - X_h\beta) - F(\mu_{i-1} - X_h\beta) \quad (9)$$

where F(.) is the cumulative distribution function of the standard normal variable.

Equation (9) then gives the ordered probit model estimated here in order to explain variations in willingness-to-pay bid values among households. In this model, there is no significance to the actual values as well as the unit distance between the set of observed values of Y_h. They merely express respondents preferences to the proposed improved service with the sort of ordinal ranking.

Estimates from the model are obtained by maximizing the appropriate likelihood function. If we now enter the probabilities in equation (9) into the log-likelihood function, the model to be estimated reduces to:

$$\ell n\, L = \sum_h \ell n\, L_h = \sum_h \ell n\, \text{Prob}(Y_h = i) \qquad (10a)$$

$$= \sum_h \ell n[\, F(\mu_i - X_h\beta) - F(\mu_{i-1} - X_h\beta)] \qquad (10b)$$

where **h** represents each household (i. e. observation) in the sample and **i** is the appropriate WTP category into which the particular household falls. The results of the model (estimated with the help of the computer package LIMDEP, version 6.0) are presented in Table 5.1. Before discussing the results, a brief description of the nature as well as the specification of the explanatory variables is presented below.

5.2 Variables in the model

Ten explanatory variables are used in the model. *A priori*, these variables are believed to represent the major economic and social factors that can influence WTP responses. The first two variables serve to capture the effects of education on WTP for improved water. The level of exposure of household heads to formal education is hypothesized to be capable of influencing the family's valuation for the proposed improvement. Hence, two dummy variables, ELEM, and HIGH, are used in the model to specify whether the family head's educational level is limited to the primary school level, ELEM, and whether the head has at least high school level education, HIGH, respectively.

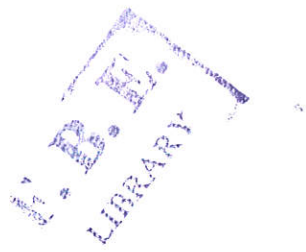
The involvement of any household member in small commercial activity has also been incorporated in the model in the form of a dummy variable. Existence of such a member is indicated by the value (1) while (0) expresses absence. The same procedure of specification

was followed to incorporate the information whether there is any family member engaged in agriculture. Another explanatory variable is the water consumption indicator. This position was taken by households average daily per capita water consumption as measured in *insera* or any 20-liters capacity container.

The fourth variable is time. It estimates the average time that families spend to fetch one *insera* of water. Water fetching time was observed to vary with the distance of the water source as well as the length of time spent queuing. Alternatively the time variable can be viewed as one of the costs of using the current source.

Income is the monthly average income of the household. Since water is a normal good, income is expected to influence the demand for water positively. Similarly, the average price that each household pays currently is also expected to contribute positively towards the valuation process. The latter represents price of a close substitute and hence given that the new substitute has more desirable features, its influence is expected to be positive.

And finally, as proxy for wealth, a dummy variable was included which specifies whether the household owns domestic animals or not. Households who own at least one domestic animal are represented by (1) while the rest are coded as (0).



5.3 Results

From the results presented in Table 5.1, one discovers that the estimated model exhibits an overall significance ($\chi^2_{(10)} = 18.773$). This implies that a likelihood ratio test of the null

hypothesis that all explanatory variables are irrelevant in the determination of the variation in the dependent variable can be rejected at 0.04239 level of significance

Table 5.1: Determinants of households willingness-to-pay for improved water services

	Coefficient	t - ratio
Dependent variable:		
Probability that respondent's WTP for the service falls with in specified interval		
Independent variables:		
Constant	0.50219	0.590
Head's education, 1 - 6 years (ELEM)	0.01576	0.073
Head's education, > 6 years (HIGH)	-0.06347	-0.265
Small trader (BUSS)	-0.25189	-1.374
Water consumption per capita (CONSPC)	0.15907	1.312
Time (TIME)	0.34953	1.925
Income (INCA)	0.71301	2.778
Farmer (AGRI)	-0.30779	-1.645
Price of water (PRIC)	-0.16179	-0.612
Domestic animal (STOC)	-0.04962	-0.276
Piped service in use (PIPS)	-0.38510	-1.017
Log-likelihood -309.89		
Restricted (slopes = 0) Log-L. -319.28		
Chi - Squared (freedom = 10) 18.773		
Significance level 0.04239		

Source: Computed from survey data

In conformity to what economic theory suggests, average monthly household income was found to be a significant determinant of the demand for improved water service in Meki town. The probability that families' WTP falls with in a specified interval is positively influenced by household income level.

