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ECONOMIC VALUATION OF HOUSEHOLD BENEFITS FROM VILLAGE WATER SOURCE IMPROVEMENTS IN THE PHILIPPINES

RESEARCH DRAFT REPORT

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INTRODUCTION

In this paper, I estimate willingness to pay for distance to a water source, the availability of piped water into a house and deepwell or yard tap water using household survey data from the Philippines. In estimating willingness to pay, two estimation approaches are taken using the hedonic property models.

Past efforts to estimate willingness to pay for improved water sources have involved surveys which have provided limited information about households because they have been narrowly focused on household's demand for water sources. Also willingness to pay estimates have been primarily based on bidding games.(Griffin & North 1989, Whittington et al 1988, Altaf & Jamal 1988, Smith & Liu 1989) These studies suffer from potentially biased estimates involved in collecting information on a hypothetical market.[1]

The model I will use assumes that housing and water source characteristics are not separable in the household's utility function. Thus when households choose housing, they do so considering the water source characteristics among other housing characteristics. This is different from the work done with the bidding games and other work looking into the demand for water sources. In these studies it is assumed that water sources and housing are separable in the household's utility function. In other words, when a household chooses to rent or purchase a house, the water source characteristics are not considered. In Mu et al (1988) demand for water sources was estimated by assuming that households chose their water source given their housing.

Households choose to rent or purchase a house based on the housing and community characteristics. Values of housing will vary based on those characteristics. In rural areas of developing countries, characteristics of water sources available with housing are also important housing characteristics. Hence the value of water source characteristics is capitalized in the rental value of housing.

Housing can be considered a heterogeneous commodity that provides a flow of consumable services. These services are dependent on the characteristics of the housing unit which include characteristics of water sources available. When different houses have different levels of water source characteristics, it is possible to determine a household's willingness to pay for a change in the level of water source services from variations in equilibrium housing prices.

The literature on the demand for housing characteristics reveals several ways in which such information can be revealed. The theoretical basis for much of the literature is the work of Rosen (1974). There have been many econometric applications of the Rosen model but only recently has the methodology been applied to developing country issues. Using very different approaches, four recent studies, Quigley (1982), Follain et al (1982), Follain & Jimenez (1985) and Gross (1988) estimated willingness to pay for housing characteristics in various developing countries. All these studies are exclusively urban and only Follain et al and Quigley included water source among the housing characteristics. In both cases, the only water source characteristic included was a qualitative variable for whether or not the house had piped water. Water sourcing was also not a focus of either study.

In this paper, I will provide two frameworks which can be applied to household level data to reveal the demand for housing characteristics and especially water source characteristics. Section 2 provides a theoretical basis for estimating the demand for housing characteristics. Section 3 provides empirical specifications which will be utilized to reveal willingness to pay for improved water source characteristics. Section 4 will focus on the data used in estimation and Section 5 will analyze the empirical results from our two approaches to the hedonic property model.

II. Theoretical Basis for the Demand for Housing Characteristics

The theoretical justification for analyzing a market for a single commodity with many characteristics is found in the work done by Rosen (1974). This work has been extensively applied to housing. Follain & Jimenez (1985b) have reviewed the literature applying the Rosen model to housing and the following discussion draws primarily from the work done by Follain & Jimenez, Quigley (1982), Ellickson (1981) and Lerman & Kern (1985).

A housing unit consists of a vector of housing characteristics, h. I will assume there are two housing characteristics, h_1, h_2 and h_1 is a characteristic of the water source at the housing unit. These characteristics are jointly priced and p(h) represents the total cost of the housing unit related to h_1 and h_2. P(h) is nonlinear and is generally called a hedonic price function. It is nonlinear because purchasers of housing services can not have the characteristics which go along with a housing unit repackaged without considerable effort and expense. Hence the price varies nonlinearly with the amount of housing services purchased.

I will assume consumers have well-defined preferences over h_1, h_2 and x, a composite commodity whose price is one. Thus the consumer's problem is to;

1) $$\text{Max } u(h_1,h_2,x) \quad \text{s.t. } y=x + p(h)$$

The first order conditions require $@p/@h_i = u_i/u_x$ where u_i and u_x are the respective marginal utilities for housing characteristic i and the composite good x. Thus in equilibrium, the marginal cost of h_i is equal to the marginal rate of substitution between h_i and x for a given level of income and utility.

An important feature of the Rosen model is the bid-rent function, B. The bid-rent function can be defined as the amount of money a consumer is willing to pay for alternative amounts of h_i at a given level of utility and income. Everywhere along a bid-rent function, a consumer is indifferent. Thus the utility function can be defined as;

2) $$U^0 = u(y^0 - B, h_1, h_2)$$

where U^0 is a particular utility level and y^0 is a given income level. Figure 4.1 shows the hedonic price function and a series of bid-rent functions which each represent a different income and/or utility level. This shows the relationship between the hedonic price function and the consumer bids for different levels of a characteristic, h_1 which I can assume is the water source characteristic. The hedonic price function is an aggregate market determined function while the bids are determined by the individual consumer. In equilibrium the consumer will be at the tangency between the two curves or at points A', B' or C' for h_1. The same relationship occurs for each of the characteristics. In each case the hedonic price function $p(h_i)$ is an envelope of bid rent functions where movement from one bid rent curve to the next one takes place with changes in utility or income level.

Figure 4.2 indicates the compensated demand curves, C^1, C^2, C^3, which are generated by taking the first derivative for each of the bid-rent functions in figure 4.1. They show the relationship between some marginal cost for a characteristic and the quantity of the characteristic demanded at a given level of utility and income. The data which I will use is household level data so it is reasonable to assume that the individual consumer can not have any affect on the supply of characteristics. Thus supply is fixed. With supply fixed and assuming equilibrium in the market for a characteristic, I can assume that the derivative of the hedonic price function with respect to h_1, p_1, represents the equilibrium point or the point at which the compensated demand function meets the fixed supply for a characteristic. I have drawn in a derivative curve, p_1, which I assume represents a series of equilibrium points between supply and demand for characteristic 1 as I vary income and utility. This can also be said to be a marginal price function for housing characteristics.

I can look at the composite bid for all the characteristics making up a housing unit. Given equilibrium level bids for each of the characteristics, holding utility and income constant, B is the maximum amount that will be offered for all other bundles of characteristics and keep the consumer as well off as h_1 and h_2 and the following equality will exist;

3) $$u(y^0-p[h^0],h_1,h_2)=U^0=u(y^0-B,h_1,h_2).$$

At a new utility and income level, there will be a new bid.

A. Implications of the Model

In order to discuss the implications of the model with its non-linear budget constraint and at this point, I will assume there are more than two housing characteristics.[2] Observations of identical individuals at different income levels are sufficient to trace out the contour of the indifference curves due to the nonlinearity of the budget constraint. This can be extended to an approximation of a family of curves if preferences are homothetic and a sample of household observations is used. Figure 4.3 shows nonlinear budget constraints yielding optimal bundles with different slopes at points A, B and C. The changing slopes indicate that changes in income yield changes in the marginal rate of substitution.

Also with several housing characteristics and nonlinear prices, individuals with identical incomes and preferences of type u_1 could choose different budget constraints and bundles because they chose different amounts of some other characteristic, h_3. Thus these individuals could choose bundles of h_1 and h_2 identified by A' and A''.

With the nonlinear budget constraints, I can trace out the utility curves numerically and homotheticity of preferences is not a necessary assumption. Assumptions about the functional form of the utility function is sufficient to permit estimation of the parameters defining the curves.

III. Empirical Specification

Several estimation procedures have been developed to estimate the demand for housing characteristics. Follain & Jimenez (1985b) have reviewed these approaches. I will briefly describe the two approaches I take in estimating the demand for housing characteristics.

A. Two-Step Utility Function Estimation

The first estimation technique is the two-step approach. This approach has been widely used.[3] It involves first estimating the hedonic function with respect to each characteristic and using a non-linear estimation technique. For the second step, the derivatives of the hedonic function are used as price vectors in a system of demand and supply equations for the various characteristics. In other words each equilibrium between demand and supply is connected in the second step. The derivative or marginal price for each characteristic should be non-constant because of the non-linear nature of the hedonic function. The second step is equivalent to tracing the demand and supply curves in figure 4.2 and involves holding the demand and supply curves constant in order to reveal the structure of the functions.

An application of this approach has been to estimate the parameters of the individual's utility function.(Quigley 1982 & Follain & Jimenez 1985) This is done during the second step where the marginal prices are regressed against the components of the utility function. With the derived parameters, willingness to pay measures for the characteristics can be generated.

As Follain & Jimenez (1985b) have mentioned, there has been considerable discussion of the potential problems with this approach. First there are a couple of simultaneity issues which must be discussed. The first issue involves the traditional simultaneity problem of error terms being correlated with the right-hand side variables because price and quantity are simultaneously determined by demand and supply. In my study, this will not be a problem because I am using household level data. The behavior of individuals can not affect the market determined hedonic price functions. Households must accept prices as given. Thus the error terms of the demand system are independent of the parameters of the hedonic price function.

A second potential simultaneity problem relates to the nonlinearity of the price function. This stems from the fact that the hedonic price function depends on the vector of characteristics consumed by an individual and the marginal prices derived from the hedonic function depend on the individual's choices. Thus the individual is free to choose points along the hedonic price function. With a non-linear price function, the marginal price of characteristics is the derivative of the hedonic function and it varies as you move along the function. Thus the marginal price paid by the consumer is simultaneously determined along with the choice of the quantity of a characteristic to be consumed.

To deal with simultaneity caused by the non-linear price function, Follain & Jimenez (1985) replaced the marginal price with an instrumental variable. The instrumental variable is obtained by regressing the marginal price on a set of variables thought to be correlated with the marginal price but not correlated with the error terms in the individual consumer's demand equation. This will be done by estimating the parameters of the utility function in the second step.

Brown & Rosen (1981) discussed a problem of identifying the parameters from the demand system and the hedonic price function. They showed that if the hedonic price function had a quadratic functional form while the demand equations are linear, there would be no need to estimate the demand equations in the second step. The coefficients in the demand equations would be exact functions of the coefficients in the hedonic equation. A way to deal with this problem is to specify a functional form for the hedonic function which is different and more complex than the demand equations' functional form. I will follow Quigley (1982) and Follain & Jimenez (1985) in specifying functional forms which enable identification of the demand structure.

A final problem with the two-step approach is the way in which discrete characteristics have been dealt with. Quigley (1982) attempted to estimate willingness to pay which were consistent with theory but the methods were ad hoc and generally unsuccessful. The water source characteristics which I will use as household characteristics are distance to water source, whether or not the water source is piped water and whether or not the water source is deep well water. The second and third characteristics are unfortunately discrete variables. An 'ad-hoc' approach used by Quigley to estimate willingness to pay for the use of the discrete characteristic will be applied in my estimation. The former characteristic is continuous and should provide us with willingness to pay estimates consistent with theory.

B. Model Specification for the Utility Function Two-Step Approach

The two-step approach requires first estimating the hedonic function. The functional form of the hedonic function must be more complex than the utility function whose parameters are estimated in the second step. This is required in order to identification of the utility function parameters to take place.

Since I have no prior notions of the shape of the hedonic function, I can search alternatives by using the Box-Cox model;

7) $(p^w-1)/w=B_0 + B_j h_i + u$ for $w=1$

w is determined by nonlinear estimation techniques to yield the 'best fit.' This regression will derive a curve for each characteristic as is shown in figure 4.1. The derivative of the hedonic function will represent the marginal price at a given amount of a characteristic or $@p(h)/@h_i$.

With the Box-Cox approach specified, a utility function can now be specified which will allow the identification of the parameters of the utility function. It was earlier established that homotheticity of preferences is not a necessary assumption. Thus I will assume a generalized constant elasticity of substitution utility function. This functional form will permit me to identify the indifference curves with different observed bundles of h and z. It also allows for nonhomothetic preferences and takes the following form:

4) $\text{Max } U=u(\sum a_i h_i^B + x^e)^d + g[y-p(h)q-x]$

where a_i, B_i, e and d are parameters, g is the LaGrange multiplier and only when B_i=B_j=e will the function indicate homothetic preferences.[4] The first order conditions are;

5) $@u/@h_i=d*u(\ a_ih_i^B +x^e)^{d-1}(B_ia_ih_i^{B-1})-g(@p/@h_i)=0$

$@u/@z=d*u(\ a_ih_i^B + x^e)^{d-1}(e*z^{e-1})\ -\ g=0$

$@u/@g=y-p(h)-x=0$.

Simplifying the system yields;

6) $B_ia_ih_i^{B-1}e^{-1}(y-p(h))^{1-e}=@p/@h_i$.

The left hand side of the above equation is the marginal rate of substitution between consumption of h_i and x. A verbal interpretation of this is that it reflects the amount that an individual is willing to pay in reduced consumption of x in order to get another unit of h_i. In figure 4.2, this reflects the marginal price of h_i at points A and B. One can tell that even with fixed parameters, the marginal rates of substitution will change as the amounts of h are varied affecting the nonlinear hedonic price function. p(h).

In the second step, I will take logs of equation (6) and estimate n equations to yield estimates for a_i's, B_i's and e's using the marginal prices for the characteristics which were derived in the first step using the Box-Cox estimation approach. e is held constant across equations to be consistent with utility maximization. Equations to be estimated are;

8) $\log @p/@h_i=\log(a_iB_i/e + (B_i-1)\log h_i -(e-1)\log(y-p(h)) + t$

Thus I can identify the parameters in the demand system.[5]

C. **Discrete Choice Bid-Rent Approach**

The second estimation procedure is known as the bid-rent approach. In this approach, the individual bid-rent curves are estimated. In other words, the sample is divided into groups in which each member is assumed to have the same utility level. Rather than estimating a hedonic price function, each of the bid-rent function, B, are estimated for households assumed to be at the same utility level. This is done by non-linear estimation with the housing rental value as the dependent variable and income and housing and location variables as right-hand side variables. Estimates of the utility function parameters will then be revealed which will differ for each group. These will be utility function parameters at each level of utility. An advantage to this approach is the clear equity implications from derived valuation of housing characteristics at for different socioeconomic strata.

The key problem with this approach is the ad-hoc nature of identifying a group of individuals receiving the same level of utility. There is no systematic approach for doing this. Estimates of utility parameters will be inaccurate when there are differences in utility level among households in the same group.

Ellickson (1981) showed that the bid-rent models could be estimated using a discrete choice approach which bypasses the utility function and directly specifies and estimates the bid-rent function. His approach was to estimate the probability that a particular household type makes the maximum bid for a given housing unit using the logit estimation approach and thereby inferring the residential preferences of households. Lerman and Kern (1983) have described the Ellickson approach as a random bidding model.

Unfortunately his approach had limited policy application because estimates of willingness to pay could not be derived. However Lerner & Kern (1983) modified the Ellickson approach and developed a technique for estimating willingness to pay for housing characteristics. Gross (1988) used the Lerner & Kern approach to generate willingness to pay estimates by using the information on rent actually paid. This approach estimates the joint probability that the bid of a particular household type is greater than the bids of other household types along with the probability that the bid of a household in a particular household type is equal to the actual rent. This allows the estimation of the slopes and levels of the bid-rent functions.

The major problem with this estimation technique is the restrictiveness of the number of housing choices households have. Nonetheless the ease with which this approach can be applied to equity questions makes it an attractive alternative.

D. Model Specification for the Lerman and Kern Bid-Rent Model

Ellickson's (1981) approach was to estimate a discrete choice 'random bidding' model whereby the bid-rent parameters are estimated by predicting the type of household likely to occupy a particular house. With a competitive market, the highest bid for a dwelling is made by the occupant. Therefore the probability of the household type t occupying a particular house, h, is as follows;

9) $P(t|h)=P(B_t>B_{t'})=P((b_t(h) + e_t)>(b_{t'}(h) + e^{t'}))$

for all t not equal to t' where t and t' are different household types. B_t is the bid for dwellings with a fixed quantity or supply by households of type t and b_t is the bid of a representative household of type t.

The parameters that are derived for this model are relative to a reference household group. Thus it determines differences in slopes of the bid-rent function and not the actual slopes or levels of the bid rent function. Using the Ellickson approach, it can be determined which household type has the highest bid but not which household within a household type has a maximum.

Lerman and Kern (1983) suggested that by using the rent actually paid, this last shortcoming could be overcome. They suggest that the parameters of the bid-rent function can be derived by estimating the joint probability that a given household type has the highest bid and the probability that the bid of a particular household within that type is equal to the actual rent. This conditional probability is;

$$10)\quad P(t,R|h)=we^{-w[R-b(h)]}\exp\{-e^{-w[R-[1/w]\ln\ \exp w[b\ (h)]}\}$$

where R is the actual rent and w is a scale parameter of the Weibull disturbances. The w is constrained to be greater than zero. As long as $b_t(h)$ is linear in its parameters, the above specification leads to consistent estimates of the bid-rent parameter

IV. Data

The focus of this study will be rural Philippines. The water supply situation in the rural Philippines is better than the average for the rest of the world's developing countries. As of 1975, 31% of rural households had access to safe water.(Standing and Szal 1979) This compares with 22% of rural households in the rest of the developing world. While there was a significant expansion in the number of rural households with access to safe water between 1970 and 1974 in the Philippines, the incidence of water-borne disease increased among the general population and among children. Safe water should reduce the incidence of water-borne diseases. Thus the access to safe water may not be enough to reduce water related disease. One possible explanation for the lack of progress in reducing disease is that households with access to safe water do not use that water.

On the cost side of providing additional access to safe water, the World Health Organization estimates the average cost per person of providing safe water to rural areas of the Philippines as $121 as of 1980.(Standing and Szal 1979)

The data used will be the Bicol Multipurpose Household Survey of 1978. The Bicol region of the Philippines consists of six provinces at the Southeastern tip of Luzon Island. It is one of the poorest regions of the Philippines in terms of per capita income and its income growth rate has been slower than most of the rest of the Philippines. In 1974 per capita income was only 49% of the national average at $179 and the poorer half lived on $45 per capita indicating severe maldistribution of income.

The 1978 sample involves a survey of 1903 households who were asked a wide range of questions regarding their socioeconomic characteristics, individual nutrition, health and time allocation and Barangay (village) level information. Relevant to my analysis will be household data dealing with the households' source of drinking water and distance from the water source. I will also need information on housing characteristics including value of housing, house size, house construction materials, availability of electricity, distance from the nearest road and distance to the nearest poblacion (town). The socioeconomic information used will be household income and in order to make estimates of permanent income, individual head of household information on education and age, and household information on income and non-housing or water source assets will also be used.

A. Water Source Data

In the 1978 survey, information on household water source for drinking water was collected. Table One provides information on how many households are using each of nine water sources . Piped water in the house refers to water which is supplied by an organized water system operated by the government or by the barangay itself. The government sourced water is treated while locally provided water may not be. Pumped water in the house is water which is pumped up from a deep well inside the house. Piped or pumped water in the yard could be water coming from either of the first two sources but is located in the yard. Public piped or pumped water is water available at a public location which can either be pumped up from a deep well or piped in and treated by the government. Rainwater is water collected from rooftops through ducts into cans or barrels. Open well tends to be a shallow well which has no cover and where water is brought up in a pail. Spring, river or lake water is water retrieved from flowing sources. Purchased water is water brought in plastic gallon jugs from vendors. This is a common practice in certain barangays where tapped water is undrinkable. Now the sanitary condition of these sources was rated by the interviewers and was found to be most sanitary in the first four sources with the first source being the most sanitary if provided by the government. The final three sources were rated as very unsanitary for drinking.

There are both direct and indirect costs of using a water source. Table Two provides information on the frequencies of the direct cost, monthly expenditure, on water by water source. Information is not available on the cost per unit of water used. Expenditure information alone is endogenous. As one can see, only water piped in house or purchased had a sizable proportion of households who had any direct expenditures. Of these the vast majority of monthly expenditures are under 12 pesos per month which annually works out to 5% of the mean household income or the maximum level of expenditure which the World Bank and others have traditionally felt poor households can afford to pay for water from improved sources.(Van Damme & White 1984)

Indirect cost indicators include the time spent collecting water from its source and the cost and time spent purifying water from a source. Obviously both of these indirect costs is endogenous. The household determines the quantity of water it uses and thereby determines the amount of time spent collecting from a source. Purification costs could be divided into the direct costs of purification and the indirect time costs of purification. Also a household chooses whether or not to purify water from a source.

Table Three indicates the frequencies of time per week spent collecting water by sex and by whether the collector is an adult or a child. Note that one quarter of the children spend some time collecting water while two-fifths of the adults spend some time collecting water. Just under half of the males use some time collecting water while only one quarter of the females use any time collecting water.[6]

In Table Four, I have frequencies of water purification by water source. As expected, households more frequently choose to purify the water when they use open well water and water from a spring, lake or river which are considered to be far less safe than when they use the safer sources. They purify water least often when using the pumped or piped water to their yard or house which is considered the safest sources of water.

Another attribute of a water source is its distance from the household's residence. Obviously this is closely related to the time spent collecting water and to the quantity of water a household uses. As mentioned earlier in addition to use of safe water, quantity of water is an important determinant of improved health. Table Five provides frequencies of distance to a water source used by source. For obvious reasons, the first two sources have zero distances. Also spring or lake, public tap and open well all tend to be the farthest from the household's residence.

To provide an indication of the relationship between income levels and water source used, I have compiled the cross frequencies in Table Six of the water source used by households in each income quintile.[7] Interestingly in the top quintile, 56% used the first three water sources or the most sanitary and closest sources while only 24.5% of those in the lowest income quintile used the first three sources. Of those earning the highest incomes, 8.8% used the government provided and treated piped water in the house while just 1.3% of the poorest group used the piped water. However as we have seen, expenditures on water from the piped in house source is not prohibitively high for even the poorer groups. The freely provided public tap water is used by a large proportion of each income group. 38.6% of the poorest quintile are using water from the open well, spring, lake or river or buying water or the least sanitary ones while only 17.6% of the highest quintile use these sources. This may reflect a lack of availability of the cleaner water sources in the villages where the poor live. In addition, it could reflect poor household's low opportunity costs of collecting from the far source and spending time purifying the water.

B. Data for the Two Step Utility Function Approach

Column One of Table Seven contains the descriptive statistics for the variables used in the two-step approach for the full sample. To compare results from the overall sample with those for one specific housing market, estimates were also made using only households residing in Naga City. Column Two of Table Seven provides the descriptive statistics for the variables used in estimation of Naga City's housing market. Variables used to describe housing characteristics include water source characteristics, quality of housing, size of housing unit and a location characteristic variable.

The water source characteristic variables include a continuous variable measuring the distance in meters to the water source used by the household. It is assumed that there is disutility with additional distance to a water source. Also included are two discrete variables. The first indicates whether or not the residence has piped water into the house and the second incicates whether or not the household has a deep well with water pumped into the house or the yard. Note that just 5 percent of the households in the survey have piped water into their house but 30 percent use a deepwell. Relative to public tap or traditional source each of these should add to the utiliity of the household.

As measures of the quality of housing, an index of the material used in constructing the house has been utilized. The index ranges from one to three. The value is one if the house is made of nipa, a straw-like material or some similar material. The index has a value of two if the house is made of a mixture of nipa-like material and cement or wood and a value of three is given to houses made entirely with wood or cement and an iron roof. The better quality materials should provide more utility relative to other materials.

Size of residence is measured by two continuous variables. The first variable is the size of the house in square meters and the second is the number of bedrooms in the house. Larger households should provide more utility to the household that occupies it. To measure the location characteristics, the variable used is the distance from the barangay of residence to the nearest town in kilometers to measure the attraction of the nearest town. One would expect that the greater the distance to the municipal center is the poorer is the infrastructure and the lower the level of government services is. Hence distance to municipal center has a negative effect on utility.

In the two step hedonic approach a measure of consumption of non-housing goods and services is needed. In order to derive this, income is needed. Income measurement in rural areas of developing countries is extremely difficult because household's income is frequently received in kind or derived from household production. An indication of the trouble with reported income is the 217 households or 11.5% of the survey with negative income. If one is to assume that households will consume a relatively constant amount over time, regardless of transitory charges in income, it becomes appropriate to attempt to measure some permanent income level for a household. This was done and in order to obtain positive measures of permanent income for all households, several techniques were used. These are discussed in the Appendix A.

An assumption is made that all income is spent on housing or other goods and services. Non-housing consumption should provide the household with positive utility.

Next a measure of imputed housing value is needed for the households. About ninety percent of the households in the survey owned their own home and only one quarter of the remainder pay rent on their house. Thus there was little indication that an active rental market was present in the region. There were estimates of housing structure value made by the housing owners in the survey. This measures the value of the house alone and does not include any valuation of the land that a household might own surrounding a residence. Thus I utilized the housing structure value for the housing owners and dropped the approximately 200 renters from the sample. I further developed a measure of imputed rent as others have done by multiplying the housing value by one percent following Follain & Jimenez(1985). They state that a common 'rule of thumb' for analysis in developing countries is the assumption that imputed rent is 1% of housing value. The average derived imputed rent for the owners of approximately 30 pesos is very close to the average rent of 32 pesos for the few renters in the survey.

C. Data for the Discrete Choice Bid-Rent Approach

The data requirements for this approach are similar to the two-step approach except an additional discrete variable must be created which describes household types. Also there is not a need for a measure of non-housing consumption. Table Eight contains the descriptive statistics for the data used in the discrete choice bid rent estimation. It breaks down descriptive statistics into household type and for the overall sample.

The development of a system for classifying households involved attempting several ways of breaking down the households.[8] It was found that by simply dividing the households based on income into three equal categories provided the best explanation of behavior as indicated by the data. These categories contain about the same numbers of observations.

The joint probability estimation approach involves estimating a bid-rent function for each of the household types. Marginal values will be estimated for each housing characteristic and each household type. These marginal values are marginal willingness to pay for the characteristic. Thus one would expect similar signs for the attributes as were expected for the utility parameters in the two-step hedonic approach.

For the non-water characteristics, this means that distance to town should be a disutility and thus the marginal willingness to pay should be negative. The number of bedrooms in the house should yield a positive marginal willingness to pay. The index of housing materials should have a positive marginal willingness to pay. As the quality of housing materials increases, households are willing to pay more rent.

Distance to the water source should be a disutility and yield a negative willingness to pay. Households are willing to pay to be closer to the water source. Also the availability of piped or deep well water should yield a positive willingness to pay. Households are willing to pay to have the use these improved water sources rather than lower quality sources.

Now one can hypothesize changes in the marginal willingness to pay from one household type to the next. As one increases income, it is expected that for the housing characteristics which yield positive utility, marginal willingness to pay will increase. Also for the characteristics which provide disutility, one would expect that as income increased, households would be willing to pay more to reduce the impact of the characteristic.

V. Estimation Results

This section will present the results of my estimation applying the techniques discussed earlier. Results from estimation using the overall sample and the Naga City subsample using the two-step approach will be presented and this will be followed by a presentation of the results for the discrete choice bid-rent approach. Finally the results will be compared.

A. Two Step Utility Function Estimates

Estimates of the two-step hedonic approach were made for the full sample and include households from the three provinces in Bicol. Also estimates are made for a subsample of households living in Naga City. This was done because Naga City represents a single urban market which is likely to be more active than the housing markets in rural areas of the Philippines. Hence I will be able to compare these two estimates and thereby to check to see that the results for the overall sample are consistent with those for Naga City. A closer look will be taken at the indicated willingness to pay for the water characteristics included among the housing characteristics.

I will discuss in detail each intermediate step taken in attaining the ultimate goal of developing some measures of willingness to pay for water source characteristics. The first step of the two-step approach is the estimation of a hedonic equation which sets imputed rent as a function of the physical and locational characteristics of a house. As described earlier, the Box-Cox transformation provides a technique for finding the nonlinear relationship between the imputed rent for housing and its characteristics. To find the 'best-fit', the dependent variable, rent (R), is transformed as follows;

11) $R^{(w)}=(R^{w}-1)/w$ for $w\neq 0$

$=\log R$ for $w=0$.

The w is varied until the value is found which minimizes the RSS.

This procedure was performed and it was found that the RSS is minimized when w=.05. The results are reported in Table 9. Column 1 indicates the coefficients and t-statistics for the respective variables. The function explains nearly 60% of the variation in imputed rents. In addition six of the eight coefficients are significant and all have the expected sign.

Also estimated from the hedonic function are the marginal prices for the housing characteristics. From the nonlinear Box-Cox estimates, the marginal prices can be derived by first transforming the dependent variable back to its original value as follows;

12) $R=[(1+wB_0)+w\ B_jz_j]^{1/w}$.

To obtain marginal prices for each of the housing characteristics, derivatives are taken of the function in (12) and the following is obtained;

13) $R=B_iR^{(1/w)-1}$

$=B_iR^{(1-w)}$

which will vary by observation.(Follain & Jimenez 1985) These are marginal prices given the level of other characteristics in the housing unit. Column 2 of Table 9 contains the average marginal prices and standard deviations for each characteristic. For the dummy variables, piped and deep well water, the price represents the mean additional cost of using each calculated at the sample means. For the continuous variables, such as rooms, the average marginal price of 9.8 means that the average cost of an additional room is 9.8 pesos per month.

With the marginal prices estimated in the first step's Box-Cox hedonic equation, the parameters for the generalized constant elasticity of substitution (GCES) utility function. By assuming that the utility function takes on a GCES form as follows;

14) $U=u(\sum_{i}^{n} a_ih_i^{B} + a_6h_6 + a_7h_7 + x^{e})^{d}$

where

h_1=distance to water source

h_2=index of housing materials

h_3=house size per household member

h_4=rooms per household member

h_5=distance to town

h_6=piped water

h_7=deep well water

where a_i, B_i, e and d are parameters. Maximizing this functional form subject to a budget constraint yields first order conditions which can be simplified into a system of five equations for each of the first five continuous variables.[9] In each case the marginal price should be equal to the marginal rate of substitution between the particular housing characteristic and consumption of other non-housing goods and services. These equations are defined in equation 6. The parameter d is arbitrary and the remaining parameters define household preferences.

The equations in 6 were estimated using ordinary least squares with the dependent variable being the marginal price of each of the continuous variables derived from the results in Table 9. One restrictions was made. The coefficient for the log of non-housing consumption is equal across all equations. This is done to be consistent with the utility function.(Quigley 1982) The results are shown in Table 10. As can be seen, the data explains more than 25% of the variations in the marginal prices for all the equations except the one for barangay distance. Additionally each of the coefficients is significant.

From the results, the parameters of the continuous variables in the GCES utility function can be estimated. Additionally willingness to pay for each of these continuous variables can also be established. The two discrete variables, presence of piped water and presence of a deepwell, can not be described by the marginal conditions for consumption which the other variables have been. Thus a methodology for estimating these two variables is reported in the Appendix B. Combining the results for the discrete variables with those in Table 10 gives the following estimate of households' utility;

15) U=[-.0000589*(distance to water source)$^{.832032}$+.6569948*(housing materials)$^{3.22566}$+.0099253*(house size per person)$^{1.69721}$+3.3937692*(rooms per

$\text{person})^{1.50256} - .0199663*(\text{distance to town})^{.870861} + 33.0438*(\text{piped water}) + 8.46858*(\text{deep well}) + (\text{non-housing expenditure})^{.931945}]$

From the estimates in Table 10, predicted marginal rate of substitution between the housing characteristic and non-housing consumption was estimated for each of the continuous variables. In Table 11a, descriptive statistics for the predicted marginal rates of substitution are provided. Consider the willingness to pay estimate for housing materials. On average households are willing to pay over one-third of their average monthly imputed rent for the next level of housing material quality. Also households are willing to pay an average of 3.5 pesos a month for an additional bedroom. Households are willing to pay, on average, 0.08 pesos a month for an additional square meter of living space. Finally for distance to town, households are willing to pay to pay 0.03 to be one kilometer closer to town.

Now for the willingness to pay for reduced distance to the water source, the average willingness to pay is 0.0000685 pesos to be one meter closer to a water source. As Table 11B indicates, this measure varies a good bit according to the household's present distance to a water source. Households less than 5 meters from a water source are willing to pay 0.00012597 to be one meter closer. This compares with households that are over 50 meters from their water source and are willing to pay, on average, 0.00003462 or just over one-third as much as the households in the closest range to the water source.

Table 11C is a tabulation of the households' willingness to pay by income quintile. Note that there is some variation in willingness to pay by income. As income rises, willingness to pay also rises, as expected. Households in the highest quintile are willing to pay are willing to pay 0.00008105 while households in the lowest quintile are willing to pay an average of 0.00005901.

In other words the households in the highest quintile income level are willing to pay 25% more than those in the lowest category.

The values for the presence of piped water and deepwell water are quite large by comparison to the marginal valuation of distance to water source. Due to the technique of estimating the value for each of these discrete variables, there is no variation in the value between observations. Households are willing to pay 33.044 pesos per month to have piped water. This represents approximately 100% of household's monthly imputed rent. For deep well water, households are willing to pay approximately 8.5 pesos or 25% of imputed rent. Thus while households are willing to pay a small amount to bring water closer, they are willing to pay substantial amounts for higher quality water sources, such as piped and deep well water sources. However there is some evidence that households are willing to pay substantially more to bring water closer if they are presently close to their water source, 5 meters or less. Additionally willingness to pay for closer water is responsive to income with higher income households willing to pay more than low income households. A caution with respect to these results for distance to water source is that from the hedonic price function, distance to a water source was insignificant.

With higher imputed rents in Naga City, marginal valuations derived and presented in Tables 12 & 13 indicate a much greater marginal willingness to pay for housing characteristics. The valuation of the discrete variables by comparison is quite small and may be explained by the small sample size.

A. Discrete Choice Bid-Rent Approach Estimates

The model limited the functional form to a linear in parameter specification. Several specifications were tried but it was found that a simple linear specification described the data best. By using this, it is implied that there is a flat willingness to pay for each attribute.(Gross 1988)

Table 14 contains the estimates from the discrete choice bid-rent approach to estimating the bid-rent functions for housing characteristics. 16 of 22 coefficients are significant at the five percent level and one more is significant at the ten percent level. For the household type with the highest income level, all coefficients are significantly different from zero. For the household type at the middle income level, five of seven coefficients are significant. For the household type with the lowest income level, three of seven are significant at the five percent level and one more coefficient is significant at the ten percent level of significance. Hence the model fits very well for the upper income households while the fit is not as good for low income households.

Willingness to pay for a marginal change in the continuous housing characteristics is simply the coefficient for that characteristic since the functional form is linear. For the discrete variables, availability of piped water and deepwell water, their coefficients represent the willingness to pay for the availability of the water source. Since housing materials is an index, the coefficient represents the willingness to pay for the next higher quality material.