Similarly, one may infer from the results that households are generally conscious of the time cost that each water-fetching session demands of the family's labor. The regression results indicate that not only water fetching time explain part of the variations in WTP bids but also the relationship is positive. Since new residential constructions are sprouting around the town's boundary while expansion of the public as well as private piped water service has largely been limited to few cases per annum, the problem of distance from a water source is expected to worsen in the near future. This in turn will generate new additions to the ranks of population who prize the proposed service.

The two features describing households occupational status (i.e. AGRI and BUSS) do not both seem to have any significant impact on WTP bid responses. Hence, engagement in an agricultural activity or in a small commercial activity, as such, may not have anything to do with consumers' valuation of the proposed good.

One major outcome which happens to yield results contradictory to normal expectations is the role of price on WTP bids. As indicated by the low t-ratio, the prevailing price of water households face plays no significant role in their valuation of the improved service. The current price is expected to reflect the value of a close substitute for the proposed service. The plausible explanation seems that most families are already paying higher price in

comparison to the quality of service they are getting presently. Hence, the variance between current and proposed prices may not be weighty enough to affect their valuation.

Another unconventional result is the one regarding education's role in the valuation process. Although the coefficient for the variable ELEM displays the expected sign, its influence in the determination of willingness to pay for the improved service is insignificant. Whether the household head has more than 6 years of education or not does also seem immaterial in the determination of the bids. One may, however, note at this point that similar studies in Nigeria and Morocco also yielded insignificant relationship between education and WTP for improved water services (Whittington *et. al.*, 1991; McPhail, 1993).

The impact of household size on demand for water as represented by current per capita water consumption is also observed to be minimal. Similarly, household differentials on domestic animals ownership can be ignored as determinant of WTP. The implication is that families who possess domestic animals do not expect to cover their water needs for the animals from the improved sources. Demands of this sort can suitably be met from other sources, such as river water, as is commonly practiced in the town. The investigation regarding the role of using different modes of piped services on WTP values also turned out to be insignificant.

In conclusion, one may note that income and the time cost of fetching water proved to be significant determinants of WTP for improved water in Meki town, while most of the social variables were not so strong. This outcome is a real indication of the role economic variables can play in influencing consumers' preferences regarding improved water.

Chapter Six

6. Conclusions and policy recommendations

The study employed the method of contingent valuation to appraise households' assessment and preferences towards a proposed provision of improved urban water supply to the inhabitants of Meki town. The specific good to be valued was water delivered to households through project financed private connection. The valuation centers on eliciting information on how much each household is willing to pay for an *insera* of water delivered to it through the medium of such a connection.

Since the valuation is contingent on the provision of the proposed good, the hypothetical market scenario model used to elicit the desired information is frequently questioned whether it can enable researchers to capture genuine expressions of potential consumers' preferences. This concern was given due emphasis in the present study such that appropriate test measures were incorporated into the research process. Based on the results, some strong points can be made regarding the CV methodology and the results of the willingness to pay elicitation.

The hypothetical market model presented in this particular study was well designed enough that WTP revelations obtained from the survey largely correlate with the major social and economic characteristics of households. These results can also be described as free of major bias components since statistical tests indicate the effect of such issues to be minimal.

Regarding strategic bias, for instance, in spite of a deliberate effort to leave room for households to behave strategically, the observed WTP results were not significantly influenced

by such a behavior. Similarly, small variations in bid-starting points do not seem to create significant variations in WTP responses for the proposed service. Hence, the CV methodology, if applied with an appropriate research design, can give reliable WTP estimates in Ethiopia.