The coefficients of the non-water characteristics are generally as hypothesized. Rooms are significant and positive for the middle and upper income households. While the coefficient for the lowest income households is not significant, it does have the correct sign. Households are willing to pay for larger houses. Distance to town is negative and significant for the lowest income households but it is positive and insignificant for the middle income and positive and significant for the high income households. Low income households are willing to pay to stay close to the town but upper income households are willing to pay to stay farther from town. Finally households regardless of income level are willing to pay for a higher quality building material.

The distance to the water source coefficient is negative and significant, as expected for only the high income households. Both the low income households and the middle income households have positive but insignificant coefficients. There is a tendency going from the lowest to the highest income households for the value of water availability to increase. High income households are willing to pay 0.0036 to have water a meter closer. High income households have a higher opportunity cost of time spent collecting water so this result is expected.

Now for the two discrete variables, pipe and deepwell availability, the signs are significantly positive in five of the six cases. Piped water is significantly positive at the five percent level of significance for middle and high income households. Households in the middle and high income range are willing to pay approximately half their monthly imputed rent to have piped water available to them. The willingness to pay works out to 18 pesos for middle income households or approximately $2.25 in 1978 U.S. dollars.[10] For high income households, willingness to pay is 15.5 pesos or approximately $1.95.

Piped water availability also is positive for low income households but it is significant at the ten percent level of significance. Low income households are willing to pay about fifty percent less for piped water than high income households. Since piped water is provided into the residence and is purified, it is expected that high income households with larger opportunity costs of time spent either collecting or treating water are willing to pay more to avoid spending time in gathering or treating water.

For deepwell water availability, middle and high income households are willing to pay positive and significant amounts. Middle income households are willing to pay about 7 pesos or approximately $0.87 while high income households are willing to pay 6.5 pesos or approximately $0.81. These two household types are willing to pay just over 20% of their imputed rent to have deep well water. Poor households have a negative willingness to pay for deepwell water but it is insignificant. Once again, the increased availability of deepwell water and the fact that it will usually not be necessary to treat deepwell water mean that households with higher opportunity costs, such as high and middle income households, will be willing to pay more for it than low income households with lower opportunity costs.

The middle and high income's willingness to pay for piped water is approximately two and a half times the willingness to pay for deepwell water. This may be a result of a couple differences in the characteristics between the two sources. First piped water is generally considered to be the safest because it has definitely been treated before going to the home. Deepwell water may have been treated if it is provided by a water authority but more likely, it simply comes from a deep well in the household's yard. A second and perhaps the decisive reason for the higher willingness to pay for piped water is the fact that much of the deep well water is available in the yard and not the house. Thus in order to utilize it household members must go outside to collect it. Piped water, on the other hand, is always available in at least one source within the house. To collect water, there is not a need to leave the house.

VI. Conclusion

In this paper, empirical estimates of willingness to pay for water sources and water source characteristics are made for rural Philippines. It was found that there is some willingness to pay for increased availability of a water source. This willingness to pay increases with income and decreases with the distance to the water source. However in the bid-rent model, only upper income households value increased availability and in the two-step model, distance to water source was insignificant in the hedonic price function. Also it was found that households have a significantly positive willingness to pay for piped water. Although less than for piped water, there is also a positive willingness to pay for deep well water. Again there is a positive correlation between willingness to pay for piped water and deep well water and income. While the amounts of willingness to pay are not a substantial portion of income, they do represent an amount which is much larger than is presently paid for water.

There are several policy implications of these findings. First there is an opportunity for provision of piped water into homes with water tariffs charged at substantially higher rates than are presently charged. If monthly rates of $2 were charged, substantial amounts of moderate and upper income would use the source. At charges of $1 per month, it appears that most households would use the piped source. If these charges are too low to justify the investment, there is some willingness to pay for deep wells or yard taps. Charges of about $1 per month would attract many middle and upper income households.

An alternative investment opportunity is to provide public taps which make sources more available to households. From estimates of the disutility of the distance to the water source, it is evident that there is some willingness to pay for this increased availability which could be provided if public taps brought water sources closer to their users. However as just mentioned, this increased availability may simply attract upper income households. Both approaches found low-income households to have lower or insignificant willingness to pay for increased availability.

From an equity standpoint, it would be preferrable to provide yard taps or piped water in house and price discriminate. One method of doing this would be to charge higher water rates in moderate and upper income neighborhoods than in low income neighborhoods since low income households are willing to pay less than higher income households.

In this study, willingness to pay estimates have been made from two techniques to estimating the hedonic property models. The estimates for the continuous variable, distance to a water source, seem reasonable. However caution must be taken with the discrete variables, piped water and deep well water. This is particularly true for the two-step approach. The estimates of willingness to pay for the discrete variables are a bit too ad-hoc. More work needs to be done to incorporate theoretically sound estimates of willingness to pay for discrete variables.

Endnotes

1.Cummings et al ? have outlined three types of potential bias from bidding game or contingent valuation results; a) hypothetical bias-Respondent does not understand or perceive correctly the characteristics of the good being described in the hypothetical market, b) strategic bias-Respondent thinks he can influence provision of services by not answering questions truthfully and c) Compliance bias-Respondent gives answers which are influenced by desire to please interviewer.

2. This is drawn from Follain and Jimenez (1985b).

3.Follain & Jimenez (1985b) estimated willingness to pay with the two-step approach using data from developing countries.

4.As mentioned earlier, I will assume the hedonic price function, p(h), is unaffected by the actions of the individual consumer.

5.Willingness to pay estimates can then be derived for each characteristic including the water source characteristics.

6.This contrasts with Africa where 90% of the time allocated to collection of water is done by women.(UN 1976)

7. As I will get into momentarily, there is some question of the reliability of the income data collected in the Bicol Survey but the collected information should provide a general indication of the relationship.

8.Several systems of classifying the households were considered. Each classification system was tested by estimating a multinomial logit model with the household types on the left hand side and the housing characteristics on the right hand side in an estimation very similar to Ellickson (1981). The household classification system used was the one which provided the best fit.

9.Note that rooms and house size enter the household utility function as space per person. Households gains utility from additional space per person and not simply space. However the housing market is simply measured based on space.

10. For 1978, the average exchange rate of Philippines Pesos for U.S. dollars was 7.4 pesos for each dollar.

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Table 1

Number of Households Using a Water Source
(1978 Data)

Water Source	Number of Households	Percentage of Households
Piped Water, in House	98	5.2%
Pump Water, in House	163	8.6
Pump or Piped Water, in Yard	406	21.4
Pump or Piped Water, in a Public Place	462	24.3
Rainwater	5	0.3
Open Well	289	15.2
Spring, Lake or River	278	14.6
Bought	20	1.0
Other	179	9.4
Totals	1900	100.0

Table 2

Expenditures by Water Source Used
(1978 Data)

Water Source	Monthly Expenditures				
	0	0.2-4.0	5.0-8.0	9.0-12.0	>12.5
Piped Water, in House	34 (34.7)	22 (22.4)	18 (18.4)	5 (5.1)	19 (19.4)
Pump Water, in House	150 (92.0)	1 (0.6)	3 (1.8)	2 (1.2)	7 (4.3)
Pump or Piped Water, in Yard	364 (89.7)	30 (7.4)	8 (2.0)	4 (1.0)	0 (0.0)
Pump or Piped Water, in a Public Place	428 (92.6)	19 (4.1)	7 (1.5)	1 (0.2)	7 (1.5)
Rainwater	5 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Open Well	279 (96.5)	2 (0.7)	2 (0.7)	2 (0.7)	4 (1.4)
Spring, Lake or River	257 (92.4)	2 (0.7)	7 (2.5)	2 (0.7)	10 (3.6)
Bought	5 (25.0)	7 (35.0)	1 (5.0)	3 (15.0)	4 (20.0)
Other	161 (89.9)	9 (5.0)	5 (2.8)	2 (0.7)	2 (0.72
Totals	1683	92	51	21	53

Note: The row percentage is in parenthesis.

Table 3

Time Spent Collecting Water per Week
by Sex and Adult/Child
(1978 Data)

Time Spent per Week	Male	Female	Child	Adult
0	2091 (53.4)	2943 (74.7)	350 (72.2)	4686 (63.6)
0.1-1.0	467 (11.9)	395 (10.0)	35 (7.2)	827 (11.2)
1.1-2.0	300 (7.7)	207 (5.3)	24 (4.9)	483 (6.6)
2.1-3.0	227 (5.8)	84 (2.1)	16 (3.3)	295 (4.0)
3.1-4.0	253 (6.5)	109 (2.8)	16 (3.3)	346 (4.7)
4.1-5.0	80 (2.0)	28 (0.7)	7 (1.4)	101 (1.4)
5.1-6.0	57 (1.5)	16 (0.4)	2 (0.4)	71 (1.0)
6.1-7.0	206 (5.3)	101 (2.6)	21 (4.3)	286 (3.9)
>7.0	231 (5.9)	56 (1.4)	14 (2.9)	373 (5.1)
Totals	3912	3939	485	7368

Note: The first row represents the number of individuals in the sex or adult/child category who are spending the amount of time collecting water. The second row is the percentage of the column spending that amount of time on water collection. Children are 12 to 15 years of age and adults include everyone over 15 years of age.

Table 4

Frequencies of Water Treatment by Water Source
(1978 Data)

Water Source	Yes	No
Piped Water, in House	24	75
Pump Water, in House	38	125
Pump or Piped Water, in Yard	106	302
Pump or Piped Water, in a Public Place	171	291
Rainwater	2	3
Open Well	168	121
Spring, Lake or River	125	153
Bought	6	14
Other	71	108
Totals	711	1192

Table 5

Distance (in Meters) to Water Source Used
(1978 Data)

Water Source	Distance 0	1-25	26-50	51-75	>76
Piped Water, in House	99 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Pump Water, in House	163 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Pump or Piped Water, in Yard	7 (1.7)	345 (84.6)	35 (8.6)	2 (0.5)	19 (4.7)
Pump or Piped Water, in a Public Place	3 (0.7)	210 (46.1)	95 (20.8)	8 (1.7)	140 (30.7)
Rainwater	1 (20.0)	4 (80.0)	0 (0.0)	0 (0.0)	0 (0.0)
Open Well	5 (1.7)	119 (41.2)	61 (21.1)	6 (2.1)	98 (33.9)
Spring, Lake or River	3 (1.1)	88 (31.6)	60 (21.6)	10 (3.6)	117 (42.1)
Bought	1 (5.0)	0 (0.0)	0 (0.0)	0 (0.0)	19 (95.0)
Other	1 (0.6)	103 (57.5)	39 (21.8)	5 (2.8)	31 (16.3)
Totals	283	869	290	31	424

Note: The first row represents the number of households in the distance group using the water source. The second row is the percentage of households using the water source who are in the distance group.

Table 6

Number of Households Using a Water Source
by Income Quintile
(1978 Data)

Water Source	Income Quintile 1st Quintile	2nd Quintile	3rd Quintile	4th Quintile	5th Quintile
Piped Water, in House	5 (1.3)	21 (5.6)	20 (5.3)	19 (5.1)	33 (8.8)
Pump Water, in House	20 (5.3)	21 (5.6)	24 (6.4)	32 (8.5)	63 (16.8)
Pump or Piped Water, in Yard	67 (17.8)	73 (19.5)	77 (20.5)	73 (19.5)	114 (30.4)
Pump or Piped Water, in a Public Place	99 (26.3)	89 (23.8)	109 (29.1)	91 (24.3)	73 (19.5)
Rainwater	3 (0.8)	0 (0.0)	0 (0.0)	2 (0.5)	0 (0.0)
Open Well	62 (16.5)	69 (18.4)	66 (17.6)	58 (15.5)	29 (7.7)
Spring, Lake or River	77 (20.5)	54 (14.4)	53 (14.1)	55 (14.7)	32 (8.5)
Bought	6 (1.6)	3 (0.8)	3 (0.8)	3 (0.8)	5 (1.3)
Other	37 (9.8)	44 (11.8)	23 (6.1)	42 (11.2)	26 (6.9)
Totals	376	374	375	375	375

Note: The column percentage is in parenthesis.

Table 7
Descriptive Statistics for Two-Step Hedonic Approach

Variables	All	Naga City
Distance to Water Source	262.113 (1113.84)	44.745 (106.29)
House Size in Square Meters	28.986 (43.38)	51.108 (101.17)
Number of Bedrooms	1.391 (0.93)	1.763 (1.37)
Distance to town	5.891 (6.89)	-----
Index of Housing Materials	1.561 (0.69)	1.917 (0.73)
Head of Household's Years of Schooling	5.876 (4.48)	8.292 (5.58)
Household Size	6.417 (2.72)	6.691 (3.08)
Head of Household's Occupation-Farmer	0.506	0.072
Availability of Piped Water-Available=1	0.052	0.175
Availability of Deep Well Water Available=1	0.30	0.402
Non-Housing Expenditure per month	1115.102 (530.95)	668.321 (332.93)
Imputed Monthly Rent= House Value*.01	30.806 (238.12)	73.40 (221.15)
N	1589	60

Note: The first row is the mean value and the second is the standard deviation. Mean values are only provided for discrete variables.

Table 8
Descriptive Statistics for Discrete Choice Bid-Rent Approach, by Household Type

Variables	1	2	3	Entire Sample
Annual Income	≤ 9053.16	9053.16 to 16367.4	>16367.4	All
Distance to town	3.591 (5.942)	6.243 (7.331)	7.008 (7.188)	6.043 (6.898)
Distance to Water Source	402.039 (1401.16)	276.534 (1311.15)	149.76 (624.259)	275.314 (1164.31)
Bedrooms in House	1.222 (0.912)	1.404 (0.944)	1.495 (0.919)	1.374 (0.931)
Index of House Materials	1.476 (0.661)	1.575 (0.70)	1.559 (0.67)	1.536 (0.678)
Availability of Deep Well Water	0.239	0.318	0.331	0.296
Availability of Piped Water	0.043	0.058	0.048	0.049
Imputed Rent	22.140 (72.777)	38.238 (95.547)	31.172 (81.548)	30.419 (83.842)
N	536	515	546	1597

Note: First row includes mean values for the variables. The second row includes the standard deviations. Standard deviations are not included for the discrete variables.

Table 9

Hedonic Regression Computed from the Box-Cox Transformation of the Dependent Variable and Market Wide Average Marginal Prices of Housing Attributes
(1626 Observations-1978 Data)

Variable	Coefficients	Mean Marginal Prices
Intercept	-0.315 (3.99)	
Distance to Water Source	-.0000077 (0.32)	0.0002 (0.001)
House Materials	1.041 (20.73)	24.372 (162.42)
House Size	0.009 (10.38)	0.206 (1.370)
Number of Rooms	0.419 (10.74)	9.801 (65.316)
Piped Water (1=Available)	0.782 (5.55)	18.315 (122.058)
Deep Well (1=Available)	0.450 (6.80)	10.540 (70.241)
Distance to Poblacion(town)	-0.0037 (0.91)	0.087 (0.583)
Lambda	0.05	
Adjusted R_2	0.596	

Table 10

Estimates of Utility Parameters
(1589 Observations-1978 Data)

Parameter	Estimate
$\log(a_1b_1/e)$	-9.853 (85.85)
$\log(a_2b_2/e)$	0.822 (7.31)
$\log(a_3b_3/e)$	-4.013 (34.03)
$\log(a_4b_4/e)$	1.559 (13.11)
$\log(a_5b_5/e)$	-3.981 (34.99)
(b_1-1)	-0.168 (24.27)
(b_2-1)	2.226 (67.35)
(b_3-1)	0.697 (29.49)
(b_4-1)	0.503 (24.07)
(b_5-1)	-0.129 (12.43)
c	0.068 (4.22)

Equation	R^2
Log(Water Source Distance)	0.27
Log(House Size)	0.35
Log(Rooms)	0.27
Log(House Materials)	0.74
Log(Barangay Distance)	0.09

Table 11a
Mean Estimates of Marginal Rate of Substitution between the Housing Characteristics and Non-Housing Consumption Derived From GCES Utility Function Estimates

Variable	Estimate
Distance to Water Source	0.0000685 (0.0000475)
House Size	0.0812095 (0.0673143)
Rooms	3.5361 (1.5967)
Housing Materials	12.093667 (11.9824)
Distance to Town	0.02949 (0.01109)

Note: Standard Deviations are in parentheses.

Table 11B
Mean Estimates of Willingness to Pay to be One Meter Closer to Water Source by Distance to Water Source

Distance to Water Source	Estimate
Less than 5 Meters	0.00012597 (0.00005434)
Between 5 and 10 Meters	0.00006277 (0.00000317)
Between 10 and 20 Meters	0.0000558 (0.0000028)
Between 20 and 50 Meters	0.00004893 (0.00000256)
More than 50 Meters	0.00003462 (0.00000763)

Note: Standard Deviations are in parentheses.

Table 11C
Mean Estimates of Willingness to Pay for Distance to Water Source
by Income Quintile

Income Quintile	Estimate
First	0.00005901 (0.00003894)
Second	0.00006037 (0.00003983)
Third	0.00007362 (0.0000525)
Fourth	0.00006703 (0.00004488)
Fifth	0.00008105 (0.00005468)

Note: Standard Deviations are in parentheses.

Table 12

Naga City Hedonic Regression Computed from the Box-Cox Transformation of the Dependent Variable and Market Wide Average Marginal Prices of Housing Attributes
(60 Observations-1978 Data)

Variable	Coefficients	Mean Marginal Prices
Intercept	0.883 (2.69)	
Distance to Water Source	-.0019 (1.74)	0.644 (5.246)
House Materials	0.463 (2.50)	193.544 (1577.34)
House Size	0.0069 (2.52)	3.310 (26.975)
Number of Rooms	0.209 (2.08)	105.363 (858.68)
Piped Water (1=Available)	0.388 (0.98)	179.194 (1460.38)
Deep Well (1=Available)	0.102 (0.36)	74.954 (610.86)
Lambda	-0.10	
Adjusted R^2	0.596	

Note: T-statistics are in parentheses in first column and standard deviations are in parentheses in second column.

Table 13
Naga City Estimates of Utility Parameters
(60 Observations-1978 Data)

Parameter	Estimate
$\log(a_1b_1/e)$	-6.318 (8.63)
$\log(a_2b_2/e)$	-1.864 (2.54)
$\log(a_3b_3/e)$	-5.878 (7.88)
$\log(a_4b_4/e)$	-0.431 (0.57)
(b_1-1)	-0.210 (7.00)
(b_2-1)	2.035 (8.45)
(b_3-1)	0.685 (6.21)
(b_4-1)	0.535 (6.17)
c	0.499 (4.43)

Equation	Adjusted R^2
Log(Water Source Distance)	0.50
Log(House Size)	0.44
Log(Rooms)	0.44
Log(House Materials)	0.58

Note: T-statistics are in parentheses.

Table 14

Estimates for the Discrete Choice Bid-Rent Function
1672 Observations

Variable	Estimate		
	Household Type- Income Level per Year(In Pesos)		
	<9053.2	9053.2 to 16367.4	>16367.4
Intercept	-25.924 (5.52)	-46.243 (10.87)	-47.321 (11.02)
Rooms	2.194 (1.38)	7.967 (6.21)	11.29 (9.77)
Distance to Town	-0.834 (5.81)	0.011 (0.51)	0.396 (2.04)
Distance to Water Source	0.0014 (1.10)	0.0002 (0.18)	-0.0036 (2.19)
House Materials	9.863 (4.18)	12.734 (5.98)	10.321 (4.97)
Piped Water Available	10.427 (1.70)	18.13 (3.85)	15.486 (3.31)
Deepwell Water Available	-2.147 (0.57)	6.948 (2.42)	6.459 (2.25)
Scale Parameter		0.044 (123.96)	

Note: T-statistic is in parentheses.

Appendix A

Deriving a Measure of Permanent Income

Consumption levels are needed in a couple of the models. Since it has been assumed that households consumption rate is based on permanent income levels or levels devoid of transitory effects, it is necessary in this section to derive estimates of permanent income.

Income is very difficult measure in a developing country setting, such as the Philippines, where much production is done within the household and received as transfers from other members of the family. It is particular difficult to measure in a rural setting where few workers are employed in a formal labor market. However frequently economic theory calls for a measure of income to be used. In its place researchers have often used a measure of asset valuation as its proxy.(Whittington et al 1988)

In our models and particularly in the two-step hedonic model, it is imperative that a measure of total household consumption be present in order to estimate the utility parameters and subsequently willingness to pay for water source characteristics. Since consumption expenditures that are accurate are unavailable, income must be used and the assumption can be made that income equals consumption.

The data on income shows that there must be substantial negative transitory income during the 1978 period of survey because 217 households or 11.5% of the survey have negative income. Obviously their consumption levels also can not be negative so an approach must be used which accounts for these negative income earners and tries to predict what their income would have been if they had had positive income or their permanent income.

The approach used was a selection model where it is assumed that the appropriate equation for permanent income is when income is within a certain band. Also selection between being in the band and being outside is not random. The parameters derived using observations inside the band are different than those from outside the band;

1) $Y_p = X'B_1 + u_1$

$_Y0 = X'B_2 + u_2$

where Y_p is income within the band and Y_0 is outside the band. If the model is estimated including all observations of Y and not accounting for the parameter differences, there will be selectivity bias.

To correct for selection bias, a selection correction term must be derived as follows;

2) $E(u_1 | Y_p \text{ chosen}) = -s_{1u}[f(Z)/F(Z)]$

where $Z = (X'B_1 - X'B_2)/s$, s is standard deviation, s_{1u} is the covariance between u_1 and u and f and F are respectively the density function and the distribution function for the standard normal. Then equation (1) can be written as;

3) $Y = x'B_1 - s_{1u}[f(Z)/F(Z)] + V$

where $E(V) = 0$ and the estimates in (3) are consistent. To see if selectivity bias is present in the model, test the null hypothesis that $s_{1u} = 0$. The approach taken in estimating (3) is to first estimate the parameters in Z by probit method and using predicted Z, estimate the f and F or the Mill's ratio so that equation (3) can then be estimated.

For the situation at hand, it is assumed that permanent annual income is within the range of 1000 to 120700 pesos a year. Thus a probit was estimated with the choices being within the band and outside the band. The results are shown in Table B1. Approximately 15% of the observations were outside the band. The exogenous variables in the probit were typical human capital variables, such as work experience, work experience squared, education. Also included were household and occupational characteristics including household size, head of household's occupation being farmer and professional. Finally there are place of residence variables including distance to the nearest road and residence in city. Since most of the households outside the band are at the low end and outside the band is given a value of zero, it is assumed that indicators of high human capital yield positive coefficients and the human capital coefficients behave as expected with schooling and work experience positive and significant. Work experience squared is negative and significant indicating decreasing returns to increased experience as expected. Household size is positive and significant. Professional occupation is positive and significant while farmer's income is positive and significant. This last finding was unexpected as farmers were expected to be the primary recipients of the negative transitory income. Finally residence in city and distance from the nearest road were positive but insignificant.

The Mill's ratio was estimated,distance to the nearest road was used as the instrument and the second stage of the selectivity model was estimated using all of the remaining variables from the probit. The Mill's Ratio term was found to be significant indicating that if all observations had been included and we had estimated the equation as if there was no selection, there would have been inconsistent results. The other variables behaved in a similar manner as in the probit estimation. Predicted permanent income measures were then derived with less than one percent having predicted permanent income below zero.

To compare results, alternative estimates of permanent income were made using the same explanatory variables. First a simple ordinary least squares was estimated with all the observations and this is shown in Table B2. Finally an ordinary least squares estimation was made using only observations from within the 1000 to 120700 peso band and predictions were made for all households using the estimated parameters. These results are shown in Table B3.

Since it is assumed that asset values provide a good proxy for income, correlations were estimated between these three predicted permanent income measures and the original measured income, and three measures of asset valuation; value of house, value of furniture and value of appliances. These results are shown in Table B4 along with the means and standard deviations for the four measures of income. It should be noted that with the exception of furniture values, the predicted permanent income measures were more highly correlated with asset values in every case. Also there is very little difference in correlation amounts between the three predicted incomes. On the pessimistic side, no measure of correlation is very strong which indicates problems with all measures.

Table B1
Ordinary Least Squares Regression of Income on Socioeconomic Characteristics to Create Measure of Permanent Income (1896 Observations-1978 data)

Variable	Estimate
Intercept	10485.1 (2.23)
Head of Household's Years of Work Experience	122.261 (0.53)
Head of Household's Years of Work Experience Squared	-0.082 (0.03)
Head of Household's Years of Schooling	957.360 (4.05)
Household Size	1161.365 (3.50)
Head of Household's Occupation=Farmer	10729.9 (6.20)
Head of Household's Occupation=Professional	-4406.86 (0.83)
Residence in City	-3487.01 (1.45)
Adjusted R^2	0.04

Note: T-statistics are in parentheses.

Table B2
Two Stage Selectivity Model of Income Determination with Selection Being Made between Positive and Negative Income to Create Measure of Permanent Income
First Stage Probit
Dependent Variable=1 if Measured Income Greater Than 1000 Pesos or Less Than 120700 &
=0 Otherwise
(1877 Observations-1978 data)

Variable	Estimate
Intercept	-1.105 (2.39)
Head of Household's Years of Work Experience	0.020 (2.39)
Head of Household's Years of Work Experience Squared	-0.00018 (1.72)
Head of Household's Years of Schooling	0.042 (5.00)
Household Size	0.049 (3.99)
Head of Household's Occupation=Farmer	0.777 (11.44)
Head of Household's Occupation=Professional	0.165 (1.67)
Residence in City	0.0060 (0.07)
Distance to Nearest Road	0.000015 (1.40)
Adjusted R^2	0.08

Note: T-statistics are in parentheses.

Second Stage Selection
Regression of Measured Income on Socioeconomic Variables and Mill's Ratio to Obtain Permanent Income Measure

Variable	Estimate
Intercept	-108898 (1.81)
Head of Household's Years of Work Experience	830.102 (1.42)
Head of Household's Years of Work Experience Squared	-6.579 (1.09)
Head of Household's Years of Schooling	2610.54 (2.49)
Household Size	2742.31 (2.21)
Head of Household's Occupation=Farmer	44196.8 (2.36)
Head of Household's Occupation=Professional	9010.61 (1.64)
Residence in City	-3042.29 (0.89)
Lambda	75748.1 (1.79)
Adjusted R^2	0.10

Note: T-statistics are in parentheses.

Table B3
Ordinary Least Squares Regression of Income on Socioeconomic Characteristics to Create Measure of Permanent Income
Excludes Income Observations Less than 1000 Pesos and Greater than 120700 Pesos
(1896 Observations-1978 data)

Variable	Estimate
Intercept	-2305.31 (0.67)
Head of Household's Years of Work Experience	-20.313 (0.12)
Head of Household's Years of Work Experience Squared	1.381 (0.68)
Head of Household's Years of Schooling	858.423 (5.44)
Household Size	702.637 (3.18)
Head of Household's Occupation=Farmer	10786.125 (8.88)
Head of Household's Occupation=Professional	845.913 (0.22)
Residence in City	-3115.93 (1.84)
Adjusted R^2	0.09

Note: T-statistics are in parentheses.

Table B4

Correlation Between Income and Asset Measures

Asset Measures

Income Measures	House Value	Furniture Value	Appliance Value
Measured Income	0.0799	0.12278	0.05657
Selection Model Income	0.10677	0.08155	0.06994
OLS Predicted Income	0.11072	0.08463	0.08407
OLS Predicted Income w/ Selection Model Restriction	0.11056	0.08696	0.08760

Descriptive Statistics for Income Measures

Income Measure	Mean	Standard Deviation
Measured Income	11465.16	36482.14
Selection Model Income	13474.17	6525.83
OLS Predicted Income	11465.16	7082.73
OLS Predicted Income w/ Selection Model Restriction	13213.76	6510.84

Appendix B

Derivation of WTP for Two-Step Approach

As mentioned in the text, two variables in the two-step hedonic approach are discrete and their parameters can not be derived from the utility maximization problem. Hence the utility parameters derived in the model neglect the possibility of substitution between piped water or deep well water and non-housing consumption. As was indicated earlier, 5% of the households have piped water and 30% of the households have a deep well for their water.

Quigley (1982) presented one approach for deriving the parameters of discrete variables. Given the assumption that households are well informed and the market is therefore in equilibrium, households with similar socioeconomic characteristics will have identical levels of satisfaction. If the model is assumed correct and without any unobserved characteristics, differences in the value of the utility index computed from equation (8) must reflect variations in preferences for piped water and deep wells.

Thus by partitioning out households considered identical based on the levels of several socioeconomic characteristics(education, household size and whether or not the head of household is a farmer), an index can be computed for three distinct groups as follows;

U_{00}=those households without piped or deep well water.

U_{10}=households with piped water.

U_{01}=households with deep well water.

For each group, the following relationships are true;

A1) $U_{00}=U_{10}-a_6$

$U_{00}=U_{01}-a_7$

The solution to one of the above two equations will provide the values for the two parameters for deep well and piped water.

In the first part of Table A7, the 1040 without piped water or deep well water have been included and the utility index calculated from the computed GCES function, U_{00}, is regressed against the head of household's years of schooling, household size and a dummy variable for whether or not the head of household is a farmer. The results of the regression explain 82% of the variation in the utility index.

Next the coefficients of the upper half of Table C1 provide utility indexes for households in the survey, excluding households that might have piped water or deep well water. Based on the assumption of identical utility level for households of similar socioeconomic status, any difference in utility between those included in the first regression and those households with piped water or deep well water is explained by the utility the latter households derive from the improved water source. If U00 is the calculated utility from the top half of C1 and U is the utility for those households with piped water or deep well, the following relationship must hold;

A2) $U=U_{00}+a_6+a_7$ or

$U_{00}-U=-a_6-a_7$

which results in the estimation of the second half of A7 which involves estimation using all 1591 households in the survey.

The coefficients for piped water and deep well, -33.044 and -8.469 are estimates of $-a_6$ and $-a_7$ respectively.

The same approach was used with the Naga City estimates and results are shown in Table C2.

Table C1
Regression of Computed Utility From GCES Function
for Households without
Piped Water or Deep Well Water
(1040 Observations-1978 data)

Variable	Estimate
Intercept	128.097 (10.95)
Head of Household's Years of Schooling	27.283 (25.68)
Household Size	25.852 (17.56)
Farmer	473.207 (60.93)
Adjusted R^2	0.82

Note: T-statistics are in parentheses.

Regression of Difference between
Utility Level Computed above and
Utility Level Computed from the GCES Function
on the Piped Water and Deep Well Water Dummy Variables
(1591 Observations-1978 Data)

Variable	Estimate
Intercept	-0.076 (0.02)
Deep Well Water	-8.469 (0.58)
Piped Water	-33.044 (4.69)
Adjusted R^2	0.01

Note: T-statistic is in parentheses.

Table C2

Naga City Regression of Computed Utility From GCES Function
for Households with
Piped Water or Deep Well Water
(32 Observations-1978 data)

Variable	Estimate
Intercept	16.005 (10.75)
Head of Household's Years of Schooling	0.749 (8.11)
Household Size	0.503 (3.31)
Farmer	13.434 (7.19)
Adjusted R^2	0.78

Note: T-statistics are in parentheses.

Naga City Regression of Difference between
Utility Level Computed above and
Utility Level Computed from the GCES Function
on the Piped Water and Deep Well Water Dummy Variables
(59 Observations-1978 Data)

Variable	Estimate
Intercept	-1.217 (2.49)
Deep Well Water	0.204 (0.21)
Piped Water	1.596 (2.24)
Adjusted R^2	0.05

Note: T-statistic is in parentheses.

19

HOUSEHOLDS' WILLINGNESS TO PAY

FOR WATER IN RURAL AREAS OF THE PUNJAB, PAKISTAN

I. INTRODUCTION

Background

1.1 The World Bank has been placing increasing emphasis on the rural areas in its lending in the water sector. Considering all World Bank expenditures on water supply, the proportion of funds allocated to rural projects has increased from an average of 8% between 1974 and 1980 to an average of 14% from 1981 to 1985. However, a Bank review of performance in this sector concluded that overall performance was disappointing. The review suggested that technology per se did not appear to be a major problem. It was concluded that the design of rural water supply projects had been overly supply oriented and that crucial demand aspects had been neglected. In particular, it recommended an emphasis on understanding (i) what people want and (ii) what they are willing to pay for.[1/]

1.2 In light of the above conclusions a research study was approved to find ways to improve the financial and economic performance of water sector projects by developing improved information on the willingness to pay for upgraded services in rural areas. This research project, titled "Willingness to Pay for Water in Rural Areas," involved field studies in six countries: Brazil, Nigeria, Tanzania, Zimbabwe, India, and Pakistan. This document reports on the results obtained from the field study carried out in Pakistan.

Objectives of the Study

1.3 The objectives of the study were to determine the following:

a. the willingness of households to pay for improved service levels;

b. the determinants of the willingness to pay for improved service levels;

c. the preferences of households regarding the management of water delivery systems; and

d. the appropriateness of the existing government policy on the provision of water in rural areas.

1.4 An additional objective was to test and validate a rapid appraisal method (the contingent valuation method to be described later) as a potential tool for planners in designing rural water supply systems. It was hoped that the

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1/ World Bank: Water for Rural Communities - Helping People to Help Themselves, Policy and Research Division, Water and Urban Development Department, 25 pages, May 1987.

use of this method and the information derived from it would help the water authorities improve their decision-making on appropriate levels of service, cost-recovery policies, and water pricing in rural areas.

Overview of Rural Water Supply Policy in Pakistan[2/]

1.5 Coverage, Targets, and Allocations. At the start of the Sixth Five Year Plan (1983) 22% of the rural population of Pakistan was considered to have access to water of acceptable quality. Identifying rural water supply as a neglected sector, the plan announced a doubling of rural coverage to 44% by the end of 1988. By the mid-point of the Sixth Plan, however, progress was well below target, with only 28% deemed to be covered.

1.6 Under the 5-Point Programme announced on December 31, 1985 rural water supply was again identified as a priority sector, and a target was set of increasing coverage from 28% to 66% by 1989. While the administration associated with the 5-Point Programme is no longer in office, recent policy pronouncements have indicated an even greater commitment to rural water supply. The tentative target being set for the end of the Seventh Plan in 1993 is 75%.

Institutional Responsibilities

1.7 Virtually all resources for the rural water supply sector flow from the federal to the provincial governments. Accordingly it is the federal government which is the critical policy-making level of government, with the provincial agencies having responsibility for implementing the policies set at the federal level.

1.8 At the federal level the Ministry for Planning and Development (Planning and Development Division, Physical Planning and Housing Section) is the key policy-making body with major responsibility for incorporating rural water supply into overall development plans.

1.9 The Ministry of Housing and Works (Environment and Urban Affairs Division) has the major responsibility for the technical aspects of rural water supply. The technical agencies at the provincial level must report to this ministry.

1.10 At the provincial level the Public Health Engineering Department (PHED) is the technical agency which has responsibility for the construction and initial operation of most rural piped water supply systems. The local authorities (District and Union Councils), under the Department of Local Government and Rural Development, are supposed to be responsible for the operation and maintenance of public water supply systems. In fact, because neither of these bodies discharges this responsibility, in most instances, it is assumed by the PHED.

2/ The information reported below is drawn from J. Briscoe, Pakistan: Sector Work and Willingness to Pay for Water Study, memorandum, World Bank, Water and Urban Development Department, April 26, 1987.

1.11 The major consequence of the dominance of the rural water supply sector by the PHED is the over-emphasis of the engineering aspects and the relative neglect of the social and economic aspects of sectoral issues.

Levels of Service and System Costs

1.12 Decisions on the level of service to be provided by government rural water supply programs are made entirely on technical/administrative grounds. In Punjab, for instance, the current policy regarding service levels is as follows:

a. sweet water areas: public supplies are no longer built;

b. brackish areas with canal irrigation and arid areas:

1. for villages with population below 5000 - standpipes,

2. for villages with population above 5000 - house connections.

The efficency of these policies from a strictly economic perspective has yet to be established.

1.13 With rare exceptions, the government bears 100% of the capital costs of public water supply projects. In Punjab and Sind typical capital costs for piped systems providing house connections are as follows:

a. Areas with sweet water - supplied by tubewell - Rs.450 per capita in Punjab and Rs.620 in Sind.

b. Irrigated areas with brackish water - supplied with filtered canal water - Rs.600[3/] per capita in Punjab and in Sind Rs.900 (where perennial canal water is available) to Rs.1300 (where canal supply is non-perennial).

c. Arid areas - Rs.1200-1800 per capita in Punjab.

1.14 Based on experience in Punjab, standpipe systems generally cost the PHED only 10% to 20% less per capita. In parts of Sind, where settlements are more scattered, the unit cost differences between house connections and standpipes are greater. The costs to the household for a domestic connection are typically Rs.80 to the PHED as fee and about Rs.500 for the materials and labor to effect the connection from the distribution line.

1.15 The cost to the PHED of operating and maintaining piped water systems (based on an average household size of 6.5) is estimated to be between Rs.20 to

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3/ These cost figures of Rs.450 and Rs.600 for Punjab are reported by Briscoe (1987). The figures reported to us were Rs.300 and Rs.500, respectively. These are also the figures used by the PHED in preparing cost estimates. (U.S.$1 = Rs.20 approximately during 1987-1989.)

Rs.30 per household per month in Punjab and about Rs.35 per household per month in Sind.[4/]

1.16 In principle, after a two-year "demonstration period," District or Union Councils should take over the running of piped systems. In fact this does not happen, and the PHED continues to bear the responsibility and the expenses.

Tariffs

1.17 For systems with public taps users are supposed to pay Rs.5 per family per month. However, partially because the users are dissatisfied with such systems (they demand house connections) and partially because of the difficulties inherent in collecting for standpipe systems, essentially no attempt is made to collect the user fee.

1.18 For systems providing house connections, the monthly tariff is between Rs.10 and Rs.25 per connection. This is a flat tariff, since household water supplies in Pakistan are not metered. Collection is uneven; in some areas most who are connected pay, in other areas compliance is less. In Punjab the PHED has no data on overall compliance but believes that about 60% of those connected pay. Those who do not pay are threatened with disconnection, but in fact the threat is rarely carried out.

Future Plans

1.19 Cost recovery is beginning to emerge as an important issue in the financing of rural water supply projects. An institutional development in this regard is the proposal for the establishment of village development committees. This is seen by planners as a necessary step in the assumption of local responsibility for the efficient operation and maintenance of village water supplies.

4/ Again, the figures for Punjab, reported by Briscoe, seem to be on the high side. The PHED uses a figure of between 3% and 5% of capital costs as the annual operation and maintenance (O&M) estimate. These generally work out to be lower than the figures mentioned above.

II. STUDY DESIGN, METHODOLOGY, AND SITE SELECTION

Study Design

2.1 To achieve the objectives of the study, the proposed research design envisaged fieldwork in three different regions chosen to cover a range of economic and environmental conditions. In each region two types of sites (Type "A" and Type "B") were to be chosen. Type A sites were to be located in an area where a functioning improved water supply system was being used by between 30% and 70% of the population, while Type B sites were similar ones nearby at which an improved water supply system was not yet available. It was hoped to conduct 200 household interviews at each site yielding an overall sample size of 1200 households.[5/]

Methodology

2.2 Since Type A sites would include both types of households (connected and voluntarily unconnected to an available improved water source) it would be possible to use an indirect approach (one based on observation of actual choices) to understand household behavior. Thus, it would be possible to assess the effects of different characteristics of improved and alternative sources (price, distance to source, quality, level of service, reliability, time since installation, etc.) and users (economic, social and demographic factors) on the likelihood of a household's using an improved source.

2.3 In Type B sites, since no observations on actual choice would be available, a direct approach (the willingness to pay [WTP] or contingent valuation method) would be used to elicit household preference for improved service.

2.4 WTP studies are simply household surveys in which a member of the household is asked a series of structured questions that are designed to determine the maximum amount of money the household is willing to pay for a good or service. When WTP studies are conducted to assist with water sector policy or planning, the specified good or service could be a house connection to a piped distribution system, access to a handpump or standpost, or provision of household sanitation facilities. WTP studies are also termed "contingent valuation" studies because the respondent is asked about what he or she would do in a hypothetical (or contingent) situation.[6/]

2.5 Comparisons between the results obtained from Type A and B sites (e.g., connection frequency at given tariff rates) should help to validate the

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5/ World Bank, Willingness to Pay for Water in Rural Areas, Research Proposal, Water and Urban Development Department, March 1987.

6/ For details of the methodology, see Ronald G. Cummings, David S. Brookshire, and William D. Schulze (editors), Valuing Environmental Goods: An Assessment of the Contingent Valuation Method (Totowa, New Jersey: Rowman and Allanheld, 1986).

reliability of the WTP method as a tool for rapid appraisal of planning choices and alternatives.

Site Selection

2.6 The overall research framework proposed for the multi-country study was tailored to the needs of the specific conditions obtaining in Pakistan. Deliberations by the Pakistan team followed by consultations with the counterpart staff at the World Bank led to the following decisions:

a. Restriction of the study area to Punjab. It was felt that since the WTP surveys involved techniques that were unfamiliar to the enumerators and that involved excessive interviewing, it would be advisable for team leaders and interview supervisors to be familiar with the language of the respondents. This effectively restricted the sample area to Punjab. In terms of population, Punjab is the largest province in Pakistan with 57% of the rural population.

b. Within Punjab, three environmental zones were identified based on groundwater characteristics: the sweet water zone where good quality water is easily accessible; the brackish water zone where water is easily accessible but of poor quality; and the arid water zone where water is not easily accessible though of good quality.

c. Restriction of improved source to piped distribution systems with household connections. The research design deemed it important that households be paying a money price for the improved water supply. This limited the choice to piped distribution systems with household connections since tariff collection for handpumps or public standposts was virtually non-existent.

d. Selection of large villages. Partly as a result of the restriction mentioned in (iii) (in Punjab household connections are supposed to be provided only to villages with populations exceeding 5000) the sample villages had to be large in size. It was also felt that from a planning perspective the many large villages close to major cities would present challenging and immediate policy problems as they would evolve into peri-urban towns within the next five to ten years. Analysis of such locations would be particularly useful for the planning authorities. However, where possible, as in the arid zone, smaller villages were included in the sample.

e. Disaggregation of Type B villages. It was decided to include two types of Type B villages - B1 where an improved supply was scheduled to be installed in the near future, and B2 where no such supply was scheduled. This was considered to be helpful in testing whether any strategic bias was incorporated in the WTP bids. Such a bias would occur if households in B1 villages, already assured of a water supply, systematically under-reported their bids in order to convey the impression that they would not connect if the tariff were raised. Households in B2 villages, with no prospects of access to a piped supply in the foreseeable future, on the other hand, might systematically over-state their bids in the hope of influencing policy-makers to include their village in those marked for the installation of piped water supplies.

2.7 Based on the above considerations villages were selected and surveyed in the following areas:

a. Sweet water zone - Sheikhupura District;
b. Brackish water zone - Faisalabad District;
c. Arid zone - Rawalpindi District.

2.8 The locations are depicted in Figures 2.1, 2.2, 2.3, and 2.4. According to information obtained from the PHED (1986), approximately half the rural population of Punjab resides in the sweet water zone and a quarter each in the brackish and arid zones.

General Description of the Study Areas

2.9 Punjab. Punjab, the largest province in Pakistan, contains 57% of the total rural population and 56% of the total number of rural localities in the country according to the 1981 census. The size distribution of rural localities in Punjab is virtually identical to that characterizing the country as a whole (see Table J-1). In 1981, about 3% of the villages exceeded a population size of 5000, 22% exceeded a size of 2000, and 46% exceeded a size of 1000.[7/] However, in terms of the proportion of total rural population, 17% resided in villages exceeding a size of 5000, 57% resided in villages exceeding a size of 2000, and 83% resided in villages exceeding a size of 1000 inhabitants.

2.10 The level of economic affluence in rural Punjab is also very similar to that of rural Pakistan. In 1984-1985 the monthly rural household income per capita[8/] was Rs.243 in Punjab and Rs.234 in Pakistan as a whole.

2.11 In Punjab Province, 21% of rural localities (15% of rural households) had access to electricity in 1981. By 1986-1987 the percentage of rural localities with access to electricity had increased to 49%.[9/] This is important since connection to the electric grid facilitates the economic provision of piped water.

7/ At the 3% population growth rate per annum used by the PHED, the proportion of larger villages would have increased considerably since 1981.

8/ The monthly rural household income is obtained from the Household Income and Expenditure Survey, 1984-1985. The average rural household size is obtained from the Population Census, 1981.

9/ Punjab Development Statistics, Bureau of Statistics, Government of the Punjab, Lahore, 1988.

FIGURE 2.1

FIGURE 2.2

FIGURE 2.3

FIGURE 2.4

2.12 According to the 1980 Housing Census, 45% of rural households had access to water inside their homes. Of these, 3% relied on piped water, 37% on handpumps and 5% on wells. The remaining 55% households obtained water from outside their homes. Of these, 3% relied on piped sources, 15% on handpumps, 16% on wells, 4% on ponds, and 17% on springs, rivers, streams, etc. (see Table J-2). Thus, by 1980, 6% of rural households had access to piped water; 3% to domestic connections and 3% to public taps. Access to piped water is stated to have doubled by 1986.

Sheikhupura, Faisalabad, and Rawalpindi Districts

2.13 Within Punjab, Sheikhupura District (sweet water area) and Faisalabad District (brackish water area) lie in the central canal-irrigated plain while Rawalpindi District (arid area) lies in the northern rain-irrigated region.

2.14 The size distribution of rural localities is shown in Table J-1. It can be seen that the proportion of larger-sized villages is much higher in Sheikhupura and Faisalabad Districts than in Rawalpindi District. Thus 26% of the rural localities of Sheikhupura District and 60% of Faisalabad District exceed a population size of 2000 inhabitants. The comparative figure for Rawalpindi District is 11%. This is most probably due to the fact that the available water resources in the arid zone cannot support large sized habitations.

2.15 Data for Sheikhupura, Faisalabad and Rawalpindi Sub-districts is also provided in Table J-1, since the sample villages are located mostly within the sub-districts. The data shows that the first two sub-districts have a higher proportion of larger sized villages than the districts as a whole.

2.16 It was mentioned earlier that the monthly rural household incomes per capita for Pakistan and Punjab in 1984-1985 were Rs.234 and Rs.243, respectively. The comparative incomes for Sheikhupura, Faisalabad, and Rawalpindi Districts are Rs.307, Rs.247 and Rs.217, respectively. The range in Punjab is from Rs.175 to Rs.320. Thus Sheikhupura is among the more affluent districts, Faisalabad represents the average level of affluence, and Rawalpindi is among the less affluent districts in Punjab.

2.17 The occupational structure in the three districts is shown in Table J-3. Sheikhupura and Faisalabad Districts have very similar profiles while Rawalpindi District has a much lower proportion of the working population engaged in industry and a higher proportion engaged in services. The proportion of the working population engaged in agriculture is virtually the same in all three districts and accounts for just over half of the total working population.

2.18 The comparative situation with respect to access to water is shown in Table J-2. The main point to be noted is that in Sheikhupura and Faisalabad Districts the primary source of water is handpumps inside the house: 72% and 64% of total households, respectively, rely on such sources. The second main source is handpumps outside the house. In Rawalpindi District, on the other hand, 62% of households rely on wells outside the house and another 25% on springs, rivers, and streams. It should be obvious that the modeling of water source choices would be much more complex in the arid zone especially because many sources dry up during the summer months and are not accessible.

2.19 The other point to be noted is that the zones with accessible ground water have a lower proportion of households supplied with piped water than the average for the province as a whole. This suggests a supply policy based on need and not necessarily on demand.

III. ANALYTICAL OVERVIEW

Principal Lines of Inquiry

3.1 The analysis shall be directed towards the investigation of the following broad issues in each environmental zone:

a. actual choice behavior;
b. hypothetical choice behavior; and
c. the economic viability of investments in rural water supplies.

The details of the issues to be investigated and the techniques to be used for that purpose are discussed in the following sections.

Actual Choice Behavior

3.2 In each environmental zone households have a number of choices in deciding upon the type of water source to use. The study would identify the set of choices and infer from the observations the effects of different variables on the likelihood of a household's making a particular choice.

Hypothetical Choice Behavior

3.3 In many villages a particular service option, e.g., house connections to a piped system, may not exist. Such an option is not part of the choice set of households. The valuation of such a choice is obtained by offering the households a well-described hypothetical choice in a bidding game format. The responses, in terms of willingness-to-pay bids, are then used to estimate the value placed on the particular option offered.

3.4 The description of the hypothetical choice includes presentation of all the relevant characteristics of a specific piped service option. These include hours of supply, quality of water, expected pressure and reliability, and the cost structure. In Punjab, the cost structure for piped service includes a one-time cost (an official connection fee payable to the PHED plus the cost of connecting the house to the distribution line, which is borne by the household) and a flat monthly tariff. In this study, the amount of the one-time costs are included as part of the description (in villages where the distribution lines have not yet been laid, the households are given an average cost figure based on the costs in villages with piped water systems). The households are then asked whether they would connect to the system described at a given monthly tariff. Depending upon the response, the tariff is raised or lowered and the household is asked to respond again. This pattern is followed consistently in the study: the one-time costs are always indicated to the household and the bidding is on the level of the monthly tariff.

3.5 The willingness-to-pay bids are used for three different purposes:

a. To determine the proportion of households which would accept a particular service option at any given tariff, thereby allowing a calculation of the possible revenue yield.

b. To study the determinants of the willingness-to-pay bids and thereby to identify possible trends as social and economic conditions change in the future.

c. To compare, where possible, the pattern indicated by the hypothetical choices (e.g., connection ratio at a given tariff level) with the pattern reflecting actual choice behavior. Such a comparison would serve as one test of the validity of the contingent valuation methodology.

Economic Viability of Investment in Rural Water Supplies

3.6 The willingness-to-pay bids for any particular option would yield an estimate of the number of households that would choose the option at a given price. In the case of water sources these responses would be interpreted in terms of the choice to connect given a particular connection cost and tariff level.

3.7 The above information on the percentage of households connecting to a service level at varying tariff rates is sufficient to estimate the monthly revenues that could be generated if that service were actually offered. This estimate could then be compared with actual data on maintenance and capital costs to determine the degree to which cost recovery is possible in any specific situation.

Description of Variables Used in the Analysis

3.8 In explaining household behavior, either in terms of actual choices or willingness to pay for hypothetical choices, responses would need to be related to a set of independent variables representing both source and household characteristics. The following is a complete listing, description, and rationale of the independent variables used in the multivariate analyses. (Not all variables may be present in any specific analysis.)

3.9 We identify a set of broad factors that are relevant to an analysis of water-related behavior. To capture particular aspects of these factors, a number of variables are specified within each one. The factors, variables, and their indicators are given below.

Factor	Variable	Specification
Need for Water	- Household Size	Number of household members.
	- Consumption of Water	Liters per capita per day.
	- Ownership of Animals	Number of cattle owned and kept inside or just outside the house.
Available Labor Supply	- Adult Women	Percent in household.

	- Children Child = household member less than or equal to 15 years of age.	Percent in household.
Ability to Pay	- Household Expenditure	Rupees per capita per month.
	- Construction Value of House	Rupees.
	- Ownership of Land or Property	Dummy Variable : 1 if household owns land or other property, 0 otherwise.
Existing Arrangements for Water	- Private Source	Dummy Variable : 1 if household has a private source, 0 otherwise.
	- Vendors	Dummy Variable : 1 if household uses vendors, 0 otherwise.
	- Time	Minutes of household time (one-way) spent per week in obtaining water from outside the house.
Quality of Water Currently Used	- Safety	Dummy Variable : 1 if respondent considers water safe for health, 0 otherwise.
Personal Characteristics of Household Members	- Age	Age of head of household.
	- Education	Number of years of education of most educated member of household.
	- Occupation	Dummy Variable : 1 if occupation of head of household related to farming, 0 otherwise.
	- Sex	Dummy Variable : 1 if male respondent, 0 otherwise.
Attitudes of Respondent	- External Exposure	Dummy Variable : 1 if any male member has had exposure to life outside village for a period exceeding 6 months, 0 otherwise.
	- Awareness of Piped Systems	Dummy Variable : 1 if respondent has visited a

		village with a piped water system, 0 otherwise.
	- Metering of Water Supplies	Dummy Variable : 1 if respondent feels domestic house connection ought to be metered, 0 otherwise.
	- Responsibility for Provision of Water	Dummy Variable : 1 if respondent believes water ought to be provided free by the State, 0 otherwise.
	- Satisfaction with Experience of Water System	Dummy Variable : 1 if respondent in village with a piped system is satisfied with its management, 0 otherwise.
Other Factors	- Distance of House from Distribution Line	Yards.
	- Distance of Village from Provincial Headquarters	Kilometers.
	- Proximity of Village to Perennial Source of Water	Dummy Variable : 1 if village close to perennial source of water, 0 otherwise.
Control Variables	- Village Dummies	Identification of specific villages.
	- Household Type Dummies	Identification of household types A1, A2, B1, or B2.
	- Bidding Game Starting Point Dummy	Identifies whether the game was started with a low or a high value.

Explanation and Rationale of Independent Variables

3.10 Need for Water. The preference for an improved source ought to be directly related to the need for water. The most obvious determinant of need is household size. The water needs of animals, especially cattle, are also significant. In the hot summers of the Punjab, cattle have to be kept cool by being allowed to wallow in pools of water or by being hosed down. Because this entails considerable expenditure of household time, the convenience of having running water available within the house ought to be an attractive proposition. (Information on the ownership of animals was not obtained in the sweet water zone.)

3.11 The total household need for water is also related to the level of consumption of water per capita per day. In households where the primary source of water supply is either handpumps inside the house or taps, it is very difficult to estimate the total quantity of water consumed. The task is somewhat more manageable in villages (as in the arid zone) where most of the water is either fetched from outside the house or delivered by vendors. We have experimented with estimating the minimum amount of water a household would normally need for its essential purposes. This estimate is determined by posing the respondent with a hypothetical situation in which the household's primary source was out of order or under repair (a situation with which all households were familiar). The respondent was asked to indicate the vessel in which water would be fetched from outside the house in such a situation and to give the number of vessels that would be required to meet the essential needs of the house (it is reasonable to assume that households would curtail non-essential usage in such situations). The capacity of the vessel was estimated by asking the respondents how much milk it could hold, a judgment which rural respondents made with great ease. In the arid zone, where households are familiar with the vending of water, respondents were simply asked to state how much water they would acquire from a vendor for meeting essential household needs on a representative day.

3.12 It is obvious that the variation in essential consumption would be much less than the variation in total consumption. However, under the circumstances this was the only quantitative measure of water consumption that it was possible to estimate with any degree of accuracy.

3.13 In households with access to improved water sources it is possible that the consumption of water per capita per day, even for essential usage, might be higher than that of comparable households without improved sources. Such endogeneity would render difficult the interpretation of the variable.

3.14 Available Labor Supply. Wherever water is primarily fetched from outside the house, as in the arid zone, the available labor supply (which, in the context of fetching water in the Punjab, is predominantly women and children) assumes critical significance. Households with scarce labor ought to be more desirous of improved water sources.

3.15 The choice of the proportion of women and children as independent variables means that the excluded category is the proportion of men. If an increase in the proportion of women at the expense of men makes only a marginal difference to the need for water, the preference for an improved source would be lessened because of the increase in the available labor supply. However, if a woman needs more water than a man (inability to bathe at natural sources could be one reason), the overall impact could be ambiguous. An increase in children at the expense of men, on the other hand, could be expected to both decrease the need for water and increase the available labor supply. Therefore, an increase in the proportion of children should have an unambiguous negative impact on the preference for expensive improved sources of water.

3.16 Ability to Pay. A greater ability to pay could normally be expected to be directly related to a greater preference for an improved source of water. However, if more affluent households have already made significant investments in expensive private water supply arrangements (e.g., installation of an electric motor on a handpump), the impact could be rendered ambiguous.

3.17 The estimation of rural household income is generally very difficult because of seasonal variations and non-cash components (e.g., own production). The effort required for accurate estimation is not feasible in surveys where the primary objective is not the estimation of income, as, for example, in willingness-to-pay studies. We have used monthly cash household expenditure per capita as a proxy for household income per capita. This variable is subject to limitations since it is unable to correct for the possible lower cash expenditures of farming households. (Information on this variable was not obtained in the sweet water zone.)

3.18 The estimation of household wealth is also a difficult proposition. We have used two proxy variables. The ownership of land or other property is fairly straightforward. The construction value of the house in which the family resides could be more controversial. It has been frequently documented that the highest priority in the use of discretionary funds is given to housing. This is especially true for rural households in Pakistan where housing is a very visible indicator of social status and achievement. The pattern of utilization of remittances from the Middle East by rural recipients has established this beyond doubt. Thus, housing quality could be a reasonable indicator of household wealth. We have measured it by asking the amount of money that would be required to construct a house similar to the one occupied by the household if the construction were to be carried out at the time of the survey. The latter condition takes care of the problems inherent in the possible valuation at different points in time.

3.19 One alternative which is frequently used is to enquire about the ownership of household assets (usually durable goods like TVs, motorcycles, etc.) and to construct an index of asset value. We feel that the valuation problems associated with this procedure (when were the goods purchased? at what price? new or used? are they in working order? do they really exist? etc.) result in an estimate whose reliability is not likely to be any better than that of the indicator we used. This is especially true since the residence can be considered to be the primary and most valuable asset of the household, dominating assets like TVs, radios, etc., and is also visible to the enumerator. The benefits of relying on a single indicator are savings in terms of time and less apprehension on the part of respondents who are generally suspicious of enquiries into ownership of assets (TVs, radios, and motorcycles require licenses) and reluctant to admit to social deprivation.

3.20 Existing Arrangements for Water. The impact of the ownership of a private source of water on the preference for a piped supply can be quite complex. If the source involved high recent capital expenditure and is an acceptable substitute for piped water the impact could be negative. However, if it is not considered a substitute (e.g., does not provide the same quality of water, as is the case in the brackish zone) the impact could well be positive, being an indicator of the desire for improved service. At the same time, if the running costs are higher than the tariff for piped water and the capital costs are recoverable (e.g., by the sale of used equipment) the impact could again be positive.

3.21 Households using vendors could be expected to express a clear preference for piped water, since vended water is much more expensive than the flat monthly rates at which piped water is supplied in the Punjab.

3.22 The excluded households, according to the dummy variable, are those which exclusively use their own labor supply to fetch water from outside the house. Such households exist only in the arid zone, since in the other two zones virtually every household has at least a private handpump inside the house. The important implication is that in the arid zone the amount of time spent fetching water is highly correlated with the ownership of a private source of water or the use of water vendors.

3.23 In the sweet and brackish water zones, households can be distinguished from each other by whether or not they own an improved private source of water which consists of an electric motor installed on the handpump. However, since the quality of the ground water in the brackish zone is generally poor most households spend some time in fetching water for drinking and cooking from outside the house. It can be hypothesized that households having to expend more time would express a greater preference for a connection to a piped water supply.

3.24 Quality of Water Being Used. Households that consider the water currently being used to be unsafe for health could be expected to demonstrate a greater preference for a piped water supply. This is not an objective assessment of water quality, rather it depends on a certain degree of health consciousness and a judgment about the quality of the available water source.

3.25 Personal Characteristics. It is generally believed that younger and more educated households would express a greater preference for modern conveniences like piped water supplies.

3.26 Households involved in farming (landlords, tenants, and owner-cum-tenants) are likely to express less interest in piped water supplies for a number of possible reasons: flexible work schedules, the location of work close to water sources, and the ability to combine water-related activities with work (e.g., bathing and watering of animals). The generally presumed conservatism of farming households could be a contributing factor.

3.27 It is generally assumed that women would express a greater preference for piped water sources than men since the former are primarily responsible for the arduous task of fetching water. Responses from both sexes are available in the arid zone to enable this assumption to be tested.

3.28 Attitudes of Respondents. Households which include members who have had exposure to life outside the village might express a lower or higher preference for the service being offered depending upon how it compares with what they have seen elsewhere. Thus, the reaction to public taps or limited service hours could well be negative.

3.29 Respondents who have seen operational piped water systems themselves could be expected to have a positive attitude towards the provision of a similar facility in their own village. The attitude of respondents in villages with piped water could be affected by their level of satisfaction with the management of the system.

3.30 Respondents in favor of the metering of water supplies could be taken to represent those who are comfortable with the notion that a commodity like water should be charged for. They are, therefore, likely to be willing to pay more for piped water than those who consider the provision of water to be an obligation of the state.

3.31 Other Factors. Households have to bear the costs of connecting their houses to the distribution line. It is thus reasonable to expect that households further away from the line would be less likely to connect to a piped system. Probably the cost would be higher and because beyond some critical distance the alternative of installing a private improved source might become economically more attractive.

3.32 Village-level characteristics could be expected to have some impact on the level of preference expressed for piped systems. For example, the distance of a village from the district headquarters could be a proxy for the general level of affluence and awareness in the village.

3.33 Similarly, in the arid zone, the proximity of a village to a perennial source of water could be expected to lower the felt need for improved sources compared to other villages. Such village-level influences are tested for in the arid zone.

3.34 Control Variables. Wherever it is felt that specific village characteristics could be affecting the results, the supposition is verified by using a village identification dummy. Similarly, differences in the responses of various types of households (A1, A2, B1, B2) are tested for by the use of household identification dummies.

3.35 Some bidding games are used to test for the presence of a starting point bias. Such a bias will be manifested if there are systematic differences between the willingness-to-pay bids of respondents who were randomly assigned a high or a low starting point. A starting point dummy is used to test for the presence of such a bias.

Estimation Techniques

3.36 Analysis of Actual Choice Behavior. The analysis of actual choice behavior is based on the estimation of a logit model. The dependent variable is binary, indicating the choice or otherwise of a particular service level. The model is used to assess the impact of different factors on the likelihood of a household's making the particular choice.

3.37 Analysis of Hypothetical Choice Behavior. The analysis of hypothetical choice behavior is based on the estimation of an Ordinary Least Squares regression model. Since a bidding game is used to obtain the willingness-to-pay estimates, the observed dependent variable is not the maximum amount the household would be willing to pay, but rather an interval within which the "true" willingness to pay falls. Linear regression is actually not an appropriate technique for dealing with such an ordinal dependent variable; in this situation the correct approach is to use an ordered probit model.[10/] However, the use of the mid-points of the intervals as a dependent variable in an ordinary least squares model seems to yield results which are consistent with those obtained from an ordered probit model, and the parameters are much easier to interpret.[11/]

3.38 In this study the intervals are quite small (e.g., Rs.10-20, 20-30, 30-40, 40-50, 50-60, 60-70, 70-100 in the arid zone). In addition, zero bids are clearly identified, and bids beyond the end-points of the range (Rs.10 and Rs.100) are elicited and recorded as actual values (the sweet water zone is an exception. See Appendix B-1). The use of actual values beyond the end-points and mid-points within the range should yield close enough approximations to the "true" bids to make ordinary least squares estimation an acceptable first level of analysis.

3.39 Presentation of the Results of the Multivariate Analyses. The results are presented by reporting two models. The first model includes all the relevant variables from the list presented in Section 3.9. In the analysis of hypothetical choice behavior step-wise deletion of variables is used to identify the estimation with the highest adjusted R-squared. This is the second model reported. Such a presentation helps to ascertain the stability of the estimated parameters as insignificant variables are deleted from the model.

3.40 Mean values of all the variables used in individual regressions are reported. Variables which are statistically significant at the 90% and 95% levels are identified by one and two asterisks, respectively.

10/ "Estimating the Willingness to Pay for Water Services in Developing Countries: A Case Study of the Use of Contingent Valuation Surveys in Southern Haiti." By Dale Whittington, John Briscoe, Xinming Mu, and William Barron. Economic Development and Cultural Change, 1990, 38:2, pp. 293-311.

11/ Willingness to Pay for Water in Newala District, Tanzania: Strategies for Cost Recovery. By Dale Whittington, Mark Mujwahuzi, Gerard McMahon, and Kyeongae Choe. WASH Field Report No. 246, 1990.

IV. SWEET WATER ZONE - OVERVIEW AND FIELD PROCEDURES

The Study Area

4.1 Sheikhupura District is located in the central canal-irrigated part of the Punjab. The district capital is Sheikhupura City with a population of 141,168 according to the 1981 census. It is situated 35 kilometers from Lahore, the provincial capital, and 105 kilometers from Faisalabad, the center of the textile industry and the third largest city in Pakistan. Agriculture is mechanized, and industry is located along both the principal axes, the Lahore-Sheikhupura road and the Sheikhupura-Faisalabad road.

4.2 Three fourths of the area in Sheikhupura District lies in the sweet ground water zone, and water can be tapped at an average depth of 25 to 30 feet. The quality of the water is almost universally perceived to be good.

Policy Issues in the Sweet Water Zone

4.3 As has been mentioned earlier, the current policy of the Punjab Public Health Engineering Department is that public piped distribution systems are not to be built in the sweet water areas. This policy is the result not of a demand-based but of a need-based rationale. The PHED has been entrusted with the responsibility of providing acceptable quality water to the largest number of people possible. Given that there are many areas without such access, the scarce resources of the PHED are deployed accordingly. Within such a framework the low priority accorded to the sweet water areas is understandable.

4.4 The above policy has also been supported because the private sector is rightly considered to be more efficient than the public sector. In his recommendations to the World Bank, Briscoe (1987) states that "[I]n those areas where government-funded water supply programs are not undertaken (such as the large areas of the Punjab in which good quality groundwater is available), the private sector has a major role. Individual families contract private drillers for sinking a well, and purchase a handpump on the open market.... While there are probably some improvements which could be made in handpump design, government policy in this area - namely to leave it to families and the private sector to resolve - is appropriate."

4.5 Thus, one of the major objectives in including a sweet water zone was to investigate the extent to which the above policy was justified. The other objectives included those that form the core of the research effort, i.e., to determine the willingness of people to pay for improved services.

Overview of the Water Situation in the Sweet Water Zone

4.6 Historically, wells were the primary source of drinking water in the villages falling in the sweet water zone. Indeed, the center point of a village was identified by a well, and more were located at other convenient points, especially as the village grew in size.

4.7 However, as households became more affluent, wells were replaced by handpumps inside the house. Now virtually every household has installed a private handpump. Almost all the wells, except those in some mosques, have been bricked over. This process of improvement in the level of service took place between 15 and 20 years ago. The excess of the privately borne costs of operation and maintenance of the handpumps over whatever contribution must have been required to keep the wells operational provides a baseline estimate of the value placed on the convenience of having a water source inside the house. This convenience was almost entirely in the form of time and effort saved in fetching water from an outside source. Given the high summer temperatures on the Punjab plains, the value of the convenience is easily understood.

4.8 Our survey revealed that a process of further improvement in the level of service was underway. Perhaps as a result of increased affluence, almost 20% of the households in the villages surveyed had installed small electric motors onto the handpumps. These motors could pump water into an overhead tank from which it could be distributed to various parts of the house through indoor plumbing and also could help to operate a flush toilet. Thus the complete system associated with a piped supply was being replicated privately at the individual level. This was an important finding because it revealed that households were willing to spend on improved service levels. Numerous economic implications resulted from the spread of this process. These shall be discussed later.

Selection of the Study Villages

4.9 Since it is government policy not to install piped supplies in sweet water areas, there are very few villages with public supplies. The choice of Type A villages (villages with operational piped water systems) was thus very restricted. We selected the only two villages that lay within the maximum distance from the district headquarters that we wanted to consider. Public supplies had been installed in these villages as an exception to the general policy, most probably due to the influence of local politics.

4.10 Similarly it was not possible to locate a Type B1 village (village where a public system was due to be installed in the near future). We selected a village in which a piped household supply had been operational, but which, for various reasons, had fallen into disuse over five years ago. Currently an effort was underway to restore the system. The selection of such a village offered the opportunity to see how poor performance in the past had affected the willingness to pay in the future of those households which had been connected to the system.

4.11 The location of Type B2 villages (villages where there was no plan to install a public water supply system) posed no problem, and we selected two convenient villages close to the district headquarters.

4.12 The following are the particulars of the five selected villages:

- Jandiala Sher Khan	:	Type A
Mirza Virkan	:	

- Kharianwala	:	Type B1
- Ghazi Minara Bhaddroo Minara	: :	Type B2

While the populations of the types A and B1 villages exceeded 5000 by necessity, the two B2 villages were selected from the size category 2000 to 4000. The populations of Ghazi Minara and Bhaddroo Minara were 4514 and 2173, respectively, in 1981.

4.13 A more detailed profile of the selected villages is provided in Table A-1.[12/]

Description of the Questionnaire and Bidding Games

4.14 The core questionnaire consisted of five broad modules. The first dealt with the socio-demographic nature of the household. The second dealt with the household's water use practices. The third consisted of bidding games designed to elicit the household's willingness to pay for improved service levels. The fourth obtained information on the household's attitude towards issues connected with the provision of drinking water. The fifth module aimed to obtain information on household assets.

4.15 To capture information specific to different types of households, five questionnaire schedules were used. All the schedules contained the core questionnaire in addition to the supplementary questions required. The key details of the various schedules are as follows:

Type A village	Schedule A1	-	for households connected to an operational water supply system;
	Schedule A2	-	for households voluntarily not connected to an operational water supply system;
Type B1 village	Schedule B11	-	for households previously connected to an operational system. System currently in-operational. Restoration under consideration;
	Schedule B12	-	for households not connected to the above system when it was operational;
Type B2 village	Schedule B2	-	for households in a village without a piped water system and not expecting one to be installed in the near future.

12/ Statistical tables and analyses generated by the survey, grouped by subject, appear in Appendices A, B, and C.