Clean water delivered through a reliable and improved piped system, as seen from the results of the Meki study, is highly valid. Households are willing to pay an average price which is roughly three times the average current price of an *insera* of water. Since more than 70 percent of the households depend on secondary water markets which charge consumers significantly higher prices than is provided by the official public water supplies, the divergence between average WTP and official price of water can be seen to be much higher. The latter situation in turn is an encouraging factor for the idea of creating self-financing water supply schemes in the town.

Consequently, new water supply schemes which provide project-financed private piped-connection whose monthly consumption bill is charged to individual consumers can expect to enlist a larger proportion of potential consumers at a tariff rate of 10 cents per *insera*. Here again, if one compares the current official price of 2 cents per *insera* charged for the same amount of water by the towns Water Supply and Sewerage Services office, the gain in revenue to the new scheme and the implication of the latter towards achieving a self-financing program can not be underestimated.

Another important finding from the study is that some of the important socioeconomic characteristics of households as well as attributes of the existing water supply system do

influence the value that families place on the improved service. Particularly, the role of income and the time cost of fetching water from an alternative source was found to be very strong. Hence the researcher believes that new urban water projects would undoubtedly benefit the targeted populations if indicators on the demand side of the target group are incorporated into the design stage of similar schemes. These kind of results, together with an appropriately simulated financial estimates for the proposed project can be used to implement desirable, safe, reliable and financially sustainable urban water system.

Finally, one may note that the data needed to estimate potential benefits from changes in environmental quality may be generated in a dependable way by using the contingent valuation method. As was observed in this particular study, the method of contingent valuation is capable of yielding reasonable estimates of consumers' valuation.

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8. Appendix 1

Questionnaire on Socioeconomic Background

Interviewer: _____ **Date** _____

Interview started _____ **Interview ended**_____

Supervisor _____

We are talking to a selected sample of households in Meki town about water demand and related issues. Most of the questions have to do with your attitudes and opinions, and therefore, there are no right or wrong answers. This interview is confidential and hence your name will never be associated with your answers.

Respondent's: **Code No.** _____

Name_____

Address: Woreda_____ Kebele_____House No._____

1. Who is the head of the household ? Mr./ Ms._____

2. How many people live in this household, including yourself ? _____people

3. Please tell me the age, sex and education level of each household member, starting with the eldest member

Relationship to respondent	Sex		Age	Education						
	M	F		No Schooling	Elementary School	Junior high school	Senior high school	College	University	Others
Respondent										

4. What occupation do your household members have ? (Put **M** for male and **F** for female for each member of the household)

(1) agriculture [ ] 2) stock raising [ ] (3) commerce [ ]

(4) government employee [ ] (5) others ( ) [ ]

Questionnaire on water use conditions

5. How much water on average do you use daily ? _____ *insera* (or a 20-liters capacity container)

6. Are you satisfied with the existing way of getting water ?

(1) Yes (2) No

If " No" , what is the cause of your dissatisfaction ?

(1) distance (2) water quality (3) water availability

(4) price (5) other ( )

7. How much, on average, do you pay for water per month ?

_____Birr _____cents

8. What sources of water do you use currently ?

(1) piped water (2) others

If (1) go to "PIPED WATER", question (9)

(2) go to "OTHERS", question (36)

PIPED WATER

9. What kinds of services are you using currently ?

(1) shared yard connection (2) public fountain (3) water vendor

(4) own connection

If (1) go to "YARD CONNECTION", question (10)

(2) go to "PUBLIC FOUNTAIN", question (16)

(3) go to "WATER VENDOR" , question (29)

(4) ask questions (12) up to (15)

YARD CONNECTION

10. How many households use the yard connection ?

(1) two (2) three (3) four (4) five (5) six or more

11. How many taps does the yard connection has ?

(1) one (2) two (3) three (4) four or more

12. How much water per day do you use on average ? _____ *insera*

13. How much, on average, do you pay for water from this source per month ?

_____Birr _____cents

14. How do you rate the status of the service from this source ?

(1) Quality:

(1) good (2) average (3) not good

(2) Quantity:

(1) good (2) average (3) not good

15. For what purpose is water from this source used ?

(1) drinking and house keeping (2) washing clothes (3) livestock

(4) garden tending (5) home based business

PUBLIC FOUNTAIN

16. How far is the one way distance from the public fountain to your house ?

(1) less than 50m (2) 50m - 99m (3) 100m - 199m

(4) 200m - 399m (5) 400m or more

17. How many times on average do you go to the public fountain per day ? _____times

18. How much time do you spend fetching water at a time ?

_____ hours _____minutes

19. How many persons from your household go to the public fountain at a time ?

_____persons

20. Who goes to the public fountains ?

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

21. How many taps does the public fountain have ?

(1) one (2) two (3) three (4) four (5) five (6) six

22. How many taps, on average, function most of the time ?

(1) one (2) two (3) three (4) four (5) five (6) six

23. How much water, on average, do you collect at the public fountain at a time ?

_____ *insera*

24. How much do you pay for collection of water at a time ? _____ Birr _____cents

25. When do you prefer the public fountain to be open ?

(1) early morning (2) afternoon (3) evening (4) all day long

26. What is the present status of the public fountain service ?

(1) Quality: (1) good (2) average (3) not good

(2) Quantity: (1) good (2) average (3) not good.

(3) Convenience of service hours ? (1) good (2) average (3) not good

27. For what purpose do you use water collected from public fountain ?

(1) drinking and house keeping (2) washing clothes (3) livestock

(4) garden tending (5) home based business

28. How much on average do you pay for water from this source per month ?

_____Birr _____ cents

WATER VENDOR

29. Who do you buy the water from ?

(1) house connected people (2) yard connected people

30. How much water do you buy per day ? _ *insera* (or a 20-liters container)

31. How much do you pay for water ? _____ per 20 liters container

32. When do you buy water ?

(1) dry season (2) rainy season (3) throughout the year

33. Do you get enough water from vendor ? (1) Yes (2) No

34. How much time do you spend fetching water at a time ?_____minutes

35. How much on average do you pay for water from this source per month ?

_____Birr _____ cents

OTHERS

36. What other source do you use ?

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

37. How far is the one way distance from this source to your house ?

(1) less than 100m (2) 100m - 199m (3) 200m - 399m (4) 400m or more

38. How many times on average do you go to fetch water from this source per day ?

_____ times

39. How much time do you spend fetching water at a time ?

_____hours _____minutes

40. How many persons go to this water source at a time ? _____ person(s)

41. Who goes to the water source ?

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

42. How much water do you collect at a time ? _____ *insera* (or a 20-liters container)

43. Do you fetch enough water ? (1) Yes (2) No

44. Do you pay for water from this source ? (1) Yes (2) No

If "YES", how much on average do you pay monthly ?

_____ Birr _____ cents

Questionnaire on willingness to pay (Opening statement - 1)

I am going to ask you few questions about your family's demand for improved water services. I would like you to answer these questions at ease. There are no right or wrong answers.

Suppose that you have the option to install a private piped water connection in your yard from a new water supply system. The new system will have more capacity and reliability than the existing one, such that, it will enable your family to use as much water as you desire at any time during the day. Your monthly water bill will largely depend on the amount of water you

use each month. If you use more water, you will be charged higher monthly water bill than if you consumed lesser amount of water.

Regarding the initial costs, you do not have to pay immediately for making the private connection. Instead, after the connection is made for you, the initial cost will be distributed over several years, through charging a higher rate for each *insera* of water.

The new charging rate for each *insera* of water will be determined by the water authorities. The charged is based on connection cost as well as expenditure incurred during the provision of the improved water supply.

High starting-point bidding game

45. If the price you are charged for water is 15 cents per *insera* (or any 20-liters capacity container), are you willing to install a pipe in your yard, or do you prefer to look for water in some other place?