4.16 Some bidding games included a built-in test to determine whether the starting point of the bidding game affected the willingness-to-pay bids. This was achieved by varying the starting point; for selected bidding games half the questionnaires contained high starting points while the other half contained low starting points.

4.17 The following bidding games were included in the questionnaires:

Questionnaire Schedule	Bidding Games No.	Description	Starting Point
A1	1.	WTP for an improved system (4 hours of additional supply).	High, Low
A2	2.	WTP for a standard system with a more attractive financing option (all connection charges to be borne by the water authority).13/	High, Low
	3.	Same as bidding game number 1.	High
B11	4.	WTP for a standard system.	High
B12	5.	Same as bidding game number 4.	High, Low
	6.	Same as bidding game number 2.	High
B2	7.	Same as bidding game number 4.	High
	8.	Same as bidding game number 2.	High

4.18 The bidding games were designed to evaluate three options:

a. The standard PHED system.

b. The standard system with a more attractive financing option (all connection costs being borne by the water authorities).

c. The standard system with an additional 4 hours of water supply.

4.19 For purposes of analysis the WTP bids from the following games could be pooled:

Bidding Game numbers 4,5,7	Standard System	Households (B11+B12+B2)

13/ Existing policy requires the household to bear all the cost of connection from the distribution line into the house.

Bidding Game numbers 2,6,8	Standard System with Financing Option	Households (A2+B12+B2)
Bidding Game numbers 1,3	Improved Standard System	Households (A1 + A2)

4.20 In addition to the above bidding games, every respondent was asked to describe the characteristics of his preferred water supply system. He was then asked via a direct question to indicate the maximum monthly tariff he would be willing to pay for such a system.

Conducting the Survey

4.21 The survey was carried out in the five villages over a one-week period (March 6 - March 13, 1988). A total of 261 interviews were completed in the five study villages, as follows:

Jandiala Sher Khan	: 99 :	Type A : 144
Mirza Virkan	: 45 :	
Kharian Wala	: 58 :	Type B1 : 58
Ghazi Minara	: 28 :	Type B2 : 59
Bhaddroo Minara	: 31 :	

4.22 The number of interviews by schedule type was as follows:

A1	:	79
A2	:	65
B11	:	40
B12	:	18
B2	:	59

Three visits were made to Jandiala Sher Khan, two to Ghazi Minara, and one each to Bhaddroo Minara, Mirza Virkan, and Kharianwala. The interviews were conducted in Punjabi and the questionnaires were administered to an adult male, usually the head of the household. Some basic socio-economic characteristics of sample households and their attitudes towards water- related issues are presented in Tables A-2 and A-3.

V. FINDINGS IN THE SWEET WATER ZONE: ANALYSIS OF ACTUAL CHOICE BEHAVIOR

Water in the Sweet Water Zone

5.1 Water is freely available in the sweet water zone. The quality of water from traditional sources (wells, handpumps) is considered to be satisfactory and as good as water from piped water systems. These two facts are important: water is not a scarce good and there is little quality differential between water obtained from traditional sources and that obtained from improved sources. Therefore, if households are spending money on higher service levels it is either for considerations of convenience, status, or some indirect benefits not related to needs of water for the purposes of human consumption.

Upgrading of Service Levels

5.2 The transition from wells as the primary source of water to handpumps inside the house has long been complete. Households have incurred the capital cost of between Rs.600 and Rs.1,000 in current value for the convenience of not having to go outside the house to fetch water. This is so even though in the sweet water zone public wells were conveniently located and never very far from any household. Indeed, the village center was marked by a well in a majority of villages.

5.3 A second transition is now in progress. Our survey shows that 20% of the households in the study area have installed electric motors onto the handpumps. This capital expenditure of between Rs.1,000 and Rs.2,000 in current prices, depending on the quality of the motor, obviates the need for manual pumping. This is being followed by the installation of overhead tanks (cost: Rs.400 to Rs.500), indoor plumbing (cost: approximately Rs.400 for a 20 foot network, usually enough to operate a bathroom with shower), and flush toilets in some cases.

5.4 It is clear that households are putting in place at considerable expense modern indoor plumbing systems with their own private source of water. The monthly maintenance cost alone according to the survey is Rs.6 for the handpump and Rs.16 for the motor. To this one must add the electricity charges incurred to operate the motor. The total monthly expenses are far in excess of the flat monthly tariff of Rs.10 for a house connection to a public piped water supply system where it is available. However, even in villages where the latter option is available, 11% of the households have installed electric motors. This could signal a demand for more reliable service. (Table A-4 shows the pattern of household choice over available service options along with their approximate costs.)

Who Installs Electric Motors?

5.5 The statistical analysis (for details see Table B-1) shows that the better educated, the propertied, and the more economically affluent households have a significantly higher probability of installing electric motors. These results accord well with the theoretical expectation that better off households would be more willing to invest in improved and/or more reliable levels of service.

5.6 Since handpumps require manual effort for drawing water it could be hypothesized that overcoming this inconvenience might be a consideration in installing an electric motor. However, the statistical analysis shows that neither the variables related to the need for water (household size and per capita consumption) nor those related to available labor supply (proportion of women and children in the household) are significant. This suggests that upgraded service levels (indoor plumbing and flush toilets are possible with motor-operated handpumps but not with manual handpumps) are the main motivation for the installation of electric motors.

5.7 This conclusion is important because village elites have historically exerted a very strong demonstration effect on the rest of the rural population. Their choices can therefore be taken as a pointer to the latent demand for reliable, modern piped water systems in rural areas.

5.8 In this context the analysis highlights another important fact: in the subset of villages where a public piped water scheme exists, households are significantly less likely to install an electric motor. Indeed, in such villages only 11% of the households have electric motors, whereas in villages without piped water systems the corresponding figure is 30%. This indicates that house connections to a piped water system are considered to be, and have the potential of being, an attractive alternative for consumers.

5.9 However, it was also a fact that 7% of households that had domestic connections also had electric motors. This is a strong signal that public piped water systems have to be of comparable reliability to compete effectively with private alternatives.

Who Connects to Piped Water Systems?

5.10 In two of the sample villages, Jandiala Sher Khan and Mirza Virkan, households have had the alternative of connecting to a public piped water supply system with household connections. In the sample 55% of the households had availed themselves of this alternative.

5.11 The statistical analysis (Table B-2) indicates that households that need more water (larger household size and higher daily per capita consumption[14/]) are more likely to connect to a piped system. At the household level there is no real limit to the amount of water that can be drawn up with a handpump. However, the physical effort required increases in proportion. Therefore, one could conclude that for households with a need for substantial amounts of water the convenience of access associated with a piped connection is a factor in opting for that choice.

14/ The data suggest that essential daily per capita consumption of water is not an endogenous variable, i.e., it is not higher for households because they have connected to piped systems. Table A-3 indicates that the value of the variable is actually higher in villages without piped water supplies.

5.12 It is also quite probable that in areas with good quality groundwater households with handpumps have not invested in storage devices. Everyone draws up water for his or her own use and it is not possible for women and children to substitute their labor for that of the adult males in the house. Perhaps this is the reason that households with a higher proportion of women and children are not less likely to connect to piped water systems (note that the respondents were all adult males). On the contrary, households with a higher proportion of children in the household are more likely to connect to a piped system.

5.13 The other important conclusion suggested by the statistical analysis is that wealth is not quite as significant a determinant of the decision to connect to a piped system as it is for the installation of electric motors. This is, perhaps, because the former is a much less expensive choice (the capital and monthly operation and maintenance costs are Rs.500 and Rs.10 as against Rs.3,500 and Rs.22 for an electric motor - see Table A-4) and therefore generally affordable in an area where the monthly household income was of the order of Rs.2,000 in 1984-1985.

5.14 However, cost considerations do enter into the decision to connect. The variable representing distance of the house from the distribution line is negative and significant. The costs of connection that have to be borne by the household are directly related to this distance (approximately Rs.10 per running foot). The increase in cost with distance is likely to act as a deterrent to connection not only because of the expense but also, perhaps, because beyond a certain point the cost becomes comparable to that of an electric motor. The latter is likely to be a preferred alternative in such situations because of its greater reliability. The issue of reliability is important and shall be discussed again later.

5.15 The analysis also shows that households engaged in farming are less likely to connect to piped systems while households with better education are more likely to do so.

5.16 Households which have electric motors are not significantly less likely to connect to the piped supply system.

5.17 The reasons mentioned by the respondents for either connecting or not connecting to the piped water supply system are listed in Tables A-5 and A-6. These were obtained as responses to open-ended questions.

<u>Electric Motor and Household Connection as Alternative Choices</u>

5.18 The fact that households are significantly less likely to have electric motors in villages where a piped water supply is available clearly suggests that the two are considered to be alternative improvements in service level.

5.19 At the existing, subsidized, rates, a domestic connection to a piped supply system is a much cheaper option. Both the average privately borne capital costs and the monthly operation and maintenance costs are less than half for a domestic connection compared to a motor-operated pump. As a result, many more households can afford to upgrade to a higher service level in villages where piped water supplies are available (59% as against 30% in villages without piped supplies - see Table A-4).

5.20 If other considerations related to the use of piped water are deemed important enough to justify the subsidy, it is clear that providing piped supplies in the sweet water zone could extend the benefits to a significantly larger population.

5.21 It is also of interest to note the relationship between the choice of service level and the economic status of the household in villages where a piped supply option is available (Table A-7). Motors are installed by households at the upper end of the economic scale. On the other hand, domestic connections are affordable to households only slightly above the average value of the economic indicator used. The most affluent households have both electric motors and piped connections. Given the poor performance of public water supply systems, this probably reflects the willingness to pay for reliable back-up service by households that can afford the expense.

5.22 If the existing subsidy on the capital costs of piped systems (approximately Rs.300 per capita with a household size between 7 and 10) is removed, the capital costs of the two options become comparable while the operation and maintenance costs of the piped system remain lower. However, in such a situation the much greater reliability of the private option would make it a dominant choice, and connection rates to public piped systems would be likely to fall very steeply.

VI. FINDINGS IN THE SWEET WATER ZONE: ANALYSIS OF WILLINGNESS-TO-PAY BIDS

Hypothetical Choice Behavior

6.1 In the previous chapter the analysis was based on the actual, observable choices made by respondents. In this chapter the analysis is based on the responses proffered to hypothetical options presented to the respondents. These responses yield the maximum monthly tariff that a household is willing to pay for the particular option described.

6.2 To the extent that households understand all the changes that will result from the acquisition of the option presented, the amount they say they will pay, their bid, can serve as a measure of its benefit to them. WTP bids may include valuation of aesthetic, health, and other difficult-to-measure benefits of water. If WTP bids are an accurate measure of individuals' preferences, the summation of the WTP bids for all households served by a project could serve as an estimate of the total benefits of the project. It can be compared with the cost of the project to decide whether the investment is justified.

Service Options Offered

6.3 The following service options were presented to different groups of respondents:

a. A household connection to a standard piped water system of the type existing in type A villages.

b. The same, with a more affordable financing arrangement.

c. A household connection to an improved piped water system.

6.4 It should be borne in mind that in the Punjab the standard system is designed to provide a maximum of 15 gallons of water per capita per day with the service available for eight hours a day at the most. However, actual performance is very uneven (40% of the connected households expressed dissatisfaction with the system) with problems of reliability, insufficient pressure, and service for less than the specified period (See Tables A-8, A-9, A-10). For this reason, all households familiar with existing systems do not perceive the same product when evaluating the 'standard' system, especially because pressure variations occur almost from lane to lane.

6.5 The option with an alternative financing arrangement was offered to determine if the low connection rate (55% of households) to piped water systems was related to the structure of the costs involved. Obtaining a connection requires two types of payments: a one-time payment made up of an official connection fee and the costs of connecting the house to the distribution line, which have to be borne by the household; and a flat monthly tariff. The dominant component is the cost of connecting the house to the distribution line. The connection fee is of the order of Rs.100, the connection costs are of the order of Rs.500, and the monthly tariff is Rs.10.

6.6 It is reasonable to suspect that cash flow problems (i.e., the inability to bear the one-time costs) may be acting as a deterrent to connection for some households. To verify this hypothesis, an option was offered in which the water authorities would bear the connection costs in exchange for a higher monthly tariff. The objective was to test if connection ratios would go up with the availability of such a financing arrangement and the extent to which tariffs could be raised.

6.7 The improved system was offered to households in villages where a system was already operational. The improvement offered was an increase of 4 hours in the daily supply period and the willingness to pay for the improved system was elicited.

Response of Households in Villages without an Operational Water System

6.8 Willingness to Pay for Connection to a Standard System. At present no household in either Type B1 or B2 village has the option of connecting to a standard piped water system. The difference between B1 and B2 villages is that there are no plans to install a system in the latter category. The B1 village had a system in the past which has been out of operation for over five years and for whose restoration efforts are now underway. Within the B1 village we can distinguish those households that had obtained a connection when the system was operational (B11) and those that had chosen to remain unconnected (B12). When the standard system option was offered in the B1 village the WTP bids were conditional on the designed performance level being guaranteed. This was made necessary by the extent of dissatisfaction with the performance of the standard piped system when it was operational.

6.9 The distribution of the WTP bids is shown in Table C-1. In calculating the connection ratio we can assume that all households whose WTP bids are less than Rs.10 would not connect since the existing tariff rate of Rs.10 per month is not likely to be reduced. We also treat the "No Responses" as protest bids and add them to the group of households not likely to connect to the service offered.

6.10 The table shows that at the existing tariff of Rs.10 per month the connection frequencies for the B11, B12, and B2 households would be 70%, 83.3%, and 74.6%, respectively. The mean bids (computed over the valid responses) for the same groups are Rs.17, Rs.17, and Rs.21, respectively. The mean bids of the subset of households likely to connect are Rs.21, Rs.19 and Rs.25, respectively.

6.11 A number of observations can be made based on the above estimates:

a. 30% of the B11 households (all of which were connected when the piped system was operational) would not reconnect even if the performance of the system were guaranteed. This reflects a loss of credibility in the system.

b. The connection ratios which would result at the existing tariff rate are quite high (74% in B1 and 75% in B2). These compare favorably with the actual connection frequency of 69% which obtained in the B1 village when its piped system was operational. This correspondence supports the validity of the WTP methodology.

c. The mean bid of the households likely to connect in the B1 village is approximately Rs.20 per month. Only 4 out of the 57 valid responses were for bids over Rs.25 per month. This is reassuring. The monthly maintenance cost of a motor-operated pump is Rs.25 and because of its greater reliability it should provide an upper bound on the monthly tariff of a piped water supply. (The one-time costs of the motor-driven pump are, however, higher. See Table A-4).

d. The mean bids are approximately Rs.4 per month higher in the B2 village. This could be due to overbidding in B2, underbidding in B1, or both. However, overbidding seems the more likely explanation since nearly 19% of respondents bid Rs.50 or more in B2 compared to 5% in B1. Such high bids could be interpreted as evidence of strategic behavior.

6.12 Type of Households More Likely to Connect to a Standard System. A multivariate analysis of the WTP bids presented in Table B-3 indicates that younger, more educated and propertied households are more likely to connect. Farming households are less likely to connect compared with non-farming households. Households that have a motor-operated handpump system are willing to pay Rs.7 more than others. This could be because, compared to their expenses on the motor system, a piped connection would be a cheaper alternative even at the higher end of the feasible tariff range. Households that favor the metering of domestic connections are also willing to pay more, perhaps a reflection of their appreciation of water as a valuable resource. (The complete results of the multivariate analysis are presented in Table B-3.)

6.13 Willingness to Pay for a Connection to a Standard System with a More Affordable Financing Arrangement. Types B12 and B2 households that had never previously connected to a piped system were offered a more attractive financing option (one-time connection costs to be borne by the water authorities) to test if affordability was a factor in the decision to remain unconnected. The distribution of the WTP bids is shown in Table C-2. These can be compared to the WTP bids for the standard option presented in Table C-1.

6.14 Table C-1 indicates that 17 out of 76 households (B12+B2) would not connect when offered the standard option (WTP bids less than Rs.10 per month). The comparable numbers from Table C-2 are 17 out of 74. It is clear that the more affordable financial arrangement does not result in increasing the connection ratio. However, the mean bid over the B12 and B2 households increases by approximately Rs.3 per month. This suggests some preference for the more affordable arrangement among even the households that would otherwise connect to the standard system.

Response of Households in Villages with an Operational Piped Water System

6.15 Willingness to Pay for Connection to an Improved System. Type A villages are characterized by the existence of an operational piped water supply system which is working below its design specifications. Type A villages include two types of households: A1, which have domestic connections; and A2, which have voluntarily remained unconnected to the system.

6.16 All households in the Type A villages were offered the choice of connecting to an improved system, the improvement being an additional daily supply of 4 hours of water from the existing system. The distribution of the WTP bids is shown in Table C-3. A number of observations can be made based on the figures:

a. The number of "No Responses" or protest bids is much higher than in Types B1 and B2 villages (over 10% as compared to a maximum of 2.5%). This may be a reflection of the lack of credibility that households familiar with the performance of piped systems place in any promises of improvement in the existing system.

b. The proportion of households bidding more than the existing tariff of Rs.10 per month is about 50% (51% for A1 and 45% for A2 households). Thus, only half the households that are currently connected to the system are willing to pay more for an improved system, while half the households that are currently unconnected would connect to an improved system.

c. The mean WTP bids are low, Rs.14 for A1 households and Rs.12 for A2 households. If it is assumed that none of the A1 households connected to the standard system would disconnect if the service is improved (i.e., the protest bids are ignored) and will continue paying the existing tariff of Rs.10 per month, their mean WTP bid would rise to Rs.15 per month.

d. The mean WTP bids computed over the subset of households likely to connect are Rs.20 and Rs.19 for the A1 and A2 households, respectively.

6.17 Type of Households More Likely to Connect to an Improved System. The multivariate statistical analysis of the WTP bids (for details see Table B-4) indicates that wealthier households are willing to pay more for an improved system. Households that favor metered connections are willing to pay Rs.6 more than others. Households with motors again bid Rs.5 per month more than those without motors.

6.18 Households with a higher proportion of women and children are willing to pay more for an increased supply of water. This suggests that labor supply considerations are not relevant in areas where water does not have to be fetched from outside the house.

6.19 A very interesting aspect revealed by the multivariate analysis is the comparative behavior of farming and non-farming households. In villages without piped water the former bid Rs.4 per month less for a connection to a piped water system. However, in villages where a piped system has been in operation, farming households bid Rs.4 per month more than non-farming households for an increased supply of water. This could be attributed to learned behavior whereby farming households have come to recognize some previously (prior to the installation of a piped system) unforeseen advantages of domestic connections. Our field observations revealed that households with animals were very keen on a domestic connection because it made the task of washing them much more convenient. Buffaloes, which need to be kept cool, could be hosed down at home, rather than be taken to the canal or the village pond, thus saving on time and supervision costs. Further, water for drinking by animals could also be provided through the domestic connection. Although this hypothesis was not tested statistically, as we did not collect information on animal ownership, if farming households own more animals than non-farming households the explanation would be quite plausible.

6.20 If the explanation is true, it would also have significant implications for the design of rural water supply systems. The PHED design criteria at present take into account human needs only and use a consumption figure of 15 gallons per capita per day. However, if households are actually using the water to cater to animal needs also, including water-intensive ones like washing, the design estimate could be easily exceeded. Perhaps this suggests one explanation for the ubiquitous problem of low pressure which plagues rural water supply systems in Pakistan.

6.21 <u>Willingness to Pay for a Connection to a Standard System with a More Affordable Financing Option</u>. To explore the reasons for the non-connection of A2 households to the existing system, they were offered the same financing option mentioned earlier in the case of type B villages. The distribution of WTP bids is included in Table C-3. The data suggest that the availability of the flexible financing option in the type A villages would raise the connection ratio from 55% (79/144) to 79% (113/144) if the existing tariff continues to be charged. Approximately half the previously unconnected A2 households would connect. Their mean bid for the monthly tariff is Rs.21.

6.22 However, Table C-3 also shows that if the standard system is improved (an extra 4 hours water supply per day over the existing supply period) the same results could be obtained. Slightly less than half the A2 households would connect at the existing tariff. Their mean bid for the monthly tariff is Rs.19.

6.23 While it is possible that there may be very little overlap between the households that decide to connect in the two cases (poorer households might be the ones that connect under the flexible financing option while households dissatisfied with system performance might be the ones to connect to the improved system) the net result from the point of view of connection rates is quite similar. Therefore, any choice between the two options not concerned with distributional issues would need to be based on comparative costs.

VII. ESTIMATED REVENUES AND COST RECOVERY POTENTIAL

7.1 The willingness-to-pay bids can be used to estimate the likelihood of connection to and the revenues generated from the provision of various upgraded services. Such a computation helps determine whether the provision of such services would be economically sustainable.

Provision of a Standard Piped Water System in Villages without an Existing System but with Experience of Such a System

7.2 The Type B1 village is particularly attractive from the analytical point of view. Type B1 households have had first hand experience with a piped water system but do not have access to the same at present. Therefore, their willingness-to-pay bids are for a commodity with which they are quite familiar and for that reason could be expected to be more reliable than if the commodity had been a hypothetical one.

7.3 Connection Frequencies. The connection frequencies and revenue estimates are shown in Table C-4 and are plotted in Figure 7.1. It can be seen that at the existing monthly tariff of Rs.10 the connection frequency would be 84%, if the service level was guaranteed. This is to be compared with the actual connection frequency of 69% (at Rs.10 per month) which prevailed when the piped water system was operational over five years ago. There are numerous indications that the system was poorly managed and it eventually fell into disuse. The impact of that history is demonstrated by the fact that, even with a performance guarantee, only 82.5% of the households that had previously been connected indicated a willingness to restore their connections at the previous tariff rate of Rs.10 per month.

7.4 The plot of connection frequency against monthly tariff rates lends credibility to the bids elicited through the willingness-to-pay method. Three reference markers could be used to interpret the plot. Below Rs.7.5 per month the connection frequency is very high (95% and above). This is as it should be since Rs.7.5 is the approximate monthly expenditure at the minimum acceptable service level, the manually operated private handpump. At Rs.10 per month the connection frequency is approximately 84% which compares favorably with the actual frequency (69%) which prevailed at that rate. As mentioned earlier, the increase in connection frequency is to be attributed to the fact that a performance guarantee was part of the package offered to respondents. Increased economic growth during the past five years could also be a contributing factor. At Rs.22.5 per month the connection frequency drops to 21%. This corresponds well with the response of the 26% households that have installed electric motors in the Type B1 village; monthly expenditure on electric motor-operated systems is around Rs.25 per month. At Rs.27.5 the connection frequency becomes negligible at 7%, indicating that the electric motor is the preferred option at this tariff rate.

FIGURE 7.1

7.5 Monthly Revenues. The plot of revenue against monthly tariff (Figure 7.1) indicates that revenues would be maximized at a tariff rate of Rs.17.5 per month. Revenue yield would be Rs.1026 per 100 households of which 59% would be connected. At a tariff rate of Rs.12.5 per month the corresponding figures would be Rs.926 and 74%. (These figures are to be compared to the situation which existed when the piped system was operational when the connection frequency was 69% and the revenue Rs.690 per 100 households at a tariff rate of Rs.10 per month). Therefore, any tariff in the range of Rs.12.5 to Rs.17.5 per month should achieve the dual objectives of a reasonably high connection frequency and high cost recovery.

7.6 Operation and Maintenance Costs. To what extent can the range of revenues mentioned above pay for the operation and maintenance costs of a piped water system in the sweet water zone? An examination of the actual cost data used by the PHED for the scheme installed in the Type B1 village would be useful in this context.

7.7 The scheme was initiated during 1973-1974 and completed in 1976. The system was designed for a population of 6800 at 15 gallons per capita per day and cost Rs.3,33,080 at approximately Rs.50 per capita. The annual operation and maintenance costs were computed to be Rs.10,516 as follows (annual O&M costs work out to be 3.2% of capital costs, at the lower end of the 3% - 5% range used by the PHED):

a. Personnel (Operator, Plumber/Valveman, Watchman)	Rs.4930	(47%)
b. Operation Cost (Electrical & Mechanical)	Rs.2717	(26%)
c. Annual Repair	Rs. 351	(3%)
d. Contingencies (at 5% of b+c)	Rs. 153	(1%)
e. Depreciation	Rs.2365	(23%)
Total:	Rs.10,516	(100%)

7.8 Using the figure for household size mentioned in the 1981 Census (6.7), the O&M cost (including depreciation) work out to Rs.1 per household per month at the 100% connection rate assumed by the PHED. Even if a connection frequency of 50% is assumed, a tariff rate of Rs.2 per month would be sufficient to meet O&M costs. The tariff rate was set at Rs.6 per household per month in 1976.

7.9 Since 1976, costs have escalated rapidly. The capital costs per capita currently used for the design of tubewell systems are Rs.300. Calculating O&M costs at the upper-end rate of 5% of capital costs for a population of 10,000 (the approximate population of the Type B1 village at present) would yield a figure of Rs.12.5 per household per month (the household size at present is 10), assuming universal coverage. If the connection frequency is 75%, the tariff rate that would ensure full recovery of O&M costs would rise to Rs.16.7 per household per month.

7.10 It should be kept in mind that the estimates obtained above are upper bounds. A look at the breakdown of O&M costs enumerated above shows that only 26% of the costs are due to the actual running of the system. The rest are fixed costs of which the largest proportion is due to personnel costs (47%). Therefore, with increasing population the O&M costs per household should decrease. If we compute annual O&M costs at the lower value of 3% of capital costs, the corresponding tariff rate for full recovery of O&M costs at a 75% connection frequency would be Rs.10 per household per month.

7.11 Rs.10 per household per month is the existing tariff rate in the sweet water zone. In general, it seems that the tariff rates imposed by the PHED, which range from Rs.10 to Rs.25 per month in the Punjab, are calculated on the basis of recovery of O&M costs. In the light of the above, the tariff rates, connection frequencies, and revenue estimates revealed by the WTP analysis for the Type B1 village are quite close to, if not within, the range of economic sustainability.

Provision of a Standard Piped Water System in Villages without Experience of Such Systems

7.12 Results from the Type B2 villages, where the bidding game could be considered hypothetical, are reasonably similar. Table C-5 and Figure 7.2 show the connection frequencies and estimated revenues at various possible tariff rates. The one significant difference in comparison to the Type B1 village is the high connection frequencies (around 20%) at tariff rates beyond Rs.27.5 per month. This is due to the disproportionate number of high bids indicated in Type B2 villages as compared to both the Type B1 and the Type A villages. These could be due to the presence of strategic bias in the bidding, either overbidding in the type B2 villages or, less likely, underbidding in the other two types of villages.

7.13 Figure 7.2 shows that revenues would be maximized at a tariff of Rs.12.5 per household per month yielding a revenue of Rs.933 per 100 households of which 75% would be connected to the system. Again, this figure compares favorably with the tariff required for full recovery of O&M costs. Assuming a village population of 5000, a household size of 9, Rs.300 per capita capital costs, 3% of capital costs as O&M costs per annum and a connection frequency of 75%, the tariff required for full recovery of O&M costs works out to be Rs.9 per household per month.

Provision of an Improved System in Villages with an Existing Piped Water System

7.14 Type A villages, where a piped water supply was in operation, were offered the choice of an additional 4 hours of water supply per day from the existing system. Table C-6 and Figure 7.3 show the connection frequencies and revenues that would result at various tariff rates as revealed by the WTP bids.

7.15 The revenues would be maximized at a tariff of Rs.17.5 per month with a yield of Rs.693 per 100 households of which 40% would be connected. At a tariff of Rs.12.5 the corresponding figures would be Rs.599 and 48% (the existing revenue potential is Rs.550 per 100 households, the connection frequency being 55% at a tariff of Rs.10 per month).

FIGURE 7.2

FIGURE 7.3

7.16 It is noticeable that the connection frequencies, and therefore the revenue yields, are lower than at equivalent tariffs in the Types B1 and B2 villages. This probably reflects dissatisfaction with the performance of the existing system and the fact that an extra 4 hours of water from a poorly run system suffering from low pressure in the pipes is not very attractive to the respondents. This suggests that the emphasis ought to be on the delivering of the performance level promised to the customers.

Experiments with Alternative Financing Options for Household Connections

7.17 The alternative financing option was described earlier. Table C-5 presents the comparative connection frequencies and revenue estimates if either the standard option or the flexible option alone are offered to respondents in a Type B2 village.

7.18 Suppose the PHED desires to recover the extra capital expenditure of Rs.500 per household incurred under the flexible financing option over a period of 5 years at an interest rate of 10%. The additional monthly payment would amount to Rs.10.5. Thus the effective tariff would be approximately Rs.21 per month.

7.19 The two options can now be compared. At the existing tariff of Rs.10, 85% of the households would connect to the standard system yielding a monthly revenue of Rs.850 per 1000 households. At a tariff of Rs.21 per month under the flexible option, 54% of the households would connect yielding a monthly revenue of Rs.1134 per 100 households. Thus, the revenue yield would improve but the connection frequency would decline. The objective of the policy would not be served.

7.20 A variant of the policy would be to offer the flexible financing option only to the households that have not connected to the system at the existing tariff rate. The connection frequencies and revenue estimates resulting from such an offer to A2 households in a Type A village are shown in Table C-7. At a tariff of Rs.21 per month, 24% of the households would connect to the system raising the overall connection rate to 66% (55% households connected at the existing tariff plus 24% of unconnected households connecting under the flexible financing arrangement). Thus, under the cost recovery conditions stipulated, the policy of offering both the standard and the flexible option in the same village would succeed in raising the connection rate to some extent.

7.21 The monthly revenue yield per 100 households under the above scenario would amount to Rs.781 (Rs.10 x 55 + Rs.21 x 11). This can be compared to the revenue yield if the existing system is improved in the Type A village. Table C-6 shows the connection frequencies and the revenue estimates. While the exact costs of providing an additional 4 hours of water per day are not known, we can suppose that the tariff would have to be raised to Rs.17.5 per month. At this tariff the connection frequency would be 40% and the monthly revenue yield per 100 households would be Rs.700. Thus, the connection rate would be considerably lower and the monthly revenue would be marginally less compared to the flexible financing option.

VIII. BRACKISH WATER ZONE - OVERVIEW AND FIELD PROCEDURES

The Study Area

8.1 Faisalabad District is also located in the central canal-irrigated part of the Punjab. The district capital, Faisalabad City, had a population of 1,104,209 according to the 1981 census. It is situated 145 kilometers from Lahore, the capital of the Punjab, and is the third largest city in Pakistan. Faisalabad is an internationally recognized center of the textile industry.

8.2 Almost half the area in Faisalabad District lies in the brackish ground water zone. Water is available at accessible depths but its quality is generally perceived to be poor, although there are variations, often within villages.

Overview of the Water Situation in the Brackish Water Zone

8.3 Villages in what is now the brackish water zone formerly relied on wells as their primary source of water. In keeping with the transition in the sweet water zone almost every household has now replaced that source with a private handpump inside the house.

8.4 However, because of developments attributed to water-logging and salinity, the quality of ground water has deteriorated over time so that by now dissatisfaction with its taste and its impact on health is fairly widespread. Of the households without access to piped connections, 54% rely on sources other than their private handpumps for water used for drinking and cooking. Among these alternative sources are canals and public handpumps alongside water-courses channeling water from canals to agricultural lands where the seepage water is of better quality. Water from such sources is either fetched by household members who devote approximately 35 minutes per day to this task or delivered for a charge by water carriers.

8.5 In such a situation piped supply systems provide the only convenient source of good quality water. Neither private handpumps nor motorized pumps can provide water of similar quality. Therefore, it is not surprising that connection frequencies to piped water supply systems are on the high side, around 75%.

8.6 What is surprising is the high percentage of sample households (50%) that have nonetheless installed motorized handpumps. This is partly attributable to the fact that the motorized pump can yield somewhat better quality water than the handpump by going deeper into the subsoil. It also underscores the demand for water-related conveniences like indoor plumbing, flush toilets, and showers, which are not accessible with handpumps.

8.7 The above facts suggest that domestic connections to a reliable piped water supply system should be preferred to motorized pumps because they can provide a better quality of water fit for drinking and cooking in addition to the water-related conveniences mentioned earlier. Besides, domestic connections are a less expensive choice for the consumer.

Selection of Study Villages

8.8 The selection of Type A villages was rendered difficult by the need to ensure a reasonable proportion of households that had remained unconnected to a piped supply system by choice; the connection frequencies were generally on the high side. Two villages, Manawala and Sudhar, were selected where the connection frequencies were around 75%. Manawala, a large village now incorporated within the limits of the Faisalabad municipality, has a piped supply system more than 10 years old. Sudhar, on the other hand, has a piped supply system which was only commissioned in January 1988.

8.9 Selection of Types B1 and B2 villages was straightforward. There are many villages where piped supplies are scheduled to be installed. The selected villages of the B1 type, Bhaiwala and Akalgarh, are at the stage where the distribution mains have been laid but domestic connections have yet to be sanctioned. The system in Bhaiwala is based on a tubewell, while that in Akalgarh is based on filtered canal water. The two Type B2 villages are both located close to the district headquarters.

8.10 The following are the particulars of the six selected villages:

- Manawala	:	Type A
Sudhar	:	
- Bhaiwala	:	Type B1
Akalgarh	:	
- Santpura	:	Type B2
Gatwala	:	

All the selected villages exceeded a population size of 5000. A more detailed profile of the selected villages is provided in Table D-1.[15/]

Description of the Questionnaire and Bidding Games

8.11 The questionnaires are the same as used in the sweet water zone with only minor modifications due to site-specific considerations and the experience gained in the first round of interviewing. The one major difference is that there is only a single schedule pertaining to the Type B1 village since, unlike the sweet water zone, there was no need to distinguish among households in the B1 village.

8.12 The bidding games were designed to evaluate the following options:

a. The standard PHED piped water supply system of the kind existing in Type A villages. This option was offered to all households. The WTP of already connected households (A1) was elicited by bidding up from the existing tariff. The WTP of the voluntarily unconnected

15/ Statistical tables and analyses generated by the survey, grouped by subject, appear in Appendices D, E, and F.

households (A2) was elicited by bidding up from a tariff rate of Rs.0 per month.

b. An improved piped water supply system which would supply clean and safe water continuously with adequate pressure and reliability. This option was offered to every household.

c. The standard PHED system with alternative financing arrangements. Only A2 households were offered the following two alternatives:

(i) 50% of the connection costs to be borne by the water authorities; and

(ii) 100% of the connection costs to be borne by the water authorities.

8.13 The design of the bidding games ensured that protest bids and genuine zero bids would be clearly identified. In addition, the low and high starting points used were Rs.20 and Rs.40 per month as compared to Rs.15 (or Rs.5 in some cases) and Rs.50 in the sweet water zone. In the randomization of the starting points households either had low starting points or high starting points for both the games offered to them (for existing and improved systems).