    (1) YES (I will pay) go to question (46)

    (2) NO (I prefer to look for alternative sources) go to question (47)

    (3) NOT SURE (I do not know) go to question (47)

46. If the price you are charged for water is 25 cents per *insera* (or any 20-liters capacity container), are you willing to install a pipe in your yard, or do you prefer to look for water in some other place ?

    (1) YES (I will pay) go to question (48)

    (2) NO (I prefer to look for alternative sources) go to question (48)

    (3) NOT SURE (I do not know) go to question (48)

47. If the price you are charged for water is 10 cents per *insera* (or any 20-liters capacity container), are you willing to install a pipe in your yard, or do you prefer to look for water in some other place ?

(1) YES (I will pay) go to question (48)

(2) NO (I prefer to look for alternative sources) go to question (48)

(3) NOT SURE (I do not know) go to question (48)

48. What is the maximum you could pay for one *insera* (or any 20-liters volume) of water delivered to you through a yard connection ? _____cents per *insera*

If respondent gives zero willingness-to-pay response, i.e. "0", ask question (49)

Why do you give zero response ? _____

Questionnaire on housing characteristics and household assets

50. What is the tenancy condition of the house in which the household lives ?

(1) owned by the household (2) rented from other owners

If "rented", how much rent do you pay per month ?

(1) 1 - 4 Birr (2) 5 - 9 Birr (3) 10 - 49 Birr

(4) 100 - 149 Birr (5) 150 or more

51. What is the house made of ? { Observation }

(1) bricks (2) blockets (3) mud (4) others

52. How many rooms does the house consist ? { Observation }

(1) one (2) two (3) three (4) four (5) five or more

53. Do you use electricity ? { Observation } (1) Yes (2) No

If "YES", ask question (A) and (B)

(A) How many households use the electricity connection you presently are connected to ?

(1) only me (2) two (3) three (4) four (5) five or more

(B) How much do you pay for electricity per month ?

_____ Birr _____cents

If "NO", ask questions (C) and (D)

(C) What type of lighting do you use ?

(1) kerosene (2) lantern (3) others [ ]

(D) How much do you spend for lighting per month ?

_____Birr _____cents

54. Do you own a garden ? (1) Yes (2) No

If "YES", how much? _____square meters

55. Do you have livestock ? (1) Yes (2) No

If "YES", how much of each ?

(1) cow/ox {) (2) sheep/goat { } 3. donkey { } (4) horse/mule { } (5) others [ ] { }

56. Do you have electrical /electronic appliances ? (1) Yes (2) No

If "YES", which ones ?

(1) radio (2) television (3) refrigerator (4) telephone

(5) electric "metad" (6) others [ ]

57. Given your household size, what do you think is adequate income per month ?

_____ Birr

High income _____ Birr ,

Low income _____ Birr ,

Very low income _____ Birr

58. What is your family's average monthly income ?

(1) less than 50 Birr [ ] (4) 200 - 299 Birr (7) 600 - 799 Birr

(2) 50 - 99 Birr (5) 300 - 399 Birr (8) 800 - 999 Birr

(3) 100 - 199 Birr (6) 400 - 599 Birr (9) 1000 - 1499 Birr

(10) 1500 Birr or more

Thank you for your time !!

9. Appendix 2

1. The study area

The town of Meki is located 135 kilometers south of the capital, Addis Ababa, on the main road to Awassa. The town, according to predictions based on the 1994 population census of CSA is believed inhabited by about 22,176 people at the time of the survey for this study. The town's population is mostly engaged in either small home-based commercial activity or small agriculture (including some form of animal husbandry).

Meki's water supply system is currently served from two production boreholes. The first, constructed at around 1973, has an estimated capacity of 6.6 liters per second while the second, constructed in 1987, is capable of producing 1.5 liters per second (MoWR, 1994). Water produced from these two boreholes is then in each case pumped into adjacent elevated water tanks, where the latter is used as the final point of release into the towns water distribution network. Water generated in this way is then accessed for consumption form 500 private connections and 9 public tap facilities. When the survey was underway, 477 of the private connections and 7 of the public taps were in functioning form.