Conducting the Survey

8.14 The survey was carried out in the 6 villages over a 10-day period (August 18-28, 1988). A total of 495 interviews were completed, as follows:

Manawala	:	106	:	Type A : 202
Sudhar	:	96	:	
Akalgarh	:	106	:	Type B1: 200
Bhaiwala	:	94	:	
Santpura	:	52	:	Type B2: 93
Gatwala	:	41	:	

The number of interviews by schedule type was as follows:

A1	:	151
A2	:	51
B1	:	200
B2	:	93

Two visits each were made to Manawala, Sudhar, Akalgarh, and Bhaiwala and one each to Santpura and Gatwala.

8.15 Some basic socioeconomic characteristics of sample households and their attitudes towards water-related issues are presented in Tables D-2 and D-3.

IX. FINDINGS IN THE BRACKISH WATER ZONE: ANALYSIS OF ACTUAL CHOICE BEHAVIOR

Water in the Brackish Water Zone

9.1 Water is freely available in the brackish water zone. The quality of water from traditional sources (wells, handpumps) is generally considered to be poor for drinking and cooking except from handpumps alongside water channels which pick up seepage water from canals.

9.2 The transition from wells to handpumps as the primary source of water is complete. Most households have private handpumps inside the house to cater to their water needs. However, for the purposes of drinking and cooking many households fetch water from outside (public handpumps along water channels at the village periphery or canals) or have water delivered to their homes.

9.3 About 50% of the households in the sampled area have installed electric motors on their private handpumps. The motorized pump, because it can lift water from a greater depth than the manual pump, yields somewhat better quality water that households not willing to expend the time or effort required to fetch water from outside use for drinking and cooking as well. The electric motors also provide the same upgraded services that were mentioned in the case of the sweet water zone. However, the quality of piped water is clearly considered superior, and, wherever the option of connecting to such a system is available, the connection frequencies are high. Table D-4 shows the pattern of household choice over available service options along with their approximate costs.

Who Installs Electric Motors?

9.4 Once again, the statistical analysis (for details see Table E-1) confirms expectations based on economic theory. Better educated, economically affluent and propertied households are more likely to install electric motors. Households with fewer animals kept inside or just outside the house are more likely to install motors. This is to be expected in the case of better-off households.

9.5 One important difference from the pattern in the sweet water zone is that variables related to household size and time spent in fetching water are quite unambiguously positive. This would make sense in the brackish zone where motors are also used to improve upon the quality of water available from handpumps. Thus, motors would serve both the objective of making water-related services available and of providing better quality water for drinking and cooking inside the house. This is probably the reason for the greater incidence of motor-operated pumps in the brackish zone (62% of households in Type B villages against 30% in the sweet water zone).

9.6 As in the sweet water zone, households with access to piped water systems are significantly less likely to install electric motors (33% of households in Type A villages against 62% in Type B villages). This is because, ideally, piped connections should yield all the advantages of the motor-operated pump and provide better quality water as well.

9.7 However, 33% of households in Type A villages continue to have motor-operated pumps (29% have a piped connection as well as a motor). The corresponding numbers in the sweet water zone are 11% and 7%. Part of the explanation could lie in the fact that one of the sample villages, Sudhar, has had a water supply for less than six months. Households that had installed motors prior to the provision of piped water might continue to retain them till such time as major repairs are required (44% of households in Sudhar have motors against 23% in Manawala). The other reason could be the greater reliability of electric motors in providing water for general household needs besides drinking and cooking.

9.8 Households that consider water from their primary source (handpumps) to be satisfactory for health are less likely to install motors, but the variable is not statistically significant. This would suggest that the quality of water is not the primary motivation in installing electric motors.

Who Connects to Piped Water Systems?

9.9 In two of the sample villages, Manawala and Sudhar, households have had the alternative of connecting to a public piped supply system with domestic connections. Of the sampled households 75% had availed themselves of this alternative.

9.10 The statistical analysis (Table E-2) shows that better educated and economically affluent households are more likely to connect to piped water systems. Households located further away from the distribution line are less likely to connect because of the increase in connection costs.

9.11 Households that consider water from their handpumps to be unsafe for health are more likely to connect to piped systems. The coefficient is statistically significant suggesting that the improvement in water quality is an important factor in the decision to connect.

9.12 Farming households and those with a higher proportion of children are less likely to connect. This could be, as argued earlier, both because of reduced needs and the availability of labor to fetch water for drinking and cooking from outside the house. This reinforces the conclusion that piped water serves much more as a substitute for water fetched from outside the house than motor-operated pumps.

9.13 Contrary to the pattern in the sweet water zone, households with motors are more likely to connect to piped systems (the coefficient is positive but not significant). This suggests that the two options are not considered to be complete substitutes in the brackish water zone.

9.14 Households that favor the metering of water supplies have a greater likelihood of connecting to piped water systems.

9.15 One variable which needs explanation is per capita household expenditure. Both the linear and quadratic terms are close to significance with the former having a negative and the latter a positive coefficient. One explanation could be the poor correlation between income and expenditure at low values; an increase in expenditure unrelated to incomes (e.g., increase in family size) would strain the budget which might be adjusted by giving up items for which cheaper alternatives are available. Water, which can be fetched at zero out-of-pocket costs, is one such item. On the other hand, at higher levels, increases in per capita expenditure could be expected to reflect increases in income.

9.16 The reasons mentioned by the respondents for either connecting or not connecting to the piped water supply system are listed in Tables D-5 and D-6. These were obtained as responses to open-ended questions.

Electric Motors and Household Connections

9.17 Ideally, household connections to piped systems should be a dominant choice because they are not only less expensive than electric motors but also provide better quality water. However, in reality, piped systems have not proved to be reliable enough to be acceptable as a dependable source for water-related services like indoor plumbing, showers and flush toilets. Therefore, even in a village like Manawala where the piped supply is over 10 years old, 21% of households continue to have electric motors along with domestic connections.

9.18 This lack of reliability has restricted the utility of piped systems to providing limited water of good quality for drinking and cooking. In villages without piped supplies 38% of households rely on the base service level of handpumps; in villages with a piped supply the percentage falls to 21%. However, households that desire a reliable upgraded service level cannot do so without investing in a private electric motor.

9.19 For purposes of comparison with the sweet water zone, Table D-7 shows the relationship between choice of service level and the economic status of the household in villages where a piped supply option is available. Once again, it is the most affluent households that have both a domestic connection and an electric motor.

X. FINDINGS IN THE BRACKISH WATER ZONE ANALYSIS OF WILLINGNESS-TO-PAY BIDS

Service Options Evaluated

10.1 The following options were evaluated through bidding games:

a. a household connection to a standard piped water system of the type existing in Type A villages;

b. the same, with more affordable financing arrangements. This option was offered only to the unconnected households in Type A villages; and

c. a household connection to an improved piped water system.

10.2 The perceptions of households with experience of piped water systems are presented in Tables D-8 and D-9. It can be noted that 66% of the connected households expressed dissatisfaction with the operation of the system.

10.3 To determine the acceptance of a well-functioning system, willingness-to-pay bids were elicited for an improved system. The improved system was stipulated to provide clean and safe water on a continuous basis with an acceptable level of reliability and pressure.

10.4 Households that had remained unconnected to available piped water supply systems were offered two alternative financing packages to determine if the one-time connection costs were a factor in their remaining unconnected. The packages offered a 50% or a 100% bearing of connection costs by the water authorities in return for a higher monthly tariff.

Willingness to Pay for Connection to a Standard System

10.5 The distribution of WTP bids for connection to a standard piped water system is presented in Table F-1. In the brackish water zone bids for such a system were obtained from Type A households as well as from Types B1 and B2 households.

10.6 A number of observations can be made based on the data presented in the table:

a. There is little difference between the bids obtained from Type B1 and Type B2 households. The mean bids are Rs.41 and Rs.37, respectively; the percentages of households bidding more than Rs.12 per month (and therefore likely to connect at the prevailing tariff) are 97% and 90%, respectively; and the mean bids of the latter households are Rs.43 and Rs.40, respectively.

b. The bids and connection ratios are slightly higher in the Type B1 village in comparison to the Type B2 village. Given that distribution lines have already been laid in the former and there are no plans for the installation of a system in the latter, one would have expected strategic bias to lead to a converse pattern. One obvious explanation would emerge if, despite the advanced state of installation, Type B1 households have no more information about system parameters (connection fee, monthly tariff) than Type B2 households. This would also constitute concrete evidence of the lack of community participation in the preparation and implementation of village level projects. The relevant data is presented in Table D-10 which reveals a very high level of non-awareness regarding basic information about the parameters of the piped water system. This non-awareness is just as prevalent in Type B1 villages as in Type B2 villages.

c. It is immediately obvious that the pattern in the Type A village is quite different. The mean bid (Rs.16) and the connection ratio (75%) are much lower than in either of the villages without operational systems. Even the mean bid of the connected households (Rs.21) is about half the mean bid of potentially similar households in the other villages.

There can be two possible reasons for the above pattern. First, the experience of Type A households with the piped supply in their village could be negatively affecting their bids; Types B1 and B2 households, not aware of the actual performance of such systems, are not only bidding higher but more households are indicating an intention to connect than in the Type A village. Second, there could be an anchoring cum strategic bias because the existing tariff is known to the respondents. In this, the design of the bidding game for already connected households, which involves bidding up from the existing tariff to a value at which they would disconnect, could be a contributing factor.

d. Information on the extent of satisfaction of Type A households with the operation and management of the piped water supply systems in their villages is presented in Table D-8. It can been seen that a very high percentage (66%) of households connected at present are dissatisfied with the performance of the system, with the primary complaint relating to its reliability (Table D-9).

10.7 Types of Households with Higher Willingness to Pay for a Standard System. A multivariate analysis (see Table E-3) shows that the WTP bids are systematically related to a number of explanatory variables. Households that require more water (greater household size and per capita consumption of water) and those that need to spend more time fetching it from outside the house bid higher than others.

10.8 The bids are positively and significantly related to household expenditure per capita; an increase of Rs.100 in the variable would raise the bid by approximately Rs.2. Younger households, those which include members who have lived outside the village, and those favoring the metering of water connections bid more than others.

10.9 Households that consider the water from existing sources to be satisfactory for health bid Rs.3.5 per month less than others but the variable is not statistically significant. The non-significance of the existence of electric motors (50% of sampled households possessed motors) indicates that they are not considered as substitutes for piped water.

10.10 As mentioned earlier, households in Type A villages bid significantly less compared to Type B1 households. There was no significant difference between the bids of Types B1 and B2 households.

Willingness to Pay for Connection to an Improved System

10.11 The distribution of WTP bids for connection to an improved piped water system is presented in Table F-2. It should be kept in mind that Types A2, B1 and B2 households were asked to assume that, for the improved system, connection costs were zero. This was to maintain compatibility with Type A1 households that already had a domestic connection and would not have to incur connection expenses again for access to an improved system.

10.12 The following observations can be made based on the data presented in the table:

a. The connection ratios are very high and similar for all three types of villages: 95%, 99% and 97% for village Types A, B1, and B2, respectively.

b. The mean bids are again similar for the Types B1 and B2 villages (Rs.58 and 51 respectively), which, in turn, are higher than the mean bid in the Type A village (Rs.33).

c. The fact that Types B1 and B2 households were offered connections to improved systems at zero connection cost (compared to connections to the standard system for which they had to bear the connection costs) does not seem to have affected their bidding to any significant extent. Thus, the increases in the mean WTP bids over the standard system for the Types A, B1, and B2 households are 98.5%, 40.9%, and 37.6%, respectively. The corresponding figures computed only over those households likely to connect (those bidding more than Rs.12) are 64.9%, 37.7%, and 29.5%, respectively. In both cases the increase is much more for the Type A households. This could be due to the fact that, having had experience with the standard system, the Type A households could appreciate the improvements much better than the Types B1 and B2 households for whom the standard system itself would be a great improvement.

10.13 Types of Households with Higher Willingness to Pay for an Improved System. The multivariate analysis (see Table E-4) shows virtually the same pattern as for the standard system; households that are willing to pay more for the standard system are also willing to pay more for the improved system. Wealth, education and health considerations emerge as additional significant variables in the case of the improved system.

Response of Households in Villages with and without Operational Piped Water Systems

10.14 In order to develop an understanding of the factors that affect the willingness-to-pay bids for various service levels it is useful to focus on the Type A and Type B villages separately. Since Type A households have had actual experience of existing piped water systems, their evaluation of such a system would reflect concrete considerations. It would be of interest to see the overlap with the considerations that affect the evaluation of an hypothetical improved system. A similar analysis could be performed by comparing the evaluation of the standard system by Type A and Type B households since for the latter the standard system represents an hypothetical choice.

10.15 Response of Type A Households. The results of the multivariate analyses of WTP bids offered by Type A households for existing and improved systems are presented in Tables E-5 and E-6. It can be noted that the only significant considerations in the case of the existing system are income (expenditure) and ownership of livestock which is kept inside or just outside the house. Households with such animals are willing to pay Rs.2 per animal per month more than others. The typical livestock owning household possesses two animals. The premium of Rs.4 per month constitutes 25% of the mean value of the dependent variable.

10.16 This last consideration is important and it confirms the hypothesis that was developed during the analysis of the sweet water zone. Piped water from the existing system is used for washing livestock and this suggests that the consumption figures used by the PHED in the design criteria ought to take this factor into account.

10.17 In the case of the improved system the significant considerations are income, wealth, household size, age, concerns about health, and attitudes towards metering of domestic connections. While ability to pay and animal needs dominated in the case of the existing system, modern attitudes and quality of life considerations emerge as significant in the evaluation of the improved system. Younger, more affluent and more discriminating households bid higher for a "modern" system regardless of whether they owned animals or not.

10.18 Response of Type B Households. The response of Type B households to the existing system (Table E-7) shows that household size and per capita consumption of water are significant determinants of WTP bids indicating that the need for drinking water plays a part in the evaluation. In addition, age and preference for the metering of domestic connections are other significant determinants indicating the influence of attitudes.

10.19 It is interesting to note that the variables for wealth or income are not significant, suggesting either that the bids are not anchored by the ability to pay or that the tariff rates are a very low proportion of monthly incomes and so considered generally affordable by most households bidding in an hypothetical market. The latter hypothesis is supported by the fact that wealth does emerge as a significant variable in the bidding for the improved system.

10.20 It is also interesting to note that the coefficient for the ownership of animals is negative and not significant. This is a strong suggestion that learning has taken place in the Type A villages resulting in the significantly higher bids by the owners of livestock.

Response of Unconnected Households in Type A Villages

10.21 In order to explore the reasons for the non-connection of Type A2 households they were offered two alternative financing arrangements for sharing the costs of connection to the existing system. Under the first arrangement the water authorities would contribute 50% of the costs while under the second they would contribute 100% of the costs; in exchange the tariff would be raised.

10.22 Table F-3 shows the distribution of the WTP bids. It can be seen that while no households are at present connected at the prevailing tariff (Rs.12 per month) the connection ratios (at the same tariff) under the two arrangements would be 47% and 63%, respectively. The mean WTP bids of the connecting households are Rs.16 and Rs.21 per month, respectively.

10.23 Table F-4 shows the distribution of the WTP bids offered by A2 households for an improved system. At the existing tariff, 82% of A2 households would connect to the improved system. Their mean WTP bid is Rs.27 per month as tariff.

XI. ESTIMATED REVENUES AND COST RECOVERY POTENTIAL

Costs of Piped Water Systems

11.1 Two types of piped water distribution systems are to be found in the brackish water zone: systems based on tubewells alongside canals (as in Bhaiwala) and systems based on filtration of canal water itself (as in Akalgarh). The capital and O&M costs of the two systems under various conditions are shown in Table D-11.

11.2 The capital cost per capita of a tubewell-based system is Rs.300 while that of a canal water based system is Rs.500. Based on these figures the total capital costs of the systems can be computed for the type of large villages under study (approximate population 10,000).

11.3 The PHED estimates annual O&M costs to range from 3% to 5% of capital costs. As mentioned earlier in the case of the sweet water zone, the lower bound is more appropriate for large villages because of economies of scale; a large component of O&M costs being fixed in nature. Using the average household size in the sampled area (8.9) the monthly charges required to fully recover the O&M costs at various connection frequencies have been computed. It can be seen that for tubewell-based systems even the upper bound estimates (at 5% of capital costs) of Rs.14.83 per household per month (assuming the prevalent 75% connection frequency) are well within the achievable region. For canal water systems the corresponding value is Rs.24.71. However, at the more appropriate value of 3% of capital costs the latter figure drops to Rs.14.83, again a target which should be quite achievable given the existing tariff of Rs.12.

Provision of a Standard Piped Water System

11.4 The connection frequencies and revenue estimates pertaining to the provision of a standard piped water system at different monthly tariff rates are shown in Table F-5. The connection frequencies for the Types A, B1, and B2 villages are plotted in Figure 11.1. It can be seen that the frequencies for the Types B1 and B2 villages are very similar and much higher than those for the Type A village. The reason for the possible bias in the responses of Type A households has been mentioned earlier. The plot suggests that there is no further need to distinguish between the Types B1 and B2 villages. The corresponding plot of estimated revenues is shown in Figure 11.2.

11.5 If the target of 75% connections is to be maintained, it is clear that the monthly tariff cannot be increased beyond the existing rate of Rs.12. At this tariff a tubewell-based system is economically viable at the lower bound of O&M costs (Rs.8.9 per household per month) but not at the upper bound of Rs.14.83. A canal water based system is not economically viable even at the lower bound (Rs.14.83).

FIGURE 11.1

FIGURE 11.2

Provision of an Improved Piped Water System

11.6 The connection frequencies and revenue estimates pertaining to the provision of an improved piped water system at different monthly tariff rates are shown in Table F-6. The connection frequencies are plotted in Figure 11.3. Again it can be noted that there is no need to distinguish between the Types B1 and B2 villages. The corresponding plot of estimated revenues is shown in Figure 11.4.

11.7 Again, if a lower bound of 75% connections is to be maintained, it can be seen that the tariff can be set in the range of Rs.17.5 to Rs.25.0 per month in a Type A village. Figure 11.4 shows that revenues would be maximized at Rs.25 per month. Thus a tariff of, say, Rs.20 per month would achieve both high connection frequencies and high revenue collections. If a Type B village is used as a reference, the feasible range for the monthly tariff could extend to Rs.35. While the exact costs of improving the piped water system are not known, it seems that at least the O&M costs could be fully recovered without causing households to disconnect from the system because of an unwillingness to pay an increased tariff.

Comparison of Standard and Improved Piped Water Systems

11.8 Since the Type A villages provide the lower bounds on connection frequencies and estimated revenues we can use the responses of Type A households to compare the gains resulting from improving the existing piped water systems. Figures 11.5 and 11.6 show the connection frequencies and estimated revenues in a Type A village resulting from the provision of standard and improved systems.

11.9 It can be seen that the improved system completely dominates the standard system. The monthly tariff can be raised from Rs.12 to Rs.20 without the connection frequency dropping below 75%. The maximum estimated monthly revenues go up from Rs.935 per 100 households to Rs.1693 per 100 households.

11.10 The Response of Unconnected Households in Villages with an Operational Piped Water System. Table F-7 shows the response of Type A2 households to the four options offered to them: the standard system, the standard system with two financing arrangements, and the improved system. The connection frequencies and the estimated revenues are plotted in Figures 11.7 and 11.8.

11.11 It can be seen that the improved system dominates the other alternatives. Thus there should be little doubt that improvements in the existing system have a greater payoff than offering special incentives to households that have not connected to existing systems in the brackish water zone.

FIGURE 11.3

FIGURE 11.4

FIGURE 11.5

FIGURE 11.6

FIGURE 11.7

FIGURE 11.8

XII. ARID WATER ZONE - OVERVIEW AND FIELD PROCEDURES

The Study Area

12.1 Rawalpindi District is located in the northern, rain-irrigated part of Punjab. The district capital, Rawalpindi, has a population of 794,843 according to the 1981 census. It is situated 16 kilometers from the federal capital, Islamabad, and 272 kilometers from Lahore, the capital of Punjab. Rawalpindi is the fourth largest city in the country and is the headquarters of the armed forces. Not much industry is located in the district, which has traditionally been an area of high recruitment in the army.

12.2 Almost the entire area in Rawalpindi District lies in the arid zone. Ground water is available at much greater depths than in the other districts studied and even this dries up during the peak summer period from April to July. Perhaps because of the lack of water, the villages in the arid zone are much smaller, the typical village population lying between 1000 to 2000 inhabitants.

Overview of the Water Situation in the Arid Water Zone

12.3 Villages in the arid water zone rely on wells as their primary source of drinking water. However, unlike the other two zones studied, these wells are generally not within easy reach of the households. Because of the scarcity of agricultural land most villages are located on rocky formations, usually at an elevation above that of the agricultural land. The ground water is often at a more accessible depth near such land because of seepage from some water source (the Soan River in three of the study villages) or the lower elevation. Thus, many wells, private as well as public, are located at a distance from the village. In addition, the natural sources of water (river, ravine, etc.) are also at a distance and often involve a steep climb on the way back.

12.4 It is because of the distance and the elevation that water is fetched only for the most essential uses. Quite a lot of water-related activities take place at the sources, e.g., bathing, laundry, and watering of animals. Even so, during the summer, households spend approximately 4.7 hours per day in water-related activities (compared to 4 hours per week in the brackish water zone).[16/] Most of this time is spent by women and children except for that involved in the watering of animals, which is generally a task handled by men.

12.5 The summer months from April to July are particularly difficult because of the lowering of the water table. Water in wells becomes almost inaccessible and waiting time becomes exceedingly long. The need for water becomes an overwhelming concern during this period before the ground water is recharged by the monsoon rains.

16/ These are trip times. In the arid zone the comparable figure for person-hours per day is 6.5. The computations exclude queuing because information is only available for maximum queuing time.

12.6 Vendors are present in villages without piped water but only a minority of households (5.7%) use them on any sort of regular basis. This is perhaps due to the cost which can reach between Rs.100 to Rs.150 per month if a vendor is used to deliver 30 liters of water daily. However, vendors are routinely used on social occasions like marriages and deaths. On such occasions a vendor may be paid between Rs.300 to Rs.500 to fetch as much water as may be needed over two or three days.

12.7 Because of the desperation for water quite a few households have developed a private source (24.4%) or have attempted (5.4%) to do so. While some have experimented with wells, others have tried a simple bore down which a three inch diameter metal sleeve can be lowered and drawn up filled with water. The costs are quite high. Digging a well costs Rs.200 per yard through soft earth and Rs.400 to Rs.500 per yard through hard, stony, or rocky formations. A bore costs Rs.75 per yard and often has to be between 20 to 25 yards deep. Even so, it yields little water and invariably dries up during the summer months.17/

12.8 In view of this situation there has been a push, beginning with the 5-Point Programme, to provide public water supplies to villages in this region. Many villages have received, or are in the process of receiving, public water supplies. The important feature of this drive is that villages below a population size of 5000 inhabitants have been selected to receive piped water systems with house connections, contrary to the stated policy of the Punjab PHED. No schemes based on public taps are under consideration.

12.9 It was also noted that connection rates were very high, and even in villages where the supply was less than six months old almost all the households had connected. This was so despite the fact that the monthly tariff of Rs.20 was much higher than in the other two zones studied. This underscores the great need for water in the arid zone.

Selection of Study Villages

12.10 There were two important features of villages with public water supplies in Rawalpindi District. Most of these supplies were relatively new (two years old or less) and the connection rates were very high (close to 100%). These characteristics are reflected in the Type A villages selected.

12.11 Because of the high connection rates there is no meaningful distinction between houses with (A1) and without (A2) connections. Therefore, a comparable analysis of actual choice behavior based on connection to the water system is not possible in the arid zone.

12.12 The selection of B1 and B2 villages was straightforward. All the B1 villages selected had public water systems at an advanced stage of construction.

17/ The average capital cost of a successful private source is Rs.7960 and the monthly maintenance expenses are approximately Rs.40. The unsuccessful attempts have cost Rs.5730 on the average.

12.13 Because of the small population size of the villages in the arid water zone three villages of each type were selected.

12.14 The following are the particulars of the nine selected villages:

- Jawa :
  Banda : Type A
  Dhalla :

- Papin :
  Payal : Type B1
  Gorakhpur :

- Dhuddian :
  Mohra : Type B2
  Bodhial :

12.15 Three villages, one of each type, (Dhalla, Gorakhpur, and Bodhial) were located by the Soan River, the main perennial river in the area. The others were located by non-perennial ravines. The following villages were located at a considerable height above ground level: Dhalla, Gorakhpur, Bodhial, Papin, and Banda.

12.16 A more detailed profile of the selected villages is provided in Table G-1.[18/]

Description of the Questionnaire and Bidding Games

12.17 The questionnaires are essentially the same as those used in the brackish water zone. The one major addition pertains to sections added to obtain more detailed information on all the water sources available and on the pattern of water usage. This addition was made because, unlike the other two zones (where handpumps inside the house were the primary source of water), many more sources were used and different sources were used for different purposes. It was felt that more information ought to be collected if a source choice model was to be constructed at a later stage and also to obtain estimates of the quantity of water fetched and time spent on water-related activities.

12.18 The specification of a source choice model requires the precise identification of sources. In the situation where multiple facilities of a given type existed (e.g., more than one public handpump in the village) the facilities were recorded in the questionnaires by their local names (e.g., mosque handpump or village center handpump, etc.). At the time of data entry each facility was given a unique two digit code. Thus source 43 would indicate a public handpump (source type = 4) located by the mosque (handpump number = 3). Each code would denote the same facility for all households. These identification codes would also be used to cross-reference the data on source characteristics and water usage.

18/ Statistical tables and analyses generated by the survey, grouped by subject, appear in Appendices G, H, and I.

12.19 Information on water usage patterns during summer were obtained from all households. However, information for the winter months was collected only from a sub-sample of households. This was primarily to reduce interview time and also because the limited objective was to obtain an average scaling factor to estimate the consumption of water during the winter months.

12.20 There was one additional bidding game in the arid zone. The details of the bidding games and the options they were designed to evaluate are as follows:

a. A scheme based on public taps in which a public tap would be located at most 20 yards from any house. Water of satisfactory quality would be available for approximately 4 hours per day. This option was offered to households in B2 villages.

b. The standard PHED piped water scheme with house connections of the kind existing in Type A villages. This option was offered to all households in the sample. The WTP of already connected households (Type A1) was elicited by bidding up from the existing tariff. The WTP of unconnected households (Type A2) was elicited by bidding up from a tariff rate of Rs. 0 per month.

c. An improved piped water supply system with house connections which would supply clean and safe water continuously with adequate pressure and reliability. This option was offered to every household in Types A and B1 villages.

12.21 The design of the bidding games ensured that protest bids and genuine zero bids would be clearly identified. In addition, the low and high starting points to test for starting point bias were Rs.30 and Rs.50 respectively. These were higher than in the brackish water zone because the existing tariff was already Rs.20 per month compared to Rs.12 in the brackish water zone and Rs.10 in the sweet water zone. In the randomization of the starting points, households either had low starting points or high starting points for both the games offered to them (existing and improved systems).

Conducting the Survey

12.22 The survey was carried out in the 9 villages over a 10-day period (June 13-22, 1989). A total of 401 interviews were completed in the 9 study villages, as follows:

Jawa	:	44	:	
Banda	:	48	:	Type A : 140
Dhalla	:	48	:	(A1 : 134, A2 : 6)
Papin	:	42	:	
Payal	:	48	:	Type B1 : 140
Gorakhpur	:	50	:	

Dhuddian	:	30	:	
Mohra	:	43	:	Type B2 : 121
Bodhial	:	48	:	

12.23 It should be kept in mind that the interviews were conducted during the peak summer season which is the critical period from the point of view of water needs.

12.24 A major difference from the other two zones was the inclusion of female respondents where available; 11.4% of the respondents were women.

12.25 One visit was made to each of the 9 villages. Some basic socioeconomic characteristics of sample households and their attitudes towards water-related issues are presented in Tables G-2 and G-3.

XIII. FINDINGS IN THE ARID WATER ZONE: ANALYSIS OF WILLINGNESS-TO-PAY BIDS

Service Options Evaluated

13.1 The following options were evaluated through bidding games:

a. a scheme based on public taps (this option was offered to households in Type B2 villages);

b. a household connection to a standard piped water system of the kind existing in Type A villages (this option was offered to all households in the sample); and

c. a household connection to an improved piped water system (this option was offered to households in Types A and B1 villages).

13.2 The public tap option was offered since, under PHED guidelines, this is the service level that ought to be provided in the arid zone where the majority of villages are below the critical population size of 5000, which makes a village eligible for house connections. The bidding games would enable an assessment of the willingness to pay for public taps as well as yield an estimate of the premium that households place on domestic connections.

13.3 The perceptions of households with experience of piped water systems are presented in Tables G-4 and G-5. It can be seen that households are reasonably satisfied with the service primarily because the systems are relatively recent and, despite their shortcomings, are a major improvement over the past situation. Nevertheless, willingness-to-pay bids were elicited for an improved system. The improved system was stipulated to provide clean and safe water on a continuous basis with an acceptable level of reliability and pressure.

Response of Households in Villages without Plans for Installation of Public Water Systems

13.4 Households in villages which are not under consideration for the installation of public water systems were offered two supply options: A system based on public taps and an alternative based on house connections to a standard PHED system (the details of these systems were described earlier).

13.5 The distributions of WTP bids for the two service options are presented in Table I-1. A number of observations can be made based on the data presented in the table.

a. Contrary to the general perception of the acceptability of systems based on public taps the mean WTP bid was quite high (Rs.35 per month).

b. However, a sizeable minority (13%) of the households were not willing to pay anything for a system based on public taps. The stated tariff for such a system is Rs.5 per month, but if a more reasonable rate of Rs.10 per month is considered for the arid zone, approximately 16% of the households would not be willing to join the system.

c. The mean WTP bid for the standard PHED system with house connections was Rs.55 per month, a premium of Rs.20 over the public tap system. It should be kept in mind that the former also involves additional fixed costs due to connection and installation.

d. Only 2.5% of the households were not willing to pay anything for the standard PHED system. If the existing tariff in the arid zone (Rs.20 per month) is used as a cutoff, the data indicates that 9% of the households would not connect if such an option were offered.

Willingness to Pay for Connection to a Standard PHED System with House Connections

13.6 The distributions of WTP bids for a connection to a standard piped water system with house connections in the three types of villages are presented in Table I-2.

13.7 The following observations can be made based on the data presented in the table:

a. There is very little difference between the mean bids obtained from Type A and B1 villages. The mean bids are Rs.39 and Rs.42, respectively. The mean bid in Type B2 villages, however, is significantly higher at Rs.55.

b. There appears to be a significant difference between the connection rates in Types A and B1 villages, 95.7% and 78.6%, respectively. However, the connection ratio in Type A village is based on actual observation while that in B1 villages is derived from the WTP bids. Households biding below Rs.20 per month are assumed not to connect if the system were installed. The comparable rate in Type B2 villages is 90.9%.

c. The above information suggests the following interpretations:

i) The piped water supplies in Type A villages are of very recent origin (less than 1 year in Jawa and Dhalla and less than 2 years in Banda at the time of the survey). Type B1 villages all have almost complete piped water systems. Thus the two types of villages are quite similar in one respect. Unlike the sweet and brackish water zones, Type A households have not had sufficient negative experience of the systems to lead to lower bids in comparison with villages without such experience.

ii) If a strategic bias exists, both Type A and Type B1 households are likely to manifest the bias in the same direction, i.e. by underbidding.

iii) In the light of the above two arguments, the closeness of the mean bids is understandable. However, the underbidding in Type B1 villages is manifested in a low connection ratio (bids less than Rs.20 per month being considered as not likely to connect to the standard system). Such a manifestation is not possible in Type A villages where the connection choice has already been made.

iv) An upward strategic bias could be expected in Type B2 villages where there are no plans for the installation of piped systems but where the felt need for such systems is equally acute. Both the mean bid (Rs.55) and the connection rate (90.9%) are higher than in Type B1 villages.

Willingness to Pay for an Improved Piped Water System with House Connections

13.8 The distributions of WTP bids for a connection to an improved piped water system with house connections in Types A and B1 villages are presented in Table I-3.

13.9 The following observations can be made based on the data presented in the table:

a. Once again the mean bids in Types A and B1 villages are fairly close, being Rs.51 and Rs.59, respectively. Also the connection rates are fairly similar, being 95.0% and 99.9%, respectively. Of the 6 households unconnected to the standard system in Type A villages, 2 indicated that they would connect to the improved system, bidding Rs.35 and Rs.45, respectively. Incidentally, they had indicated the unreliability of the standard system as their primary reason for not connecting. Of the other 4, 2 were single person households and 1 was occupying a rented premises. The fourth household indicated no need for piped water because of access to a private handpump inside the house.

b. The mean bids are significantly higher compared to the standard system. The premium is 31% in Type A villages and 40% in Type B1 villages.

Multivariate Analysis of Willingness-to-Pay Bids for Piped Water Systems

13.10 Results in Type B2 Villages: Comparison of Systems with Public Taps and House Connections. The results of a multivariate analysis of WTP bids for a piped water system based on public taps in Type B2 villages are presented in Table H-1.

13.11 Larger households are willing to pay more (Rs.3 per month for each additional member) as are households with higher monthly expenditure per capita. Households dissatisfied with the quality of alternative sources of water bid much higher than households that were satisfied. Households that favored metering of water supplies also bid higher.

13.12 Most other variables had the expected sign but were not significant. The interesting interpretation relates to variables representing labor supply. It can be argued that since public taps do not obviate the need to fetch water, households with limited labor supplies would have little reason to bid higher as they well might for systems based on house connections.

13.13 In the absence of this major advantage, health considerations seem to dominate the assessment of the public tap option, although the very small number of households dissatisfied with alternative sources (3%) limits the importance of this conclusion.

13.14 The negative sign of the coefficient for external exposure reinforces the interpretation that a system based on public taps is considered an inferior good by those with experience of systems based on house connections.

13.15 The results of the multivariate analysis of WTP bids for a standard system based on house connections for the same households are presented in Table H-2.

13.16 Once again household size and monthly per capita expenditure are a significant determinant of WTP bids. In addition, for this option, water consumption per capita is much more positively related to WTP bids although it is not statistically significant.

13.17 As expected, both labor supply variables are significant and negatively related to WTP bids. This negative relationship and the positive association with water consumption per capita clearly captures the differences between systems based on public taps and house connections.

13.18 Households dissatisfied with the quality of alternative sources of water are still willing to pay more for piped water but the coefficient is not significant. This indicates that other advantages are associated with house connections. This is in contrast to the attitude towards public taps where health considerations had more weight.

13.19 None of the variables reflecting personal characteristics or attitudes is significant, perhaps indicating the fact that piped water is not considered a discretionary or luxury good but a basic necessity in the arid zone.

13.20 In both options the village level variables are significant. WTP bids decrease systematically with distance from the district headquarters and with proximity to a perennial water source (village dummy = 1 for the one village with access to the Soan River).

13.21 <u>Results in Type B1 Villages</u>. The results of a multivariate analysis of WTP bids for a standard piped water system in Type B1 villages are presented in Table H-3.

13.22 These results presented a puzzle. The most obvious manifestation is the behavior of households that could be expected to value piped water. Thus households with more animals are bidding significantly less than households with fewer animals. Similarly, households satisfied with the safety of alternative sources of water are bidding higher (Rs.17 per month) than households that consider the sources unsafe for health.

13.23 Further, households with more labor supply are not bidding lower than households with less labor supply. The signs of the coefficients of the proportion of women and children are opposite of what one would expect and are insignificant as well.

13.24 However, the bids are positively (and significantly for the first two) correlated with household size, value of house and the ownership of land or property. The value of the coefficient for household size (Rs.1.5) is much smaller than in Type B2 villages (Rs.4).

13.25 These results can only make sense if interpreted in the context of the existence of very strong strategic bias. The water supplies in Type B1 villages were at the final stage of completion and were ready to be put into operation. It could be possible that the respondents considered the bidding games to be an attempt to set the monthly tariff. Only this could explain the systematic underbidding by households that could be expected to bid (and that do so, based on evidence from B2 villages in the arid zone and most other experiments in the other zones) higher for piped water.

13.26 The general level of affluence of the households seems to have determined a base level for the WTP bids with the more affluent starting from a higher level. However, beyond that, needs seem to have been quite systematically suppressed by the respondents.

13.27 If this interpretation is correct, it would suggest that the mean bid received for a standard piped system with house connections (Rs.41 per month) is an underestimate. It would bear out the contention that average willingness to pay for piped water in the arid zone is on the high side. Perhaps the mean bid in Type B2 villages (Rs.56 per month) can be considered an upper bound yielding a range of Rs.40 to Rs.55 per month as the one within which the "true" average would lie.

13.28 The results of the multivariate analysis pertaining to an improved system with house connections are presented in Table H-4.

13.29 It can be noted that no major modification needs to be made to the conclusions derived from the response to the standard system. However, as in the other environmental zones studied, for an hypothetical improved system, attitudinal variables become somewhat more significant. Thus, households aware of piped systems bid significantly higher while households that consider the provision of water to be a government obligation bid significantly lower (Rs.15 per month).

13.30 Results in Type A Villages. The results of multivariate analyses of WTP bids for standard and improved piped water systems with house connections in Type A villages are presented in Tables H-5 and H-6.

13.31 It can be noted that the explanatory power of the models is poor in comparison with the models for the other types of villages. However, there is no distortion of responses as witnessed in Type B1 villages, most of the coefficients having the correct sign without being significant. This is probably due to the fact that the system is already in operation in Type A villages so that the respondents might not have interpreted the bidding games as an attempt to set the tariff level.

13.32 The labor supply variables are both highly significant as expected, and in contrast to Type B1 villages. The only other variable which is significant is monthly household expenditure per capita. The village level variable, distance from district headquarters, is insignificant, perhaps because two of the villages are at the same distance although along different directions. The village dummy for Jawa, a village with a new water supply having operational problems, is insignificant.

13.33 The WTP estimations were based on the responses of connected households (Type A1) only because of the very small number of unconnected households in the sample (6 out of 140). When the latter are added to the regression, the variable representing connection to the system emerges as highly significant. Not much change results in the coefficients or significance of the other variables but the overall significance of the regression improves considerably.

XIV. ESTIMATED REVENUES AND COST RECOVERY POTENTIAL

Costs of Piped Water Systems

14.1 The estimation of capital costs of piped water systems in the arid zone based on a notional value of capital cost per capita did not prove very useful. This was so because the parameter is very sensitive to population size; thus, whether the population is 1000 or 2000 (the typical range in the arid zone) makes a tremendous difference to the capital cost per capita.

14.2 To overcome this limitation, the actual project costs for the six villages included in the sample (three each of Type A and Type B1) were obtained from the PHED. Actual O&M allocations for the three Type A villages were also obtained. Using these figures, averages were computed for a typical village in the arid zone. The average capital cost was Rs.143,979 for Type A villages and Rs.130,857 for the six villages. The average annual O&M costs were Rs.68,937 for Type A villages. Thus annual O&M costs as a percentage of capital costs work out to 4.8% in Type A villages and 5.3% in the six villages. This is in conformity with the 5% benchmark used by the PHED.

14.3 To obtain per capita costs and the tariff level required for full recovery of O&M costs, the populations of the six villages were averaged to obtain an estimate for a typical village. The 1981 census yields an estimate of 1230. The 1989 population was obtained by assuming a 3% annual growth rate. A similar averaging procedure yielded a typical household size of 6.3 in 1981 (this is lower than the estimate (7.5) obtained from the sample data). The above two estimates together yield the number of houses in a typical village of the arid zone. For the three Type A villages this estimate is 222 while for the entire six villages the number is 208.

14.4 The connection rate in Type A villages determined from the survey information is 95.7% (only 6 out of 140 houses surveyed were not connected by choice). Thus, one could expect 212 or 200 houses to be connected in a typical arid zone village, depending on whether the averaging is based on Type A villages or Types A and B1 villages.

14.5 Using the above data, the average capital cost per capita in the arid zone works out to be Rs.838. The monthly O&M costs total Rs.5745. Thus, the monthly tariff required for full recovery of O&M costs varies between Rs.27 (Type A villages) to Rs.29 (Types A and B1 villages). All the above data and computations are presented in Table G-6.

14.6 The existing monthly tariff for a standard PHED system with house connections in the arid zone is Rs.20.

Provision of a Standard Piped Water System

14.7 The connection frequencies and revenue estimates pertaining to the provision of a standard piped water system at different monthly tariff rates are shown in Table I-4. The plots of connections frequencies and estimated revenues against monthly tariff are shown separately for Types A, B1, and B2 villages in

Figures 14.1, 14.2, and 14.3, respectively.

14.8 It can be noted from the plots that connection frequency is very sensitive to tariff beyond a certain threshold. This threshold occurs at Rs.25 per month in Type A villages, Rs.15 per month in Type B1 villages, and Rs.35 per month in Type B2 villages.

14.9 As remarked earlier in comparing Type A and Type B1 villages, the connection frequency in Type A villages is a better guide to actual behavior. Therefore, we can expect that a rise in tariff from Rs.20 to Rs.25 per month would not cause any lowering of connection frequency. If we further assume that there was strategic underbidding in Type A villages and overbidding in Type B2 villages we can expect that a tariff rate of between Rs.25 and Rs.30 per month would result in connection rates ranging from 95% to 85%.

14.10 At these connection rates and tariffs, the estimated monthly revenue would be approximately Rs.2500 per 100 households in the village. Using an average of 212 for the number of households in a typical village the total monthly revenue generated would be Rs.5,300, which is in the same neighborhood as the monthly O&M requirement estimated from cost data (Rs.5745).

14.11 It seems clear that tariffs can be raised to Rs.25 per month from the existing Rs.20 per month without any negative impact on connection rates. Tariff rates up to Rs.30 per month remain in the feasible range. Between Rs.25 to Rs.30 per month full recovery of O&M costs is possible. This would be even more certain with a very small increase in the number of households over the next few years (it should be kept in mind that the PHED designs systems using projected populations ten years from the date of approval of a scheme as their relevant population base).

<u>Provision of an Improved Piped Water System</u>

14.12 The connection frequencies and revenue estimates pertaining to the provision of an improved piped water system at different monthly tariff rates are shown in Table I-5. The plots of connection frequencies and estimated revenues against monthly tariffs are shown separately for Types A and B1 villages in Figures 14.4 and 14.5, respectively.

14.13 It can be seen that the tariff threshold is Rs.35 per month. Beyond Rs.35 connection frequencies fall steeply from around 85% to around 65%, much too low a rate for the arid zone. At Rs.35 per month the monthly revenues generated in a typical village of 212 households would be approximately Rs.6400.

14.14 At this moment we are not in a position to state the extent to which the O&M expenses would increase for the kind of improved system described earlier. However, the capital costs are certain to be significantly increased. This seems to suggest that, at present, such radically improved systems are premature in the typical arid zone village. However, households in larger villages with sufficient length of experience with standard piped water systems might be willing to pay tariff rates that could make the policy of providing selective improvements worth investigating.

FIGURE 14.1

FIGURE 14.2

FIGURE 14.3

FIGURE 14.4

FIGURE 14.5

Provision of a Piped Water System Based on Public Taps

14.15 Households in Type B2 villages were asked to bid on two different levels of service provision: public taps and a standard system with house connections. The comparative connection frequencies and revenue estimates are presented in Table I-6. The comparative plots of connection frequencies and revenue estimates against monthly tariff are shown in Figures 14.6 and 14.7.

14.16 It can be seen that if the target is to achieve at least a 85% connection rate, the monthly tariff for using public taps cannot exceed Rs.15 while the same percentage of households are willing to pay Rs.35 a month for house connections. The preference for a system based on house connections seems to be quite clear; over 13% households are not willing to pay anything for a system based on public taps while the comparable figure for house connections is 2.5%.

14.17 As shown earlier, the revenues generated from a system with house connections in a Type B2 village would be sufficient to fully recover O&M costs. This might not be the case for a system based on public taps since it is reasonable to assume that the O&M costs for the two systems would not be significantly different[19/]. In addition, the difficulties in collecting payments from public tap systems are well known.

14.18 We have some evidence available for the difference in capital costs for the two options. PHED data revealed that a village in the same vicinity as the study villages was originally scheduled to receive a system based on public taps.[20/] The detailed cost estimate prepared in 1986 was for a sum of Rs.1,600,000. However, on the representation of village notables, supported by elected representatives from the area, it was decided to provide house connections instead.[21/] The revised estimate was for the sum of Rs.2,280,200. The revision reflected a capital cost escalation of 42.5%. In per capita terms the capital cost rose from Rs.576 to Rs.821. (The per capita costs are based on an estimated 1987 population size of 2776). This represents a fairly significant escalation of capital costs.

19/ Savings are likely only on distribution system repair. These are estimated at 1/12% per annum of the capital cost of the distribution system. A typical estimate of the latter is Rs.600,000. This would yield a saving of Rs.500 per year which is less than 1% of the typical annual O&M cost.

20/ The scheme provided for four 2000 gallon capacity RCC ground storage tanks each with a battery of taps.

21/ Scheme based on one overhead 4000 gallon capacity tank.

FIGURE 14.6

FIGURE 14.6

FIGURE 14.7

XV. CONCLUSIONS AND POLICY SUGGESTIONS

The Nature of Demand for Water in Rural Areas

15.1 The most important finding of this study pertains to the nature of the demand for water in rural Punjab. The actual water supply situation in many of the sample villages was considerably more complex than commonly assumed. It seems clear that the perspective within which policy-makers viewed rural water supply was in the process of being rendered out of date by the pace of development.

15.2 Within Pakistan, the policy regarding rural water supply has been motivated by the objectives of health improvements via the provision of better quality water and time savings via the location of more accessible sources. Implicit in this perspective is a categorization of water as an end product, a commodity required for such direct uses as drinking, cooking, bathing, etc. Within the study area, this perspective was found to be valid only in the arid zone.

15.3 In the central canal-irrigated part of Punjab, there was a growing demand, not for water as an end product, but for water-based amenities like indoor plumbing, showers, and flush toilets. However, this demand cannot be serviced by handpumps or even public standpipes. It requires a higher level of service. What rural households are doing to fulfill their aspirations has both important economic consequences and far-reaching policy implications.

15.4 The Sweet Water Area as an Illustrative Case. The sweet ground water area of Central Punjab provides the best illustration of the above-mentioned issues. The quality of the ground water is good and it is available at easily accessible depths. Households have already upgraded their level of service from the traditional source of supply, public wells, to private handpumps inside the house. These handpumps provide convenient access to good quality water fit for all usages. The service is reliable, being efficiently installed and maintained by the local private sector, and inexpensive to maintain. Every household in the sample had a private handpump inside the house. It can be surmised that households have made this expenditure (Rs.1000 capital costs, in current value, for the pump and the shallow well; Rs.6 per month for maintenance) to avoid the inconvenience of having to fetch water from outside the house.

15.5 The official policy in the sweet water zone is not to provide public piped water supplies. This policy is based on the reasoning that private initiative has succeeded in providing convenient access to good quality water. However, the survey results indicate that a second upgradation of service levels is well underway. Many households are willing and able to pay for a higher level of service and in the absence of reliable piped water supplies they have installed electric motors on their wells at considerable expense. The electric pumps lift water to private overhead tanks from which water can be used for showers, flush toilets and other indoor plumbing services. Thus, the services which could be provided by public piped water supply systems are being replicated at the individual household level. Does the official policy retain its validity in these changed circumstances?

The Private Upgradation of Service Levels in Central Punjab

15.6 In villages without piped water in the sweet water zone, 30% of the sample households had installed an electric motor. In the brackish water zone the comparable figure was 62% (the percentage is higher, perhaps, because, in addition to the other benefits, electric pumps also provide somewhat better quality water than handpumps in the brackish zone by lifting water from greater depths). This is a very high percentage and clearly indicates the trend in the Central Punjab villages.

15.7 In villages with piped water, the percentage of households with electric motors falls to 11% in the sweet water zone and to 33% in the brackish water zone. This suggests that piped supply systems with house connections are clearly perceived as substitutes for electric motors. However, in such villages, 7% of the households in the sweet water zone and 29% in the brackish water zone continue to maintain both options. This brings to the fore the critical issue of the reliability of the various service options.

15.8 A household's decision on how to satisfy its water needs is heavily influenced by the reliability of the different service options. A private handpump is almost completely reliable because it can be repaired locally and is entirely under the control of the household. In the sweet water zone the water from the handpump is adequate for all usages, but the handpump cannot provide the amenities of indoor plumbing, showers and flush toilets. If the household wants and can afford such amenities, it has three choices in villages with public piped supplies: (1) to connect to the public system, (2) to install an electric motor, or (3) both.

15.9 In the brackish water zone, the first choice ought to be the dominant one. The piped supply not only provides better quality water but its private costs to the household are much less. The fact that 29% of households maintain both options is only due to the limited hours of supply from the public system and its poor reliability. This poor reliability imposes a high cost on households and, at the same time, undermines the economic viability of public piped water systems.

15.10 Financial Cost to an Average Household of Different Service Options. The approximate costs to an average household in the brackish water zone of various water supply options are shown in Table J-4. The handpump provides a base level of service at a total monthly cost of about Rs.18 per month. A household with both a handpump and a connection to a piped water supply would pay Rs.12 per month to the PHED for the water tariff and Rs.5 per month for operation and maintenance of its handpump. The monthly capital costs for both the handpump and the connection to the distribution supply would be Rs.19 per month for a total monthly cost of Rs.36. A household with an electric motor on its handpump would spend much more - about Rs.58 per month. Households with both an electric motor and a domestic connection are estimated to pay Rs.76 per month.

15.11 A reliable piped water service ought to cost a household approximately Rs.18 per month at existing tariff rates. Instead, households wanting upgraded services are paying about Rs.76 per month for the same level of service. The piped water system is not fulfilling its potential. It is functioning as a supplement to the handpump in the sweet water zone and as a substitute (better quality water) for the handpump in the brackish water zone. Reliable upgraded services can only be secured at present through investment in a private motor-operated system.

15.12 Who Demands Higher and More Reliable Service Levels? The survey results indicate (see Table J-5) that, as expected, it is the wealthier, more educated households that are demanding higher levels of service. The average construction value of houses of households with only a private handpump in the brackish water zone (in villages with piped water supplies) was Rs.62,000. For households with both a private handpump and an electric motor it was Rs.115,000. For households with a handpump, electric motor and a domestic connection, it was Rs.145,000. In villages with a piped water system in the sweet water zone, in households with only a private handpump, the most educated member of the household had an average of 6 years of education. For households with a handpump and an electric motor, the average was 12 years of education.

15.13 Village elites have always exerted a powerful demonstration effect on the rest of the population. At one time the elite used to be recognized by the possession of a brick house or an electricity connection. Now the distinguishing characteristic is indoor plumbing and flush toilets. If historical experience is any guide, the choice of the elite is a clear pointer to the trend of the future.

The Economics of Village-Level Water Supply Options

15.14 The efforts by households individually to provide themselves with improved water services entail substantial expenditures in the aggregate. Table J-6 presents an estimate of the actual amount of money currently being spent on private water provision in a typical village with a population of 5000 people without a piped water supply in the brackish water zone. Assuming 62% of the households have a handpump with an electric motor and 38% have only a handpump, households in such a village have already invested over Rs.1 million (in current value) for private handpumps and electric motors. The operation and maintenance costs of these privately provided water systems is estimated to be Rs.9800 per month. The total monthly costs of these systems are about Rs.23,900.

15.15 Based on cost data from the PHED in Punjab, a new piped water system for a village with a population of 5000 would cost about Rs.1,800,000- including the cost of 100% of the households connecting to the distribution system. The monthly operation and maintenance costs of a piped water system are estimated to be about Rs.3800 for a total monthly cost of Rs.19,800.

15.16 Given the approximate nature of these estimates, the total costs of a piped distribution system are essentially the same as the amount households are already spending for handpumps and electric motors. However, the estimated operation and maintenance costs of the privately provided handpumps and electric motors is over two and a half times the operation and maintenance costs of the piped water system. The estimates of the costs of the piped system assume that 100% of the households in the village are connected, the estimates of actual expenditures assume that 38% of the households only have a handpump. In this sense the cost estimates are not comparable because the piped water system provides a higher level of service for a greater number of people.

15.17 Willingness to Pay for Piped Water Supply. It is in the above context that the willingness to pay for piped water ought to be evaluated. Once again we take a village of 5000 people (562 households) in the brackish zone as an example. In such a village without piped water, the mean willingness-to-pay bid for monthly tariff for a standard piped water system with house connections was Rs.40 (this was in addition to the one-time costs of approximately Rs.600 required for connecting to the system). The summation of the households' willingness-to-pay bids yields a monthly total of Rs.22,500. This figure is essentially the same as the amount households are already spending on water (Rs.23,900). This correspondence increases the confidence in the credibility of the willingness-to-pay bids.

15.18 In practice, it is not possible to recover the entire willingness-to-pay amount because of the infeasibility of enforcing differential tariffs in the same village. The survey results indicate that in a village of the type being discussed, 78% of the households would connect to a standard piped water system with house connections if the monthly tariff were set at Rs.25. In addition, they would bear the costs of connecting to the distribution line (Rs.500, approximately) and pay a connection fee to the PHED (Rs.80). The estimated revenue based on these numbers is Rs.11,400 per month (see Table J-6). If a piped water system is designed for 78% of the population, the total monthly cost to the PHED would amount to Rs.13,400 (Rs.10,500 capital, Rs.2900 O&M). These estimates suggest that a very substantial proportion (85%) of the total costs of a public piped water system can be recovered under the conditions described above.

15.19 Willingness to Pay in Villages with Piped Water. The willingness to pay for piped water in villages with existing supply systems is much lower compared to villages without piped water systems. This is, perhaps, because the latter are not aware of how the service would operate while the former have sufficient cause to be dissatisfied.[22/] The mean WTP bid in a village with piped water in the brackish zone was only Rs.16 per month compared to Rs.40 per month in the village without piped water. However, when the option of an improved, more reliable service was offered to the households in the village with piped water, the mean bid increased to Rs.33 per month while the percentage of households willing to connect went up to 95% from 75%. This again underscores the premium which households place on system reliability.

22/ A contributory reason could be the anchoring effect of the existing tariff (Rs.12 pr month) which is known to the respondents in the village with piped water.

The Arid Zone

15.20 The situation in the arid zone of Northern Punjab is quite different from the sweet water and brackish water zones of Central Punjab. In the arid zone at the present time the demand is for water itself and not for water-based amenities. This is because of the scarcity of water and the low base level of service available to villages (public wells and surface water). Households spend an average of 5 hours per day to fulfill their water needs during the peak summer months compared to 4 hours per week in the brackish zone and even less in the sweet water zone.

15.21 The demand for private sources is, however, quite strong; 24% of the households have installed private sources while another 5% have made an unsuccessful attempt. This is despite the fact that the costs of installing private sources in the arid zone are much higher (approximately Rs.8000 with a monthly maintenance cost of Rs.40). However, these private sources, wells or boreholes, can not, in general, provide access to higher service levels. The installation of private sources is not systematically related to socioeconomic characteristics of households since the very possibility is based on the fortuitous circumstance of an appropriate location of the house such that the ground water is accessible.

15.22 It is for the above reasons that connection rates to piped systems are almost 100%, much higher than in the sweet water and brackish water zones. This is so despite the fact that the arid zone is economically less developed than the other two zones, the average village size is much smaller and the monthly tariff is much higher (comparative information for the three zones is provided in Tables J-7 and J-8).

15.23 The official policy of the PHED, of not providing house connections to villages with less than 5000 inhabitants, is not being followed in the arid zone. This has resulted in much higher capital costs per capita (approximately Rs.840) because of the small village sizes. The survey results indicate that while O&M costs can be fully recovered, it is not possible to recover the capital costs to any significant extent.

Discussion

15.24 Collective Water Supplies. As long as the highest service level demanded was the private handpump, the policy of leaving the sweet water area to be served by the private sector was justifiable. However, with a significant proportion of the population replicating a piped water system at the individual level, the policy is in need of fresh evaluation. As mentioned earlier, while the capital costs of a piped water system and private upgradation through the installation of electric pumps are comparable, the O&M costs of the latter are almost two and a half times the costs of the former. Private upgradation is not likely to be the socially optimal option.

15.25 The alternative to individual upgradation is not necessarily public piped water supplies but collective ones. Privately built and managed water systems should not only increase community participation but should also prove to be less expensive to build, thus enhancing the prospects of full cost recovery. In this context the observations of Briscoe (1987) need to reiterated:

> In government-built water supply projects the role of the private sector is much more problematic. In the Punjab and Sind the private sector has a major role - drilling and civil and mechanical works are all contracted out to the private sector. In principle this should make for an efficient sector. In practice, however, the situation appears to be quite different. It is widely acknowledged - by government officials and others knowledgeable about the sector - that there is extensive collusion between the contractors and the government agencies, a relationship based on kickbacks to the government officials, and resulting in construction costs which are much higher than need be the case. In such a system there is an incentive for both officials and contractors to build over-designed, expensive systems. As an illustration of the inefficiencies in this system, the Orangi Pilot Sewerage Project in Karachi, in which the community, not the government, finances the works, the costs of sewering houses has been reduced by over 80%.[23/] Project officials attribute the cost reductions to two factors - attention to reducing costs wherever possible, and elimination of the contractor-official corruption.

15.26 There is one other reason which makes the consideration of collective systems necessary. It has been fairly well established that the transition to higher service levels (piped connections and electric pumps) leads to an increase in the use of water. This was confirmed in the sample villages where drainage has emerged as a serious problem. Whereas it is possible to upgrade the water supply at an individual level (even if socially inefficient), it is not possible to resolve the resulting drainage problem on an individual basis. A collective solution becomes unavoidable.

15.27 Reliability. Because of the poor quality of the ground water, public piped water supplies are being built in the brackish water zone. In principle, because the amount being spent on private upgradation of services is so substantial, the discussion regarding private, collective water systems should be equally applicable to the brackish zone. However, as mentioned earlier, piped supplies, irrespective of whether they are public or private, have to be much more reliable to be able to compete effectively with the individual upgradation of service levels.

15.28 The survey suggests that the reliability of piped systems is a crucial element in achieving cost recovery. It is quite clear that people are willing to pay significantly more for a reliable system. This is demonstrated by household investment in multiple water systems: handpumps, piped connections and electric motors. It was mentioned earlier that in villages with piped water in the brackish water zone, almost 30% of the households maintained both electric motors and piped connections, spending Rs.76 per month as against the Rs.18 for

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23/ This figure may be too high. The original costs of sewering a house were about Rs.2,500. The Orangi Project's cost was about Rs.800.

the piped connection alone. It is quite clear that for public utilities to compete effectively against private providers of handpumps and electric motors, their reliability must be improved.

15.29 In a hot and dry agricultural area such as Punjab it does not seem possible for reliability to be effectively increased without the metering of household connections. This is because the demand for water at zero marginal cost (i.e., unmetered connections) is immense. One finding of the survey illustrates this point well. In villages with piped water supplies households with animals were willing to pay more for connections. Investigations indicated that the reason was the convenience in washing animals. Buffaloes, which need to be kept cool in the summer, could be hosed down at home, rather than be taken to the canal or the village pond, thus saving on time and supervision costs. Water for drinking by animals could also be provided through the domestic connection.

15.30 This finding highlights an oversight which has significant implications for the design of rural water supply systems in Pakistan. The PHED design criteria at present take into account human needs only and use a consumption benchmark of 10 to 15 gallons per capita per day. However, if households use the water to cater to animal needs also, including water-intensive ones like washing, the design estimate could be easily exceeded. It was estimated in the survey that while the minimum quantity of water required for essential human consumption varied between 20 to 30 litres per capita per day, the minimum quantity required for animal needs varied between 40 and 60 litres per animal per day (estimate based on the amount of water which, in situations of emergency, would have to be fetched from outside the house in the sweet and brackish zone and purchased from vendors in the arid zone). This means that a household with 8 members and 2 cattle (the average in the arid zone) would need approximately 200 litres for human consumption and 100 litres for animal needs. This 50% increase, which should hold for normal, non-emergency consumption patterns also, is much more than the 5% to 10% margin added on by the PHED to total estimated human consumption for all other usages (public buildings, schools, mosques, animals, etc.). Perhaps, this is one explanation for the ubiquitous problem of low pressure which characterizes rural water supply systems in Pakistan.

15.31 In such an environment, if connections are not metered, then water must inevitably be rationed by reducing the reliability of the system. If reliability is reduced, people must secure other sources, and their domestic connection becomes a back-up supply. Table A-12 provides evidence from the sweet water zone. The majority of households stated that they would keep their handpumps operational either permanently or at least until such time as the piped water system could supply water with regularity. In a village in which the piped supply system had fallen into disuse, 12.5% of the households had dismantled their handpumps at the time of obtaining the connection. They were forced to reinstall them because of the poor performance of the system. It is not surprising, therefore, that 94% of the households in this village indicated a resolve to keep their handpumps operational permanently even if the piped supply was restored.

15.32 In such situations the willingness to pay for piped water is much reduced. The PHED then cannot collect the resources it needs to run the system efficiently. A vicious circle of system deterioration and lowered willingness to pay ensues.

15.33 The concept of metering household water connections is quite acceptable in the rural areas of Punjab. The percentage of households that favored metering varied from 54% in the sweet water zone to 81% in the brackish water zone. The statistical results also revealed that such households were consistently willing to pay more in tariff for piped water systems.

15.34 There is another important reason for concentrating on system improvement. The economic viability of public piped water systems requires enhanced tariffs. Households are willing to pay significantly higher rates (see Table J-9) but only if they are accompanied by the improved performance of existing systems. A package of tariff increases tied to selective improvements would be quite acceptable to the households surveyed. This seems the only feasible way to move towards economic viability and to break the vicious circle mentioned earlier.

15.35 Public Standpipe Systems. It is quite clear that households prefer piped systems with domestic connections and are willing to pay much higher rates than thought possible earlier (see Tables J-9, J-10, and J-11). Even so, if such service is to be extended to small villages of 1000 to 1500 people, as is being done in the arid zone, it would have to be subsidized to a considerable extent.

15.36 It seems unlikely that the higher per capita capital expenditure can be recovered. In such situations it would be worthwhile to experiment with less expensive standpipe systems.

15.37 Standpipe systems should be adequate in the small villages of the arid zone since the overwhelming demand is for convenient access to water and not for water-based amenities. Contrary to the prevailing view about the acceptability of standpipe systems, households in villages without piped water were willing to pay reasonably high rates for such systems. The mean bid was Rs.35 per month and 68% of households would subscribe to the service at a tariff as high as Rs.25 per month (this tariff exceeds the present monthly tariff for piped systems with domestic connections (Rs.20) in the arid zone).

15.38 The main drawback of standpipe systems as they have been organized thus far relates to the problems of revenue collection owing to difficulties in monitoring actual usage. Some experimentation on a pilot basis with alternative structures is certainly warranted. For instance, a system based on manned kiosks should overcome the problem and require no more manpower than the present structure. Since piped systems operate for four hours a day at most, the existing full-time staff is under-utilized. The option of giving the kiosks on private contract could also be explored. Even if households purchase only 100 litres of water per day (about the average essential daily consumption for family needs in the winter) at Rs.0.10 per can of 16 litres (one tenth the existing price of vended water), the revenues realized per household would be of the order of Rs.20 per month. These would be sufficient to recover O&M costs and some part of the capital costs as well.

15.39 Organizational Issues. Any serious attempt to encourage communities privately to construct and manage water supply systems would involve difficult organizational issues. Experience has proved that collective responses to such needs do not arise by themselves but need patient groundwork, the availability of external technical expertise and accessible credit facilities.

15.40 The experience of the successful Orangi Pilot Sewerage Project in Karachi bears out the above point, even though the project required only an intermediate level of collective effort between the completely individual and the completely collective. In a sewerage project, the lane could function as the organizational unit, and a successful demonstration could induce other lanes to participate. This is not possible in a water supply project where a much larger proportion of the population has to reach an understanding before the project can be initiated.

15.41 The organizational problem is made more difficult by the fact that, contrary to the popular presumption in development circles, the villages were not willing to assume responsibility for the provision of water. Over 65% of households in all three environmental zones believed that a water supply system would be best managed by a government agency in preference to local political bodies, village water committees, or private entrepreneurs. This is perhaps a reflection of the sharp clan and political divisions that characterize villages (especially those with sizeable populations) in Punjab. These divisions affected the perceived effectiveness or fairness of elected political bodies or village committees to manage collective systems. It was considered a lesser evil to leave the system to a neutral agency, external to local village politics, even though it was inefficient. Perhaps a publicly provided but privately managed water utility would be just as acceptable and more efficient, although this alternative has not been experimented with in Pakistan. The concept was not familiar to respondents who remain wary of the lack of accountability of the private sector and the general failure of government attempts at its regulation in many other spheres of activity.

15.42 At the same time, it is clear that the solution does not lie in raising more revenues and giving them to the PHED as it is structured at present. The PHED is primarily an engineering agency and is not equipped to involve the community in decision-making or even to carry out the tasks of revenue accounting and collection in a satisfactory manner. In this, it is handicapped by the fact that in principle the PHED is supposed to hand over the management of the systems to local councils after an initial period of two years. However, the latter have neither access to the technical expertise required for maintenance and operations nor the political unity to impose effective revenue collection in the factionalized villages. As a result, the systems are inevitably handed back to the PHED after a period of mismanagement. The consequence of the lack of a clear policy in this regard has been that neither body has been equipped to the degree necessary to manage rural water supply systems in an effective manner. A resolution of this situation should be the first step in the reform of the rural water supply sector.

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Appendix-A

Statistical Tables

Table A-1

Village Profiles

	Ghazi Minara	Bhaddroo Minara	Kharian Wala	Mirza Virkan	Jandiala Sher Khan
Area* (acres)	2087	1484	4852	3560	4868
Population*	4514	2173	8990	5630	7581
Household Size*	6.7	6.2	6.7	6.9	6.6
(from sample, 1988)	(9)	(9)	(10)	(10)	(9)
Literacy Ratio*	28.6	17.6	22.7	14.0	24.0
% Males - Matric and above	8.9	5.4	6.0	4.7	9.5
% Females - Matric and above	1.7	1.9	0.8	0.4	2.6
Distance from District Headquarters (Km)	2	2	18	10	14
Road Location	On Main Road	Off Secondary Road	On Main Road	Off Secondary Road	On Secondary Road
Presence of Facilities					
Electricity	Yes	Yes	Yes	Yes	Yes
Telephone	Yes	No	Yes	No	Yes
Medical	No	No	Hospital	Clinic	Hospital
Male Education	Middle School	Middle School	High School	High School	College
Female Education	Middle School	Middle School	Middle School	Middle School	College
Bank	No	No	Yes	No	Yes
# Union Council Members from Village	5	2	4	5	9
# District Council Members from Village	0	0	1	2	1

* Figures from 1981 Population Census. All others from field visit.

Table A-2

Village Profiles*

	Ghazi Minara	Bhaddroo Minara	Kharian Wala	Mirza Virkan	Jandiala Sher Khan
Household Size	9	9	10	10	9
Percentage of:					
- Adult Women in Household	28	24	24	25	24
- Children in Household	34	35	41	38	38
Years of Education of Most Educated:					
- Member of Household	9	7	9	7	8
- Woman in Household	4	4	2	2	4
Essential Water Consumption (liters/capita/day)	24	27	23	17	20
Households Involved in Farming (%)	21	29	19	42	26
Households with Land or Other Property (%)	54	61	73	76	55
Construction Value of House ('000 Rs.)	80	65	98	51	104
Households with External Exposure (%)	43	23	31	29	37
Households that Believe Water should be Supplied Free (%)	64	48	22	44	50
Households that Believe Water can be Supplied Free (%)	64	35	29	34	39
Households that Believe Water Supply Systems should be Managed by PHED (%)	54	71	71	78	72
Households that Favor Metering of Water (%)	75	68	55	60	42

* All statistics are derived from the sample observations.

Table A-3

Profiles by Village and Household Type*

	Village Type			Household Type				
	A	B1	B2	A1	A2	B11	B12	B2
Household Size	9	10	9	11	8	10	10	9
Percentage of:								
- Adult Women in Household	24	24	26	24	24	25	22	26
- Children in Household	38	41	34	42	34	40	44	34
Years of Education of Most Educated:								
- Member of Household	8	9	8	9	6	9	8	8
- Woman in Household	4	4	3	5	3	5	4	3
Essential Water Consumption (liters/capita/day)	19	23	26	20	17	22	25	26
Households Involved in Farming (%)	31	19	25	29	34	20	17	25
Households with Land or Other Property (%)	61	72	58	68	52	75	67	58
Construction Value of House ('000 Rs.)	87	97	73	110	57	113	60	73
Households with External Exposure (%)	35	31	31	37	32	37	17	31
Households that Believe Water should be Supplied Free (%)	48	22	56	44	52	23	22	56
Households that Believe Water can be Supplied Free (%)	38	29	49	33	43	30	28	49
Households that Believe Water Supply Systems should be Managed by PHED (%)	74	71	63	73	74	73	67	63
Households that Favor Metering of Water (%)	47	55	71	47	48	63	39	71

* All statistics are derived from the sample observations.