The town was selected for this particular study mainly as a result of its current status as one of the targeted sites for the implementation of water supply and sanitation projects in the near future. Meki town, together with eleven other small and medium sizes town, all located in Oromiya region, have had a preliminary study conducted on them to upgrade the existing water supply system by the Ministry of Water Resources (former Ministry of Natural Resources Development and Environmental Protection) in 1994.

Selection for the proposed upgrading and expansion of the existing system was basically initiated after proper assessment of water supply situation was conducted for many towns in Ethiopia. Based on these assessments problem areas were identified and potential project sites prioritized in order to match the limited public funds available. Hence, the selection of Meki town for this study follows the line that the MoWR has taken in prioritizing problem areas.

2. Field Procedure

To prepare the questionnaire for this study, different documents were referred including several feasibility and preliminary design report documents for small towns water supply and sanitation study conducted by the Ministry of Water Resources (MoWR). So was the report of the recent population and housing census by the Central Statistics Authority (CSA).

The latter particularly helped in designing the relevant sample frame for the study. The 1994 census by CSA reports that there were 4537 households at the time. These households were further classified by the administrative areas (*kebeles*)they live in. Since the town is divided into three administrative zones, namely *Kebele* 01, *Kebele* 02 and *Kebele* 03, the proportional distribution of the population among these *kebeles* was used as a reference in deciding the percentage of questionnaires that should be administered in each *kebele*.

After a formal contact was established with the administrative bodies of the study area - both at the zone and the *woreda* level - a two day long advance visit was conducted in early January 1997. During this time, potential candidates who can serve as interviewers and questionnaire administrators were selected. They are four school teachers and two office workers from the *woreda's* educational bureau.

Next, the interviewers were introduced with the objective of the study and a half-day long training given to them. Since five of them are a diploma graduate and one has had an exposure to a university level education, they showed no problem in understanding the objective of the study as well as the content and structure of the questionnaire.

Then followed a pilot test session where the enumerators were given randomly chosen house numbers to which they administered the questionnaire on their own. A detailed discussion was then conducted on the pilot test results. The researcher and two supervising personnel discussed every question and answer session that the interviewers conducted for the pilot test. Minor modifications were made to the questionnaires before the scheduled date for a full scale operation.

In selecting the sample households, few modifications to a purely random sampling was needed. First, house in all three *kebeles* have unusual type of number sequencing. House numbers of adjacent households are frequently observed having a big gap between them. This made the searching of houses for enumerator as well as supervisors very difficult. Secondly, it was observed that all three *kebeles* have a new housing quarters where almost all houses in this area are relatively well constructed. These houses do not, however, have any kind of identification number. Since more than 800 of these type of houses are believed to exist, leaving them out from sample representation was considered inappropriate.

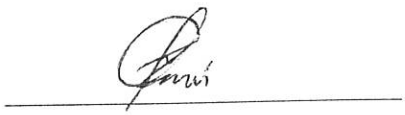
To tackle both problems, two methods were employed in selecting sample households. For those areas where there are house numbers, enumerators were given several non-overlapping number ranges (each range covers 10 consecutive numbers). Then they are instructed to

interview just one household from each range. Since enumerators will be searching any one of the 10 houses, the task of identifying samples becomes easier while at the same time the randomness of selection is preserved.

For the newly constructed areas, enumerators were assigned specifically to each locality and instructed to interview every 10 household. As one might observe, the objective of this exercise is to draw samples who as much as possible represent every locality of the town. Since some amenities tend to be concentrated in some areas only, a good geographical representation of the sample is the only way of getting a representative date. At the same time, to preserve the cross sectional randomness of the sample, just any one of the household the interviewer comes first to is include in the sample.

DECLARATION

The thesis is my original work, has not been presented for a degree in any other university and that all sources of material used for the thesis have been duly acknowledged.



Fisseha Aberra

May 23, 1997