Table A-4

Pattern of Household Choice over Available Service Options and Approximate Private Costs

Village Type/Costs		Manual Handpump Only	Motorized Handpump Only*	Domestic Connection Only	Domestic Connection + Manual Handpump	Domestic Connection +Motorized Handpump
		Available Service Options				
Type A Village:						
No. of households		59	6	0	69	10
% of households		41.0	4.2	0	47.9	6.9
Type B Village:						
No. of households		82	35	NA**	NA	NA
% of households		70.1	29.9	NA	NA	NA
Costs**** (Rs.)						
Capital:	Handpump	1000	1000		1000	1000
	Motor		2000			2000
	Overhead Tank		500			500
	Connection Cost			500	500	500
	Total	1000	3500	500	1500	4000
O & M : (per month)	Handpump	6	6		6	6
	Motor		16			16
	Electricity		NA***			NA***
	Tariff			10	10	10
	Total	6	22+	10	16	32+

* A motorized handpump can be used manually in case of power failures.
** N.A. indicates service level not available. Domestic connections are not available in Type B villages.
*** Respondents were unable to estimate the electricity charges attributable to operating the motor.
**** Capital costs are approximate values in current prices; O&M costs are obtained from sample responses.

Table A-5

Reasons Mentioned by Households Ever Connected to Piped Water System for Obtaining a Domestic Connection - Types A and B1 Villages

Reason	% of Households Indicating Reason as	
	Reason No.1	Reason No.2
Convenience	60.9	42.1
Better Quality	20.9	29.0
Reliability	8.2	10.5
Other Reasons	10.0	18.4

Table A-6

Reasons Mentioned by Households Not Connected to Piped Water System for Not Obtaining a Domestic Connection - Type A Village

Reason	% of Households Indicating Reason as		
	Reason No.1	Reason No.2	Reason No.3
Expense	57.8	44.0	0.0
No Need	21.9	40.0	50.0
Not Reliable	17.2	8.0	50.0
To Avoid Illegal Transactions	3.1	4.0	0.0
Poor Quality	0.0	4.0	0.0

Table A-7

Relationship Between Economic Standing and Choice of Service Level - Type A Village

Choice of Service Level	Average Value* of House (Rs.)
Manual Handpump Only	48,473
Manual Handpump and Domestic Connection	96,174
Motorized Handpump Only	137,500
Motorized Handpump and Domestic Connection	208,500

* The monetary amount that would be needed to reconstruct the type of house the respondent is living in is used as an indicator of economic standing. The average value of this indicator over all households in the Type A village is Rs.87,229.

Table A-8

Level of Satisfaction with Piped Water Supply System - Type A Village

Level of Satisfaction	A1 Households		A2 Households		Total	
	No.	%	No.	%	No.	%
Satisfied	48	60.8	44	67.7	92	63.9
Dissatisfied	31	39.2	19	29.2	50	34.7
No Response	0	0.0	2	3.1	2	1.4
Total	79	100.0	65	100.0	144	100.0

Table A-9

Major Shortcomings of Piped Supply System Mentioned by Households Dissatisfied with the System - Type A Village

Characteristic	% of Households Indicating Characteristic as			
	Shortcoming # 1		Shortcoming # 2	
	All Households	Connected Households	All Households	Connected Households
Reliability*	38.5	38.7	19.2	22.6
Maintenance/Design**	28.8	25.8	13.5	16.1
Interaction with Staff***	25.0	32.3	17.3	25.8
No Response	7.7	3.2	50.0	35.5

* Includes: insufficient pressure, frequent failures, and power breakdowns.
** Includes: sub-standard material, poor distribution layout, and lack of cleanliness.
*** Includes: irresponsible, uncooperative, and corrupt staff.

Table A-10

**Most Important Improvement in Piped Supply System
Desired by Households -- Type A Village**

Characteristic	% of Households*
Greater Pressure	31.6
Cleanliness	10.1
Increased Supply	7.6
Larger Storage Tank	6.3
Use of Standard Material	6.3
Reliability	5.0
More Competent Staff	3.8
Lower Price	2.5
Improved Billing Procedure	1.3
Satisfied	11.4
No Response	13.9

* Percentages do not add up to 100 because of rounding.

Table A-11

Household's Information/Beliefs Regarding Characteristics of Piped Water and Alternative Supply Systems

Characteristic	Type of Household				
	A1	A2	B11*	B12	B2**
Price Charged (% responding yes)	98.7	-	100	-	-
Billing Frequency (no. of times per year)					
Mean	12.0	-	9.0	-	-
Std. Deviation	1.9	-	4.0	-	-
Existing Monthly Tariff (Rs.)					
Mean	10.0	10.0	10.0	9.8	15.8
Std. Deviation	0	0.1	1.8	1.1	16.5
% of hhs responding	97.4	76.9	100	61.1	6.8
Total No. of Hours of Water Supply per Day					
Mean	9.0	9.0	9.6	7.6	3.7
Std. Deviation	6.3	5.1	4.5	5.3	3.0
% hh < = 4 hours/day	30.6	23.3	10.0	31.3	91.2
No. of Hours of Additional Supply Required to Meet Needs					
Mean	9.1	-	-	-	-
Std. Deviation	6.3	-	-	-	-
Frequency of Supply Failure***					
Mean	1.65	-	0.35	-	-
Std. Deviation	1.50	-	0.02	-	-
Piped Water: (% responding yes)					
Satisfaction with taste	100	-	97.5	-	-
Satisfaction with cleanliness	97.4	-	95.0	-	-
Satisfaction with hygiene	98.7	-	95.0	-	-
Alternative Water:(% responding yes)					
Satisfaction with taste	89.7	100	87.5	88.9	96.6
Satisfaction with cleanliness	97.4	100	95.0	100	100
Satisfaction with hygiene	97.4	96.9	80.0	94.4	94.9

* Information regarding piped water pertains to period when scheme was operational.

** Information regarding piped water pertains to estimates.

*** Regular supply =0, < once a week =1, once a week =2, > once a week =3, Other = 4; index constructed by summing and taking mean.

Table A-12

Number of Years Households Would Keep Handpumps Operational if a Piped Water Supply System Existed in Their Village

Response	Village Type		
	A	B1	B2
Until Piped Supply is Regular	52.1	5.6	25.4
Forever	5.6	94.4	69.5
For Up to 6 Years	0	0	5.1
Dismantle Immediately	1.4	0	0
No Response	41.0	0	0

Table A-13

Household Preference Regarding Responsibility for Operation and Management of Piped Water Supply Systems

Management Option	Ever Connected Households (%)	Unconnected Households (%)	All Households (%)
PHED (Government Agency)	73.1	68.3	70.5
Local Councils (Elected Political Body)	11.8	9.9	10.7
Village Committee	7.6	9.9	8.8
Private Entrepreneur	4.2	4.2	4.2
Indifferent	3.3	7.7	5.7

Appendix-B

Multivariate Analysis of Household Choice

and

Factors Affecting Willingness to Pay

B. Adjusted Willingness-to-Pay Bids

1. In the statistical analysis of the factors affecting the willingness to pay for improved services the dependent variable is the willingness-to-pay bid. Because of some incompleteness and inconsistency in the design of the bidding games certain adjustments have had to be made to a few of the bids elicited from the respondents. These adjustments are explained below.

2. When a respondent said "no" to the lowest bid value in a bidding game without having said "yes" at any stage it remained unclear whether his bid should be treated as a protest bid or a genuine zero bid or whether it ought to be assigned a value between zero and the lowest bid value. This issue was of some significance because in some games the lowest bid value was Rs.15 which is higher than the existing tariff of Rs.10 per month for a domestic connection.

3. This problem was resolved by relying on the response received to another question. The respondents had been asked to indicate the characteristics of what they considered to be an ideal piped water system and to indicate what monthly tariff they would be willing to pay if such a system were made available. The following rule was adopted for adjusting the bid received in the bidding game (only for those who did not say "yes" at any stage in the bidding game but said "no" at Rs.15 in the bidding game).

Bid Offered for Ideal System	Adjusted Bid Value for System Offered in Bidding Game
No Response	Protest Bid
Zero	Genuine Zero Bid
Rs.1 to Rs.5	Response placed in interval Rs.0-5
Rs.6 to Rs.10	Response placed in interval Rs.5-10
Greater than or equal to Rs.11	Response placed in interval Rs.10-15

Similar adjustments were made for those bidding games where the lowest value in the bidding game was Rs.5 per month.

4. In one bidding game (Standard System Village B2) there was an inconsistency between the high and low starting point versions. The low starting point version did not contain a bid value of Rs.15 per month so that the bid interval was Rs.10-20, whereas the high starting point version contained both intervals Rs.10-15 and Rs.15-20. The two versions were made consistent by allocating a bid received in Rs.10-20 interval in the low starting point version to either the Rs.10-15 interval or the Rs.15-20 interval based on the value offered for the ideal system. If the latter was greater than Rs.15, the bid was placed in the Rs.15-20 interval. Otherwise it was placed in the Rs.10-15 interval.

Table B-1

Decision to Install an Electric Motor

Results of a Logit Model

Dependent Variable: Probability That a Household Would Install an Electric Motor

Independent Variables	Parameter Estimate	T-Ratio	Parameter Estimate	T-Ratio	Mean Values
Intercept	- 4.71	- 2.74**	- 4.87	- 5.40**	
Household Size	- 0.28E-1	- 0.62			9.23
Water Consumption	0.34E-2	- 0.54			21.62
Proportion of Adult Women	0.43	0.20			0.26
Proportion of Children	0.35	0.24			0.41
Construction Value of House	0.67E-5	3.12**	0.65E-5	3.26**	84432
Ownership of Land or Property (1 if Yes)	1.43	2.46**	1.25	2.43**	0.63
Age	0.14E-1	- 0.81			50.29
Education	0.34	4.25**	0.33	4.31**	8.26
Occupation (1 if Farming)	- 0.21	- 0.42			0.27
Meter (1 if Yes)	- 0.78	- 1.75*	- 0.78	- 1.82*	0.55
Free Supply (1 if Yes)	0.48	1.07	0.34	0.83	0.43
External Exposure (1 if Yes)	0.41	0.95			0.33
Household Dummy					
- A	- 1.12	- 1.72*	- 1.23	- 2.04**	0.56
- A1	- 1.39	- 1.86*	- 1.22	- 1.74*	0.32
- B11	- 0.86	- 1.39	- 0.93	- 1.65*	0.16
- B12	- 0.87E-1	- 0.11			0.07
Number of Observations		244		244	
Log-Likelihood		- 80.46		- 82.22	
Restricted Log-Likelihood		-119.56		-119.56	
Chi-Square	(16)	78.20	(8)	74.68	
Significance Level		0.20E-11		0.32E-13	
Proportion Correct Predictions		0.86		0.86	

Table B-2

Decision to Connect to a Piped Water Supply System

Results of a Logit Model

Dependent Variable: Probability that a Household Would Connect to a Piped Water Supply System

Independent Variables	Parameter Estimate	T-Ratio	Parameter Estimate	T-Ratio	Mean Values
Intercept	- 2.12	- 1.59	- 2.25	- 3.10**	
Household Size	0.75E-1	1.38	0.68E-1	1.35	9.29
Water Consumption	0.23E-1	1.90*	0.24E-1	2.02**	19.00
Proportion of Adult Women	1.23	0.65			0.25
Proportion of Children	2.11	1.67*	1.86	1.88*	0.39
Construction Value of House	0.46E-5	1.48	0.46E-5	1.56	84394
Ownership of Land or Property (1 if Yes)	0.35	0.78			0.61
Private Water Source (1 if Motor)	- 0.98	- 1.37	- 0.99	- 1.39	0.12
Age	- 0.70E-2	- 0.48			49.80
Education	0.13	2.27**	0.13	2.44**	7.91
Occupation (1 if Farming)	- 0.84	- 1.81*	- 0.72	- 1.65*	0.31
Meter (1 if Yes)	- 0.25	- 0.58			0.49
Free Supply (1 if Yes)	- 0.26	- 0.62			0.48
External Exposure (1 if Yes)	- 0.40	- 0.85			0.34
Distance from Distribution Line	- 0.26E-1	- 2.16**	- 0.26E-1	- 2.26**	13.01
Number of Observations		137		137	
Log-Likelihood		-75.52		-76.77	
Restricted Log-Likelihood		-93.90		-93.90	
Chi-Square	(14)	36.77	(8)	34.26	
Significance Level		0.80E-3		0.36E-4	
Proportion Correct Predictions		0.74		0.74	

Table B-3

Statistical Analysis of Willingness to Pay for a Standard Piped Water Supply System

Results of Ordinary Least Squares Regression Model

Dependent Variable: Mid-point of Interval in Bidding Game within which Respondent's WTP Bid Falls

Independent Variables	Parameter Estimate	T-Ratio	Parameter Estimate	T-Ratio	Mean Values
Intercept	21.31	2.40**	20.06	4.40**	
Household Size	0.40	1.29	0.41	1.58	9.13
Water Consumption	0.03	0.78			25.04
Proportion of Adult Women	- 11.81	- 0.98			0.26
Proportion of Children	1.01	0.13			0.42
Construction Value of House	- 5.16E-6	- 0.44			84524
Ownership of Land or Property (1 if Yes)	4.62	1.75*	5.15	2.08**	0.64
Private Water Source (1 if Motor)	7.11	2.52**	6.76	2.56**	0.29
Age	- 0.23	2.33**	- 0.27	- 3.28**	50.84
Education	0.59	1.82*	0.49	1.63	8.67
Occupation (1 if Farming)	- 4.02	- 1.44	- 4.27	- 1.65	0.23
Meter (1 if Yes)	5.18	2.11**	5.78	2.56**	0.63
Free Supply (1 if Yes)	- 2.28	- 0.89			0.38
External Exposure (1 if Yes)	0.55	0.23			0.33
Household Dummy					
- B11	- 6.02	- 1.98*	- 5.49	- 2.03**	0.36
- B12	- 1.88	- 0.56			0.16
Starting Point Dummy (1 if Low)	- 6.19	- 2.22**	- 6.94	- 2.60**	0.34
Number of Observations		106		106	
Mean of Dependent Variable		18.16		18.16	
S.D. of Dependent Variable		12.52		12.52	
F-Value	(16,89)	3.31	(9,96)	5.83	
Significance of F-Test		0.00		0.00	
R-Squared		0.37		0.35	
Adjusted R-Squared		0.26		0.29	

Table B-4

Statistical Analysis of Willingness to Pay for an Improved Piped Water Supply System by Households in Villages with an Existing Piped Water Supply System

Results of Ordinary Least Squares Regression Model

Dependent Variable: Mid-point of Interval in Bidding Game within which Respondent's WTP Bid Falls

Independent Variables	Parameter Estimate	T-Ratio	Parameter Estimate	T-Ratio	Mean Values
Intercept	4.56	0.62	2.10	0.44	
Household Size	- 0.19	- 0.85	- 0.21	- 1.07	9.82
Water Consumption	- 0.08	- 1.26	- 0.07	- 1.23	19.37
Proportion of Adult Women	14.69	1.54	15.33	1.68*	0.26
Proportion of Children	6.54	1.00	7.86	1.31	0.41
Construction Value of House	1.75E-5	1.35	1.93E-5	1.65	90669
Ownership of Land or Property (1 if Yes)	- 0.68	- 0.29			0.62
Private Water Source (1 if Motor)	5.42	1.59	5.19	1.68*	0.14
Age	- 0.04	- 0.54			49.57
Education	0.02	0.05			8.22
Occupation (1 if Farming)	3.63	1.55	3.18	1.49	0.33
Meter (1 if Yes)	5.61	2.61**	5.87	2.90**	0.53
Free Supply (1 if Yes)	- 0.88	- 0.40			0.48
External Exposure (1 if Yes)	3.06	1.23	3.15	1.34	0.31
Satisfaction (1 if Yes)	0.16	0.07			0.62
Household Dummy - A1	1.34	0.60			0.59
Starting Point Dummy (1 if Low)	0.18	0.09			0.51
Number of Observations		118		118	
Mean of Dependent Variable		13.41		13.41	
S.D. of Dependent Variable		11.27		11.27	
F-Value	(16,101)	1.57	(9,108)	2.84	
Significance of F-Test		0.09		0.00	
R-Squared		0.20		0.19	
Adjusted R-Squared		0.07		0.12	

Appendix-C

Distribution of WTP Bids:

Tariff Rates, Connection Frequencies, and Revenue Potential

Table C-1

Distribution of WTP Bids for a Standard Piped Water System in Villages without an Operational Piped Water Supply

Mean Bid* (Rs.)	Household Group B11 No.	%**	B12 No.	%	B2 No.	%
0	1	2.5	0	0	2	3.4
2.5	0	0	1	5.6	0	0
7.5	10	25.0	2	11.1	12	20.3
12.5	5	12.5	4	22.2	17	28.8
17.5	14	35.0	8	44.4	5	8.5
22.5	6	15.0	2	11.1	9	15.3
27.5	0	0	0	0	1	1.7
32.5	1	2.5	0	0	1	1.7
37.5	0	0	0	0	0	0
45.0	0	0	0	0	0	0
50	2	5.0	1	5.6	11	18.6
No Response	1	2.5	0	0	1	1.7
Total	40	100.0	18	100.0	59	100.0
Valid Response	39	97.5	18	100.0	58	98.3
No. of Bids > Rs.10	28	70.0	15	83.3	44	74.6
Mean Bid*** (Rs.)	16.67		16.81		20.73	
Mean of Bids > Rs. 10 (Rs.)	20.54		19.00		25.28	

Note: The following applies to Tables C-1 to C-3.
- * Mean bids are the mid-points of the intervals in which the respondent's bids fell (except 0 and 50).
- ** % is computed over the number of total responses.
- *** Mean bid is computed over the number of valid responses.

Table C-2

Distribution of WTP Bids for a Standard Piped Water System with a Flexible Financing Arrangement in Villages without an Operational Piped Water Supply

Mean Bid (Rs.)	Household Group B12 No.	B12 %	B2 No.	B2 %
0	0	0	4	6.8
2.5	0	0	7	11.9
7.5	4	22.2	2	3.4
12.5	0	0	4	6.8
17.5	8	44.4	12	20.3
22.5	1	5.6	7	11.9
27.5	2	11.1	2	3.4
32.5	0	0	2	3.4
37.5	1	5.6	4	6.8
45.0	0	0	0	0
50	1	5.6	13	22.0
No Response	1	5.6	2	3.4
Total	18	100.0	59	100.0
Valid Response	17	94.4	57	96.6
No. of Bids > Rs.10	13	72.2	44	74.6
Mean Bid (Rs.)	19.71		24.04	
Mean of Bids > Rs.10 (Rs.)	23.46		30.40	

Table C-3

Distribution of WTP Bids for an Improved Piped Water Supply in Villages with an Operational Piped Water System

Mean Bid (Rs.)	Household Group A1 No.	A1 %	A2 No.	A2 %	A2* No.	A2* %
0	7	8.9	9	13.8	7	10.8
2.5	1	1.3	3	4.6	3	4.6
7.5	23	29.1	12	18.5	9	13.8
12.5	4	5.1	8	12.3	4	6.1
17.5	27	34.2	13	20.0	21	32.3
22.5	5	6.3	6	9.2	4	6.1
27.5	0	0	0	0	0	0
32.5	0	0	1	1.5	2	3.1
37.5	2	2.5	0	0	0	0
45.0	0	0	0	0	2	3.1
50	2	2.5	1	1.5	1	1.5
No Response	8	10.1	12	18.5	12	18.5
Total	79	100.0	65	100.0	65	100.0
Valid Response	71	89.9	53	81.5	53	81.5
No. of Bids > Rs.10	40	50.6	29	44.6	34	52.3
Mean Bid (Rs.)	13.87**		12.12		14.86	
Mean of Bids > Rs.10 (Rs.)	20.25		18.79		20.96	

* WTP bids for a standard system with a flexible financing arrangement.

** Mean bid would be Rs.15.19 if it is assumed that nobody at present connected at a tariff of Rs.10 per month would disconnect if the service level is improved at the same tariff.

Table C-4

Connection Frequencies and Estimated Revenues: Provision of a Standard Piped Water System in a Type B1 Village

Monthly Tariff (Rs.)	Households Connected (%)*	Estimated Revenue (Rs. per 100 hhs.)
0	100.0	0
2.5	96.6	242
7.5	94.8	711
12.5	74.1	926
17.5	58.6	1026
22.5	20.7	466
27.5	6.9	190
32.5	6.9	224
37.5	5.2	195
45.0	5.2	234
50	5.2	260

* The overall connection frequency for the Type B1 village is derived from the responses of B11 and B12 households presented in Table C-1. The weightage is based on their respective proportions in the sample, .69 and .31.

Table C-5

Connection Frequencies and Estimated Revenues: Provision of a Standard Piped Water System in a Type B2 Village

Monthly Tariff (Rs.)	Without Flexible Financing		With Flexible Financing	
	Households Connected (%)	Estimated Revenue (Rs./100 households)	Households Connected (%)	Estimated Revenue (Rs./100 households)
0	100.0	0	100.0	0
2.5	94.9	237	89.8	225
7.5	94.9	712	77.9	584
12.5	74.6	933	74.5	931
17.5	45.8	802	67.7	1185
22.5	37.3	839	47.4	1067
27.5	22.0	605	35.5	976
32.5	20.3	660	32.1	1043
37.5	18.6	698	28.7	1076
45.0	18.6	837	21.9	986
50	18.6	930	21.9	1096

Table C-6

Connection Frequencies and Estimated Revenues: Provision of an Improved Piped Water System in a Type A Village

Monthly Tariff (Rs.)	Households Connected (%)*	Estimated Revenue (Rs. per 100 hhs.)
0	100.0	0
2.5	75.0	188
7.5	72.2	542
12.5	47.9	599
17.5	39.6	693
22.5	11.8	266
27.5	4.1	113
32.5	4.1	133
37.5	3.5	131
45.0	2.1	95
50	2.1	105

* The overall connection frequency for the Type A village is derived from the responses of A1 and A2 households presented in Table C-3. The weightage is based on their respective proportions in the sample, .55 and .45.

Table C-7

Connection Frequencies and Estimated Revenues: Responses to Different Options by Unconnected Households in a Village with an Operational Piped Water Supply

Monthly Tariff (Rs.)	Improved System		Standard System with Flexible Financing	
	Households Connected (%)	Estimated Revenues (Rs./100 households)	Households Connected (%)	Estimated Revenues (Rs./100 households)
0	100.0	0	100.0	0
2.5	67.7	169	70.7	177
7.5	63.1	473	66.1	496
12.5	44.6	558	52.3	654
17.5	32.3	565	46.2	809
22.5	12.3	277	13.9	313
27.5	3.1	85	7.8	215
32.5	3.1	101	7.8	254
37.5	1.6	60	4.7	176
45.0	1.6	72	4.7	212
50	1.6	80	1.6	80

Appendix-D

Statistical Tables

Table D-1

Village Profiles

	Gatwala	Santpura	Bhaiwala	Akalgarh	Manawala	Sudhar
Area* (acres)	1899	1999	2342	2384	-	2121
Population*	6181	7339	11049	7885	20586	8333
Household Size*	6.7	6.8	6.5	6.5	7.1	6.5
(from sample, 1988)	(10)	(8)	(9)	(9)	(9)	(9)
Literacy Ratio*	38.6	32.3	32.8	30.1	58.5	19.7
% Males - Matric and above	10.4	8.4	11.6	9.5	24.0	3.9
% Females - Matric and above	3.1	1.4	2.0	2.6	14.1	0.6
Presence of Facilities						
Electricity	Yes	Yes	Yes	Yes	Yes	Yes

* Figures from 1981 Population Census. All others from field visit.

Table D-2
Village Profiles*

	Gatwala	Santpura	Bhaiwala	Akalgarh	Manawala	Sudhar
Household Size	10.0	8.1	8.6	9.2	8.9	8.7
Percentage of:						
-Adult Women in Hhold	28	28	28	28	28	29
-Children in Household	35	37	37	34	40	40
Years of Education of Most Educated:						
-Member of Household	10	8	9	10	8	7
-Woman in Household	6	4	5	6	4	2
Essential Water Consumption (liters/ capita/day)	30	35	32	29	31	31
Households Involved in Farming (%)	22	27	19	20	9	18
Households Owning Animals (%)	42	50	52	49	28	52
Water Consumption of Animals (liters/ animal/day)	62	63	63	50	76	35
Households with Land or Other Property (%)	63	63	67	60	35	38
Construction Value of House ('000 Rs.)	200	144	143	149	125	90
Households with External Exposure (%)	46	48	32	52	25	28
Households that Believe Water should be Supplied Free (%)	59	52	53	54	47	52
Households that Believe Water can be Supplied Free (%)	27	29	33	24	19	31
Households that Believe Water Supply Systems should be Managed by PHED (%)	61	75	62	62	72	67
Households that Favor Metering of Water (%)	85	87	93	77	75	78

* All statistics are derived from the sample observations.

Table D-3

Profiles by Village and Household Type*

	Village Type			Household Type	
	A	B1	B2	A1	A2
Household Size	9	9	9	9	8
Percentage of:					
- Adult Women in Household	28	28	28	29	28
- Children in Household	40	35	36	39	42
Years of Education of Most Educated:					
- Member of Household	7	9	9	8	6
- Woman in Household	3	5	5	4	2
Essential Water Consumption (liters/capita/day)	31	31	33	31	31
Households Involved in Farming (%)	13	19	25	12	18
Households Owning Animals (%)	40	51	46	37	47
Water Consumption of Animals (liters/animal/day)	48	57	63	53	35
Households with Land or Other Property (%)	37	64	63	40	27
Construction Value of House ('000 Rs.)	108	146	169	121	69
Households with External Exposure (%)	27	43	47	28	21
Households that Believe Water should be Supplied Free (%)	50	53	55	46	59
Households that Believe Water can be Supplied Free (%)	25	28	28	21	37
Households that Believe Water Supply Systems should be Managed by PHED (%)	69	62	69	70	69
Households that Favor Metering of Water (%)	76	85	86	80	65

* All statistics are derived from the sample observations.

Table D-4

Pattern of Household Choice over Available Service Options and Approximate Private Costs

Village Type/Costs		Manual Handpump Only	Motorized Handpump Only*	Domestic Connection Only	Domestic Connection + Manual Handpump	Domestic Connection +Motorized Handpump
		Available Service Options				
Type A Village:						
No. of households		42	8	13	80	58
% of households		20.8	4.0	6.4	39.6	28.7
Type B Village:						
No. of households		112	181	NA**	NA	NA
% of households		38.2	61.8	NA	NA	NA
Costs**** (Rs.)						
Capital:	Handpump	1000	1000		1000	1000
	Motor		2000			2000
	Overhead Tank		500			500
	Connection Cost			500	500	500
	Total	1000	3500	500	1500	4000
O & M :	Handpump	3.5	3.5		3.5	3.5
(per	Motor		9.5			9.5
month)	Electricity		NA***			NA***
	Tariff			12	12	12
	Total	3.5	13.0+	12	15.5	25.0+

* A motorized handpump can be used manually in case of power failures.
** N.A. indicates service level not available. Domestic connections are not available in Type B villages.
*** Respondents were unable to estimate the electricity charges attributable to operating the motor.
**** Capital costs are approximate values in current prices; O&M costs are obtained from sample responses.

Table D-5

Reasons Mentioned by Households Ever Connected to Piped Water System for Obtaining a Domestic Connection - Type A Village

Reason	% of Households Indicating Reason as	
	Reason No.1	Reason No.2
Health Considerations	74.8	14.9
Clean Water	11.9	39.6
Convenience	9.3	32.1
Other Reasons	4.0	13.3

Table D-6

Reasons Mentioned by Households Unconnected to Piped Water System for Not Obtaining a Domestic Connection - Type A Village

Reason	% of Households Indicating Reason as	
	Reason No.1	Reason No.2
High Cost	74.5	7.8
High Tariff	3.9	39.2
Low Pressure	9.8	2.0
Low Reliability	0.0	3.9
No Need	11.8	0.0
No Response	0.0	47.1

Table D-7

Relationship between Economic Standing and Choice of Service Level - Type A Village

Choice of Service Level	Village*					
	Manawala			Sudhar		
	No.	%	Average Value of House (Rs.)	No.	%	Average Value of House (Rs.)
No Private Facility	-	-	-	1	1.0	15,000
Manual Handpump Only	26	24.5	67,423	16	16.7	53,437
Motorized Pump Only	2	1.9	60,000	6	6.3	133,333
Domestic Connection Only	12	11.3	72,083	1	1.0	15,000
Manual Handpump and Domestic Connection	44	41.5	142,380	36	37.5	75,735
Motorized Pump and Domestic Connection	22	20.8	193,181	36	37.5	115,833
Total	106	100.0	124,692	96	100.0	89,680

* The average value of a house is significantly different in the two villages. Therefore, their statistics are presented separately.

Table D-8

Level of Satisfaction with Piped Water Supply System - Type A Village

Level of Satisfaction	A1 Households		A2 Households		Total	
	No.	%	No.	%	No.	%
Satisfied	51	33.8	28	54.9	79	39.1
Not Satisfied	100	66.2	20	39.2	120	59.4
No Response	0	0.0	3	5.9	3	1.5
Total	151	100.0	51	100.0	202	100.0

Table D-9

Major Shortcomings of Piped Supply System Mentioned by Households Dissatisfied with the System - Type A Village

Characteristic	% of Households Indicating Characteristic as			
	Shortcoming # 1		Shortcoming # 2	
	All Households	Connected Households	All Households	Connected Households
Reliability*	70.0	69.0	32.5	33.0
Insufficient Supply**	15.8	17.0	21.7	22.0
Maintenance/Design***	10.0	10.0	15.8	15.0
Interaction with Staff****	4.2	4.0	20.8	21.0
No Response	0.0	0.0	9.2	9.0

* Includes: Insufficient pressure, frequent failures, and power breakdowns.
** Includes: Insufficient hours and low storage capacity.
*** Includes: Sub-standard material and lack of cleanliness.
**** Includes: Irresponsible, uncooperative, and corrupt staff.

Table D-10

Extent of Information Regarding Parameters of Piped Water Systems

Parameter	Village Type: A – Manawala A1	A – Manawala A2	A – Sudhar A1	A – Sudhar A2	B1	B2
Price Charged (% responding yes)	96	-	NA*	-	-	-
Billing Frequency (no. of times per year) Mean	2.0	-	NA	-	-	-
Std. Dev.	0.2	-	NA	-	-	-
% of hhs responding	96	-	NA	-	-	-
Existing Monthly Tariff (Rs.) Mean	12.0	12.0	NA	11.0	15.6	16.9
Std. Dev.	2.3	1.0	NA	1.0	7.0	11.9
% of hhs responding	100	68	NA	30	18	14
Connection Fee (Rs.) Mean	180	257	85	86	79	144
Std. Dev.	224	203	2.8	6.3	42	129
% of hhs responding	87	57	100	78	4	9
Connection Costs (Rs.) Mean	721	947	443	445	453	503
Std. Dev.	357	782	204	267	634	495
% of hhs responding	100	82	100	87	42	17
Total No. of Hours of Water Supply per Day Mean	5.6	5.5	3.0	3.1	4.8	5.3
Std. Dev.	1.0	1.1	0.8	1.6	2.0	1.9
% of hhs responding	100	86	97	74	28	43
No. of Hours of Additional Supply Required to Meet Needs Mean	3.4	-	2.4	-	-	-
Std. Dev.	4.6	-	2.9	-	-	-
% of hhs responding	99		99	-	-	-
Frequency of Supply Failure** Mean	0.5	-	1.8	-	-	-
Std. Dev.	0.9	-	0.9	-	-	-
% of hhs responding	100	-	100	-	-	-

* The supply in Sudhar was less than 6 months old and the first billing had not been made at the time of the survey. Responses to some questions were not obtained because of the misinterpretation of a skip instruction in the questionnaire.

** For explanation of index see Table A-11.

Table D-11

Cost of Piped Water Systems

Costs		Tubewell Based	Canal Water Based
Capital Cost (Rs./Capita)		300	500
Total Capital Cost* ('000 Rs.)		3000	5000
O&M Costs at 3% of Capital Costs (Rs./Month)		7500	12500
Charges/hh/month** for full recovery of O&M costs at a connection frequency of: (Rs.)	100%	6.67	11.12
	75%	8.90	14.83
	50%	13.35	22.24
O&M Costs at 5% of Capital Costs (Rs./Month)		12,500	20,833
Charges/hh/month for full recovery of O&M costs at a connection frequency of: (Rs.)	100%	11.12	18.53
	75%	14.83	24.71
	50%	22.24	37.07

* For average village size of 10,000 inhabitants.
** Average household size in the brackish water zone is 8.9.

Table D-12

Perceptions Regarding Quality of Water

Perceptions	Type of Household			
	A1	A2	B1	B2
Piped Water: (% responding yes)				
Satisfaction with taste	98.7	-	-	-
Satisfaction with cleanliness	97.4	-	-	-
Satisfaction with hygiene	93.4	-	-	-
Alternative Water: (% responding yes)				
Satisfaction with taste	19.2	41.2	23.5	72.0
Satisfaction with cleanliness	92.7	96.1	89.5	94.6
Satisfaction with hygiene	17.9	37.3	14.0	36.6
% of households that have visited village with operational piped water system	-	-	52.0	63.0
% of households that feel piped water would be superior to available water	-	-	90.0	92.0

Table D-13

Household Preference Regarding Responsibility for Operation and Maintenance of Piped Water Systems

Management Option	Type of Household A1 (%)	A2 (%)	B1 (%)	B2 (%)	Total (%)
PHED (Government Agency)	69.5	68.6	62.0	68.8	66.3
Local Councils (Elected Political Body)	9.3	9.8	14.5	7.5	11.1
Village Committee	9.9	9.8	11.0	6.5	9.7
Private Entrepreneur	2.0	0	2.0	3.2	2.0
Indifferent	9.3	11.8	10.5	14.0	10.9

Appendix-E

Multivariate Analysis of Household Choice

and

Factors Affecting Willingness to Pay

Table E-1

Decision to Install an Electric Motor

Results of a Logit Model

Dependent Variable: Probability That a Household Would Install an Electric Motor

Independent Variables	Parameter Estimate	T-Ratio	Parameter Estimate	T-Ratio	Mean Values
Intercept	- 1.54	- 1.60	- 1.72	- 3.67**	
Household Size	0.38E-1	1.21	0.19E-1	0.74	8.87
Water Consumption	0.20E-2	0.49			31.23
Animals	- 0.97E-1	- 1.48	- 0.11	- 1.74*	0.88
Proportion of Adult Women	- 1.49	- 1.32	- 1.05	- 1.19	0.28
Proportion of Children	- 0.42	- 0.58			0.37
Expenditure per Capita	0.53E-3	0.22			216.81
Expenditure per Capita Squared	0.62E-6	0.20			72939
Construction Value of House	0.36E-5	2.46**	0.41E-5	2.85**	135330
Ownership of Land or Property (1 if Yes)	0.79	3.30**	0.76	3.30**	0.53
Quality of Alternative Water (1 if Satisfied)	- 0.23	- 0.86	- 0.20	- 0.76	0.23
Time	0.10E-2	1.50	0.83E-3	1.25	93.78
Age	0.37E-3	0.04			51.38
Education	0.13	4.26**	0.14	4.63**	9.12
Occupation (1 if Farming)	- 0.15	- 0.48			0.18
Free Supply (1 if Yes)	- 0.12	- 0.57			0.52
External Exposure (1 if Yes)	0.49E-1	- 0.21			0.38
Household Dummy					
- A1	- 0.60	- 1.88*	0.47	1.88*	0.30
- A2	- 1.36	- 2.81**	- 1.29	- 2.93**	0.11
- B1	- 0.19	- 0.62			0.40
Number of Observations		481		481	
Log-Likelihood		-264.51		-266.02	
Restricted Log-Likelihood		-333.38		-333.38	
Chi-Square	(19)	137.73	(10)	134.72	
Significance Level		0.32E-13		0.32E-13	
Proportion Correct Predictions		0.73		0.74	

Table E-2

Decision to Connect to a Piped Water Supply System

Results of a Logit Model

Dependent Variable: Probability That a Household Would Connect to a Piped Water Supply System

Independent Variables	Parameter Estimate	T-Ratio	Parameter Estimate	T-Ratio	Mean Values
Intercept	3.29	1.38	0.96	0.75	
Household Size	0.87E-1	1.36	0.66E-1	1.09	8.82
Water Consumption	- 0.69E-2	- 0.86			31.08
Animals	0.11	0.61			0.68
Proportion of Adult Women	- 2.57	- 0.88			0.28
Proportion of Children	- 4.03	- 2.08**	- 2.29	- 2.34**	0.40
Expenditure per Capita	- 0.12E-1	- 1.45	- 0.13E-1	- 1.60	203.67
Expenditure per Capita Squared	0.23E-4	- 1.56	0.25E-4	1.59	57177
Construction Value of House	0.76E-5	1.64	0.82E-5	1.87*	108640
Ownership of Land or Property (1 if Yes)	- 0.13	- 0.22			0.37
Quality of Alternative Water (1 if Satisfied)	- 0.78	- 1.75*	- 0.68	- 1.54	0.26
Private Water Source (1 if Motor)	0.77	1.37	0.67	1.24	0.34
Age	- 0.17E-1	- 1.09			51.12
Education	0.12	2.14**	0.12	2.32**	7.83
Occupation (1 if Farming)	- 1.95	- 2.66**	- 1.74	- 2.81**	0.13
Meter (1 if Yes)	1.02	2.19**	0.95	2.12**	0.77
Free Supply (1 if Yes)	- 0.28	- 0.68			0.50
External Exposure (1 if Yes)	- 0.44E-1	- 0.09			0.28
Distance from Distribution Line	0.66E-1	- 2.18**	- 0.64E-1	- 2.23**	5.86
Village Dummy - Sudhar	0.49	1.13	0.43	1.05	0.48
Number of Observations		196		196	
Log-Likelihood		- 82.38		- 84.04	
Restricted Log-Likelihood		-112.36		-112.36	
Chi-Square	(19)	59.96	(12)	56.64	
Significance Level		0.39E-5		0.25E-8	
Proportion Correct Predictions		0.82		0.81	

Table E-3

Statistical Analysis of Willingness to Pay for a Standard Piped Water System

Results of Ordinary Least Squares Regression Model

Dependent Variable: Mid-point of Interval in Bidding Game within which Respondent's WTP Bid Falls

Independent Variables	Parameter Estimate	T-Ratio	Parameter Estimate	T-Ratio	Mean Values
Intercept	34.99	4.00**	32.51	5.50*	
Household Size	0.48	1.63	0.57	2.16**	8.87
Water Consumption	0.08	1.96*	0.08	2.10**	31.23
Animals	0.31	0.50			0.88
Proportion of Adult Women	- 6.48	- 0.60			0.28
Proportion of Children	- 2.18	- 0.31			0.37
Expenditure per Capita	0.02	1.37	0.02	1.73*	216.81
Expenditure per Capita Squared	- 1.20	- 1.25	- 1.31E-5	- 1.41	72939
Construction Value of House	8.00E-6	0.84			135326
Ownership of Land or Property (1 if Yes)	- 2.04	- 0.84			0.53
Quality of Alternative Water (1 if Satisfied)	- 3.27	- 1.30	- 3.47	- 1.41	0.23
Private Water Source (1 if Motor)	0.95	0.41			0.51
Time	0.01	1.99**	0.01	2.10**	93.78
Age	- 0.21	- 2.71**	- 0.20	- 2.88**	51.38
Education	0.12	0.43			9.12
Occupation (1 if Farming)	0.86	0.30			0.18
Meter (1 if Yes)	5.58	2.11**	5.36	2.06**	0.82
Free Supply (1 if Yes)	- 0.42	- 0.21			0.52
External Exposure (1 if Yes)	4.04	1.79*	4.09	1.88*	0.38
Awareness of Water Systems (1 if Yes)	0.01	0.01			0.74
Household Dummy					
- A1	- 17.18	- 5.62**	- 17.52	- 6.64**	0.30
- A2	- 31.57	- 7.58**	- 32.60	- 9.00**	0.11
- B2	- 3.03	- 1.03	- 2.97	- 1.04	0.19
Starting Point Dummy (1 if High)	0.10	0.05			0.50
Number of Observations		481		481	
Mean of Dependent Variable		30.47		30.47	
S.D. of Dependent Variable		25.63		25.63	
F-Value	(23,457)	8.62	(12,468)	16.61	
Significance of F-Test		0.00		0.00	
R-Squared		0.30		0.30	
Adjusted R-Squared		0.27		0.28	

Table E-4

Statistical Analysis of Willingness to Pay for an Improved Piped Water System

Results of Ordinary Least Squares Regression Model

Dependent Variable: Mid-point of Interval in Bidding Game within which Respondent's WTP Bid Falls

Independent Variables	Parameter Estimate	T-Ratio	Parameter Estimate	T-Ratio	Mean Values
Intercept	37.46	3.39**	36.32	4.71**	
Household Size	0.89	2.36**	0.92	2.64**	8.87
Water Consumption	0.11	2.31**	0.11	2.29**	31.23
Animals	0.45	0.57			0.88
Proportion of Adult Women	- 1.13	- 0.08			0.28
Proportion of Children	- 2.24	- 0.26			0.37
Expenditure per Capita	0.03	1.97**	0.04	2.12**	216.81
Expenditure per Capita Squared	- 2.08E-5	- 1.72*	- 2.19E-5	- 1.83*	72939
Construction Value of House	1.77E-5	1.47	1.97E-5	1.72*	135326
Ownership of Land or Property (1 if Yes)	1.94	0.63			0.53
Quality of Alternative Water (1 if Satisfied)	- 8.55	- 2.69**	- 8.52	- 2.73**	0.23
Private Water Source (1 if Motor)	1.75	0.60			0.51
Time	0.02	1.96*	0.01	1.99**	93.78
Age	- 0.31	- 3.09**	- 0.31	- 3.44**	51.38
Education	0.69	1.98**	0.77	2.31**	9.12
Occupation (1 if Farming)	- 2.44	- 0.67			0.18
Meter (1 if Yes)	7.14	2.14**	7.03	2.14**	0.82
Free Supply (1 if Yes)	- 0.41	- 0.16			0.52
External Exposure (1 if Yes)	5.28	1.86*	5.51	1.97**	0.38
Awareness of Water Systems (1 if Yes)	- 2.70	- 0.78			0.74
Household Dummy					
- A1	-14.30	- 3.70**	-16.25	- 4.84**	0.30
- A2	-20.82	- 3.96**	-23.48	- 4.95**	0.11
- B2	- 4.52	- 1.22	- 5.19	- 1.43	0.19
Startring Point Dummy (1 if High)	1.29	0.50			0.50
Number of Observations		481		481	
Mean of Dependent Variable		46.77		46.77	
S.D. of Dependent Variable		31.72		31.72	
F-Value	(23,457)	7.51	(14,466)	12.35	
Significance of F-Test		0.00		0.00	
R-Squared		0.27		0.27	
Adjusted R-Squared		0.24		0.25	

Table E-5

Statistical Analysis of Willingness to Pay for a Standard Piped Water System - Type A Village

Results of Ordinary Least Squares Regression Model

Dependent Variable: Mid-point of Interval in Bidding Game within which Respondent's WTP Bid Falls

Independent Variables	Parameter Estimate	T-Ratio	Parameter Estimate	T-Ratio	Mean Values
Intercept	- 6.79	- 0.79	- 3.18	- 0.77	
Household Size	0.11	0.48			8.82
Water Consumption	- 0.05	- 1.53	- 0.04	- 1.43	31.08
Animals	1.93	3.50**	1.96	3.73**	0.68
Proportion of Adult Women	0.39	0.04			0.29
Proportion of Children	3.19	0.47			0.40
Expenditure per Capita	0.07	3.21**	0.06	3.39**	203.67
Expenditure per Capita Squared	- 6.55E-5	- 2.42**	- 5.90E-5	- 2.47**	57177
Construction Value of House	- 5.81E-6	- 0.87			108638
Ownership of Land or Property (1 if Yes)	- 0.41	- 0.21			0.37
Quality of Alternative Water (1 if Satisfied)	- 0.60	- 0.32			0.26
Private Water Source (1 if Motor)	0.03	0.02			0.34
Time	2.13E-3	0.09			12.16
Age	- 0.06	- 1.07	- 0.07	- 1.39	51.12
Education	- 0.05	- 0.26			7.83
Occupation (1 if Farming)	- 2.52	- 0.91	- 3.67	- 1.59	0.13
Meter (1 if Yes)	2.70	1.45	2.57	1.46	0.77
Free Supply (1 if Yes)	0.72	0.45			0.50
External Exposure (1 if Yes)	1.66	0.92			0.28
Satisfaction (1 if Yes)	- 1.05	- 0.64			0.39
Village Dummy - Sudhar	2.85	1.64	3.03	2.02**	0.48
Household Dummy - A1	16.19	7.13**	16.00	9.38**	0.74
Starting Point Dummy (1 if High)	0.48	0.30			0.50
Number of Observations		196		196	
Mean of Dependent Variable		16.49		16.49	
S.D. of Dependent Variable		13.18		13.18	
F-Value	(22,173)	6.32	(9,186)	15.96	
Significance of F-Test		0.00		0.00	
R-Squared		0.45		0.44	
Adjusted R-Squared		0.38		0.41	

Table E-6

Statistical Analysis of Willingness to Pay for an Improved Piped Water System - Type A Village

Results of Ordinary Least Squares Regression Model

Dependent Variable: Mid-point of Interval in Bidding Game within which Respondent's WTP Bid Falls

Independent Variables	Parameter Estimate	T-Ratio	Parameter Estimate	T-Ratio	Mean Values
Intercept	9.53	0.59	3.22	0.35	
Household Size	0.89	2.08**	0.99	2.44**	8.82
Water Consumption	- 0.06	- 0.92			31.08
Animals	0.31	0.30			0.68
Proportion of Adult Women	-21.94	- 1.12	-22.03	- 1.86*	0.29
Proportion of Children	- 2.69	- 0.21			0.40
Expenditure per Capita	0.14	3.47**	0.14	3.91**	203.67
Expenditure per Capita Squared	- 1.28E-4	- 2.51**	- 1.42E-4	- 2.97**	57177
Construction Value of House	- 1.44E-5	- 1.14	- 1.22E-5	- 1.02	108638
Ownership of Land or Property (1 if Yes)	7.05	1.91*	6.40	2.04**	0.37
Quality of Alternative Water (1 if Satisfied)	- 9.30	- 2.63**	- 9.56	- 2.80**	0.26
Private Water Source (1 if Motor)	1.50	0.42			0.34
Time	0.05	1.06	0.05	1.24	12.16
Age	- 0.19	- 1.75*	- 0.19	- 1.90*	51.12
Education	0.11	0.30			7.83
Occupation (1 if Farming)	- 4.95	- 0.95			0.13
Meter (1 if Yes)	5.44	1.55	5.65	1.69*	0.77
Free Supply (1 if Yes)	- 1.03	- 0.34			0.50
External Exposure (1 if Yes)	4.03	1.19	3.88	1.21	0.28
Satisfaction (1 if Yes)	- 1.43	- 0.47			0.39
Village Dummy - Sudhar	- 0.41	- 0.13			0.48
Household Dummy - A1	10.63	2.49**	12.30	3.15**	0.74
Starting Point Dummy (1 if High)	4.01	1.36	4.02	1.42	0.50
Number of Observations		196		196	
Mean of Dependent Variable		33.06		33.06	
S.D. of Dependent Variable		22.02		22.02	
F-Value	(22,173)	3.35	(13,182)	5.66	
Significance of F-Test		0.00		0.00	
R-Squared		0.30		0.29	
Adjusted R-Squared		0.21		0.24	

Table E-7

Statistical Analysis of Willingness to Pay for a Standard Piped Water System - Type B Village

Results of Ordinary Least Squares Regression Model

Dependent Variable: Mid-point of Interval in Bidding Game within which Respondent's WTP Bid Falls

Independent Variables	Parameter Estimate	T-Ratio	Parameter Estimate	T-Ratio	Mean Values
Intercept	33.36	2.42**	33.06	4.00**	
Household Size	0.90	1.86*	0.67	1.76*	8.90
Water Consumption	0.15	2.46**	0.15	2.65**	31.34
Animals	- 0.76	- 0.80			1.02
Proportion of Adult Women	-11.38	- 0.73			0.28
Proportion of Children	- 6.59	- 0.64			0.36
Expenditure per Capita	0.01	0.67			225.86
Expenditure per Capita Squared	- 9.61E-6	- 0.74			83779
Construction Value of House	2.10E-5	1.26	2.07E-5	1.41	153681
Ownership of Land or Property (1 if Yes)	- 2.04	- 0.54			0.64
Quality of Alternative Water (1 if Satisfied)	- 5.59	- 1.32	- 6.42	- 1.63	0.21
Private Water Source (1 if Motor)	- 0.80	- 0.22			0.62
Time	0.01	1.58	0.01	1.64	149.92
Age	- 0.35	- 2.73**	- 0.31	- 2.69**	51.56
Education	0.41	0.86			10.01
Occupation (1 if Farming)	2.43	0.57			0.22
Meter (1 if Yes)	7.99	1.75*	7.40	1.67*	0.85
Free Supply (1 if Yes)	- 0.39	- 0.12			0.54
External Exposure (1 if Yes)	4.93	1.40	5.11	1.55	0.45
Awareness of Water Systems (1 if Yes)	- 1.40	- 0.41			0.57
Household Dummy - B1	3.00	0.82			0.68
Starting Point Dummy (1 if High)	- 1.00	- 0.31			0.50
Number of Observations		285		285	
Mean of Dependent Variable		40.09		40.09	
S.D. of Dependent Variable		27.62		27.62	
F-Value	(21,263)	1.75	(8,276)	4.20	
Significance of F-Test		0.02		0.00	
R-Squared		0.12		0.11	
Adjusted R-Squared		0.05		0.08	

Appendix-F

Distribution of WTP Bids:

Tariff Rates, Connection Frequencies, and Revenue Potential

Table F-1

Distribution of WTP Bids for a Standard Piped Water System

Mean* Bid (Rs.)	Village Type A No.	A %	B1 No.	B1 %	B2 No.	B2 %
0	16	7.9	3	1.5	3	3.2
5.0	13	6.4	0	0	1	1.1
7.5	22	10.9	4	2.0	5	5.4
12.5	50	24.8	25	12.5	11	11.8
17.5	53	26.2	9	4.5	3	3.2
25.0	29	14.4	47	23.5	22	23.7
35.0	14	6.9	20	10.0	11	11.8
45.0	2	1.0	39	19.5	18	19.4
62.5	1	0.5	38	19.0	13	14.0
87.5	1	0.5	2	1.0	2	2.2
100+	1	0.5	13	6.5	4	4.3
Total	202	100.0	200	100.0	93	100.0
No. of Bids > Rs.12	151	74.8	193	96.5	84	90.3
Mean Bid (Rs.)	16.42		41.19		36.92	
Mean of Bids > Rs.12 (Rs.)	20.65		42.52		40.40	
Mean of Bids < Rs.12 (Rs.)	3.91		4.29		4.50	

Note: The following applies to Tables F-1 to F-4.

* Mean bids are the mid-points of the intervals in which the respondent's bids fell (except 0, 5, and 100). All genuine zero bids are included in 0; all bids greater than zero and less than or equal to Rs.5 are included in 5; and all bids equal to or greater than Rs.100 are included in 100+.

Table F-2

Distribution of WTP Bids for an Improved Piped Water System

Mean Bid (Rs.)	Village Type A No.	A %	B1 No.	B1 %	B2 No.	B2 %
0	4	2.0	0	0	1	1.1
5.0	0	0	0	0	0	0
7.5	6	3.0	2	1.0	2	2.2
12.5	26	12.9	6	3.0	3	3.2
17.5	29	14.4	11	5.5	6	6.5
25.0	47	23.3	22	11.0	8	8.6
35.0	32	15.8	29	14.5	15	16.1
45.0	32	15.8	37	18.5	23	24.7
62.5	19	9.4	43	21.5	22	23.7
87.5	2	1.0	24	12.0	5	5.4
100+	5	2.5	26	13.0	8	8.6
Total	202	100.0	200	100.0	93	100.0
No. of Bids > Rs.12	192	95.0	198	99.0	90	96.8
Mean Bid (Rs.)	32.60		58.04		50.81	
Mean of Bids > Rs.12 (Rs.)	34.06		58.55		52.33	
Mean of Bids < Rs.12 (Rs.)	4.50		7.50		5.00	

Table F-3

Distribution of WTP Bids for a Standard Piped Water System with Alternative Financing Arrangements: A2 Households

Mean Bid (Rs.)	Financing Arrangement					
	Existing System		Arrangement 1*		Arrangement 2**	
	No.	%	No.	%	No.	%
0	16	31.4	7	13.7	4	7.8
5.0	13	25.5	8	15.7	2	3.9
7.5	22	43.2	12	23.6	13	25.4
12.5	0	0	15	29.4	9	17.6
17.5	0	0	5	9.8	12	23.5
25.0	0	0	3	5.9	7	13.7
35.0	0	0	1	2.0	3	5.9
45.0	0	0	0	0	0	0
62.5	0	0	0	0	1	2.0
87.5	0	0	0	0	0	0
100+	0	0	0	0	0	0
Total	51	100.0	51	100.0	51	100.0
No. of Bids > Rs.12	0	0	24	47.06	32	62.75
Mean Bid (Rs.)	3.91		9.76		15.24	
Mean of Bids > Rs.12 (Rs.)	-		16.04		20.78	
Mean of Bids < Rs.12 (Rs.)	3.91		4.19		5.89	

* Under Arrangement 1 the water authorities bear 50% of the connection cost.

** Under Arrangement 2 the water authorities bear 100% of the connection cost.

Table F-4

Distribution of WTP Bids for Standard and Improved Piped Water Systems in Villages with Operating Piped Water Systems

Mean Bid (Rs.)	Standard System				Improved System			
	HH Type A1		HH Type A2		HH Type A1		HH Type A2	
	No.	%	No.	%	No.	%	No.	%
0	0	0	16	31.4	0	0	4	7.8
5.0	0	0	13	25.5	0	0	0	0
7.5	0	0	22	43.2	1	0.7	5	9.8
12.5	50	33.1	0	0	16	10.6	10	19.6
17.5	53	35.1	0	0	21	13.9	8	15.7
25.0	29	19.2	0	0	36	23.8	11	21.6
35.0	14	9.3	0	0	28	18.5	4	7.8
45.0	2	1.3	0	0	25	16.6	7	13.7
62.5	1	0.7	0	0	17	11.3	2	3.9
87.5	1	0.7	0	0	2	1.3	0	0
100+	1	0.7	0	0	5	3.3	0	0
Total	151	100.0	51	100	151	100.0	51	100.0
No. of Bids > Rs.12	151	100.0	0	0	150	99.3	42	82.4
Mean Bid (Rs.)	20.65		3.91		35.94		22.70	
Mean of Bids > Rs.12 (Rs.)	20.65		-		36.13		26.67	
Mean of Bids < Rs.12 (Rs.)	-		3.91		7.50		4.17	

Table F-5

Connection Frequencies and Estimated Revenues: Provision of a Standard Piped Water System

Monthly Tariff (Rs.)	Village Type A HH Conn. (%)	A Est. Rev. (Rs./100 hhs)	B1 HH Conn. (%)	B1 Est. Rev. (Rs./100 hhs)	B2 HH Conn. (%)	B2 Est. Rev. (Rs./100 hhs)
0	100.0	0	100.0	0	100.0	0
5.0*	92.1	461	98.5	493	96.8	484
7.5	85.7	643	98.5	739	95.7	718
12.5	74.8	935	96.5	1206	90.3	1129
17.5	50.0	875	84.0	1470	78.5	1374
25.0	23.8	595	79.5	1988	75.3	1883
35.0	9.4	329	56.0	1960	51.6	1806
45.0	2.5	113	46.0	2070	39.8	1791
62.5	2.0	125	26.5	1656	20.4	1275
87.5	1.5	131	7.5	656	6.4	560
100**	0.5	50	6.5	650	4.2	420

Note: The following apply to Tables F-5 to F-7.
- * All bids between Rs.0 and Rs.5 are consolidated in the Rs.5 category.
- ** All bids greater than Rs.100 are consolidated in the Rs.100 category.

Table F-6

Connection Frequencies and Estimated Revenues: Provision of an Improved Piped Water System

Monthly Tariff	Village Type					
	A		B1		B2	
(Rs.)	HH Conn. (%)	Est. Rev. (Rs./100 hhs)	HH Conn. (%)	Est. Rev. (Rs./100 hhs)	HH Conn. (%)	Est. Rev. (Rs./100 hhs)
0	100.0	0	100.0	0	100.0	0
5.0	98.0	490	100.0	500	98.9	495
7.5	98.0	735	100.0	750	98.9	742
12.5	95.0	1188	99.0	1238	96.7	1209
17.5	82.1	1437	96.0	1680	93.5	1636
25.0	67.7	1693	90.5	2263	87.0	2175
35.0	44.4	1554	79.5	2783	78.4	2744
45.0	28.6	1287	65.0	2925	62.3	2804
62.5	12.8	800	46.5	2906	37.6	2350
87.5	3.4	298	25.0	2188	13.9	1216
100*	2.4	240	13.0	1300	8.5	850

Table F-7

Connection Frequencies and Estimated Revenues: Provision of Options to A2 Households

Monthly Tariff	Option							
	Standard System		Standard System (Arrangement 1)+		Standard System (Arrangement 2)++		Improved System	
(Rs.)	HH Conn. (%)	Est. Rev. (Rs./100 hhs)	HH Conn. (%)	Est. Rev. (Rs./100 hhs)	HH Conn. (%)	Est. Rev. (Rs./100 hhs)	HH Conn (%)	Est. Rev. (Rs./100 hhs)
0	100.0	0	100.0	0	100.0	0	100.0	0
5.0	68.6	343	86.3	432	92.2	461	92.2	461
7.5	43.1	323	70.6	530	88.3	662	92.2	692
12.5	0	0	47.0	588	62.9	786	82.4	1030
17.5	0	0	17.6	308	45.3	793	62.8	1099
25.0	0	0	7.8	195	21.8	545	47.1	1178
35.0	0	0	1.9	67	8.1	284	25.5	893
45.0	0	0	0	0	2.2	99	17.7	797
62.5	0	0	0	0	2.2	138	4.0	250
87.5	0	0	0	0	0	0	0	0
100	0	0	0	0	0	0	0	0

+ Under Arrangement 1 the water authorities bear 50% of the connection cost.
++ Under arrangement 2 the water authorities bear 100% of the connection cost.

Appendix-G

Statistical Tables

Table G-1

Village Profiles

	JAWA	BANDA	DHALLA	PAPIN	PAYAL	GORAKHPUR	DHUDDIAN	MOHRA	BODHIAL
Area* (acres)	1263	3664	2801	3298	508	2228	277	629	1441
Population*	835	2129	1129	941	854	1563	610	1222	480
Household Size*	5.8	6.0	5.2	7.1	6.0	6.2	5.5	4.4	6.3
(from sample, 1989)	(7.9)	(7.3)	(7.2)	(6.5)	(8.0)	(7.6)	(7.1)	(6.8)	(6.5)
Literacy Ratio*	30.9	36.1	25.8	15.6	33.4	28.2	59.6	36.9	38.0
% Males - Matric and above	5.5	11.3	7.2	1.0	7.9	6.0	16.8	9.0	10.4
% Females - Matric and above	0.9	2.0	1.1	0.2	1.6	0.6	8.3	4.4	0
Distance from District Headquarters (Km)	24	45	24	56	35	14	37	48	25
Road Location	Off Rawat-Banda Link Road	Rawat-Chak Beli Link Road	Main Adiala Road	Off Rawat-Chak Beli Road	Off Rawat-Chak Beli Road	Main Adiala Road	Rawat-Chak Beli Link Road	Main Rawat-Chak Beli Road	Off Adiala Road
Presence of Facilities									
Electricity	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clinic	No	No	No	No	No	No	Yes	No	No
Education (Boys)	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No
Education (Girls)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

* Figures from 1981 Population Census. All others from field visit.

Table G-2

Village Profiles*

	JAWA	BANDA	DHALLA	PAPIN	PAYAL	GORAKHPUR	DHUDDIAN	MOHRA	BODHIAL
Household Size	8	7	7	6	8	8	7	7	7
Age of Head of Household	53	50	49	56	55	51	54	52	49
Percentage of:									
-Adult Women in Household	30	30	33	37	28	28	32	30	28
-Children in Household	39	37	35	32	43	42	32	36	38
Years of Education of Most Educated:									
-Member of Household	8	8	9	8	8	8	10	8	7
-Woman in Household	2	3	3	2	3	4	4	2	2
Essential Water Consumption (liters/capita/day)									
- Summer	20	23	25	21	23	20	23	29	23
- Winter	13	16	18	14	17	14	15	21	17
Households Involved in Farming (%)	30	15	23	52	40	38	10	44	56
Households Owning Animals (%)	77	63	73	86	86	58	83	86	83
Water Consumption of Animals (liters/animal/day)									
- Summer	42	40	26	44	47	20	34	70	41
- Winter	29	24	20	26	31	15	23	51	27
Households with Land or Other Property (%)	73	52	56	83	88	90	60	93	83
Construction Value of House ('000 Rs.)	91	75	85	69	115	116	102	95	77
Per Capita Monthly Expenditure (Rs.)	238	232	201	188	204	182	268	212	238
Households with External Exposure (%)	27	23	25	36	31	16	43	26	25
Households that Believe Water should be Supplied Free (%)	93	85	83	100	90	80	100	95	90
Households that Belive Water can be Supplied Free (%)	66	58	54	71	79	56	77	77	83
Households that Believe Water Supply Systems should be Managed by PHED (%)	91	100	90	55	67	86	60	77	71
Households that Favor Metering of Water (%)	68	44	46	57	67	68	70	67	63

* All statistics are derived from the sample observations.

Table G-3

Profiles by Village Type*

	VILLAGE TYPE A	VILLAGE TYPE B1	VILLAGE TYPE B2
Household Size	8	7	7
Age of Head of Household	51	54	51
Percentage of:			
-Adult Women in Household	31	31	30
-Children in Household	37	39	36
Years of Education of Most Educated:			
-Member of Household	8	8	8
-Woman in Household	3	3	3
Essential Water Consumption (liters/capita/day)			
- Summer	23	21	25
- Winter	16	15	18
Households Involved in Farming (%)	22	43	41
Households Owning Animals (%)	71	76	84
Water Consumption of Animals (liters/animal/day)			
- Summer	36	37	50
- Winter	24	24	35
Households with Land or Other Property (%)	60	87	81
Construction Value of House ('000 Rs.)	84	102	90
Per Capita Monthly Expenditure (Rs.)	224	191	236
Households with External Exposure (%)	25	27	30
Households that Believe Water should be Supplied Free (%)	87	89	94
Households that Belive Water can be Supplied Free (%)	59	69	79
Households that Believe Water Supply Systems Should be Managed by PHED (%)	94	70	70
Households that Favor Metering of Water (%)	52	64	66

* All statistics are derived from the sample observations.

Table G-4
Level of Satisfaction with Piped Water Supply System - Type A Village*

Level of Satisfaction	Village							
	Jawa		Banda		Dhalla		Total	
	No.	%	No.	%	No.	%	No.	%
Satisfied	10	24.4	33	71.7	47	100.0	90	67.2
Not Satisfied	31	75.6	13	28.3	0	0.0	44	32.8
Total	41	100.0	44	100.0	47	100.0	134	100.0

* Water supplies were installed in Jawa, Banda, and Dhalla in 1989, 1987, and 1988, respectively.

Table G-5

Major Shortcomings of Piped Supply System Mentioned by Connected Households Dissatisfied with the System - Type A Villages

Characteristic	% of Households Indicating Characteristic as			
	Shortcoming # 1		Shortcoming # 2	
	Jawa	Banda	Jawa	Banda
Reliability*	61.3	38.5	29.0	0.0
Insufficient Supply**	16.1	7.7	29.0	46.2
Maintenance/Design***	3.2	0.0	0.0	0.0
Interaction with Staff****	19.4	53.8	35.5	15.4
No Response			6.5	38.5

* Includes: Insufficient pressure,frequent failures, and power breakdowns.
** Includes: Insufficient hours and low storage capacity.
*** Includes: Sub-standard material and lack of cleanliness.
**** Includes: Irresponsible, uncooperative, and corrupt staff.

Table G-6

Cost of Piped Water Systems in the Arid Zone

	Village Type A			Village Type B1			Average Over Type A Villages	Average Over Type A & B1 Villages
	JAWA	BANDA	DHALLA	PAPIN	PAYAL	GORAKH-PUR		
Population (1981)	835	1,974	1,129	941	935	1,563	1,312	1,238
Population (1989)							1,667	1,562
Capital Cost* ('000 Rs.)	1704.7	1152.8	1461.8	783.3	1713.3	1035.8	1439.8	1308.6
O&M Cost* per Annum ('000 Rs.)	72.51	56.2	78.1	--	--	--	68.94	--
Year Completed*	1989	1988	1989	1989-90	1989-90	1989-90	--	--
Household Size (1981)	7.1	6.0	5.2	7.1	6.0	6.2	6.1	6.3
(from Sample, 1989)	(7.8)	(7.5)	(7.3)	(6.5)	(8.0)	(7.6)	(7.5)	(7.5)
No. of Houses (1989)							222	208
No. of Households Connected [Using 0.957 connection ratio of A villages]							212	199
O&M Cost per Household per Month								
- at 100% connection rate (Rs.)							25.9	27.6
- at 95.7% connection rate (Rs.)							27.1	28.9

* From PHED project documents.

Table G-7

Reasons Mentioned by Households Ever Connected to Piped Water System for Obtaining a Domestic Connection - Type A Village

Reasons	% of Households Indicating Reason as	
	Reason No.1	Reason No.2
Need	82.1	12.1
Convenience	15.7	56.4
Cleanliness	0.7	14.5
Other Reasons	1.5	17.0

Table G-8

Extent of Information Regarding Parameters of Piped Water Systems

	Village Type				
	A				
	JAWA	BANDA	DHALLA	B1	B2
Price Charged (% responding yes)	51	100	87	--	--
Billing Frequency (no. of times per year) Mean	2	2	2	--	--
Std. Dev.	0	0	0	--	--
% of hhs responding	51	100	85	--	--
Existing Monthly Tariff (Rs.)					
Mean	20	20	20	19.30	22
Std. Dev.	0	0	1.07	8.08	9
% of hhs responding	71	100	89	35	33
Connection Fee (Rs.)					
Mean	238	229	204	150	325
Std. Dev.	91	82	46	107	340
% of hhs responding	100	100	100	18	6
Connection Costs (Rs.)					
Mean	725	835	715	431	1396
Std. Dev.	462	438	581	316	1652
% of hhs responding	100	100	100	35	16
Total No. of Hours of Water Supply per Day Mean	0.84	2.37	2.10	4	4
Std. Dev.	0.68	1.16	0.73	3	4
% of hhs responding	100	100	100	57	49
No. of Hours of Additional Supply Required to Meet Needs					
Mean	2	2.6	2	--	--
Std. Dev.	1.2	1.5	0	--	--
% of hhs responding	36	10	1	--	--
Frequency of Supply Failure*					
Mean	2	0.35	0.17	--	--
Std. Dev.	1.2	0.76	0.60	--	--
% of hhs responding	100	100	100	--	--

* For explanation of index see Table A-11.

Table G-9

Household Preference Regarding Responsibility for Operation and Maintenance of Piped Water Systems

Management Option	Village Type A1 (%)	B1 (%)	B2 (%)	Total (%)
PHED (Government Agency)	93.4	70.0	70.0	78.3
Local Councils (Elected Political Body)	2.2	8.6	10.7	7.0
Village Committee	3.7	11.4	7.3	7.5
Private Entrepreneur	0.7	0.7	12.0	0.2
Indifferent	0.0	9.3	0.0	7.0

Appendix-H

Multivariate Analysis of Factors Affecting Willingness to Pay

Table H-1

Statistical Analysis of Willingness to Pay for a Piped Water System

Based on Public Taps - Type B2 Villages

Results of Ordinary Least Squares Regression Model

Dependent Variable : Mid-point of Interval in Bidding Game within which Respondent's WTP Bid Falls.

Independent Variables	Parameter Estimate	T-Ratio	Parameter Estimate	T-Ratio	Mean Values
Intercept	126.78	3.00**	116.54	3.38**	
Household Size	3.27	3.12**	2.82	3.57**	6.77
Water Consumption	0.07	0.27			25.25
Animals	1.67	1.36	1.45	1.40	2.33
Proportion of Adult Women	-8.31	-0.40			0.30
Proportion of Children	-12.09	-0.79			0.36
Expenditure per Capita	0.05	2.07**	0.05	2.52**	236.05
Construction Value of House	- 2.18E-5	-0.47			89661.16
Ownership of Land or Property (1 if Yes)	0.91	0.12			0.81
Quality of Alternative Water (1 if Satisfied)	-28.77	-1.94	-29.61	2.17**	0.97
Private Water Source (1 if Yes)	0.57	0.09			0.37
Vendor Usage (1 if Yes)	2.87	0.27			0.07
Age	- 0.20	-1.00			51.39
Education	- 0.12	-0.14			8.01
Occupation (1 if Farming)	- 1.68	-0.26			0.41
Meter (1 if Yes)	13.12	2.23**	13.48	2.58**	0.66
Free Supply (1 if Yes)	-10.32	-0.91	-12.33	-1.19	0.94
External Exposure (1 if Yes)	- 5.50	-1.03	- 6.09	-1.26	0.53
Awareness of Water Systems (1 if Yes)	3.07	0.56			0.65
Sex (1 if Male)	0.81	0.10			0.86
Distance of Village from Dist. Headquarters	- 1.79	-2.39**	- 1.76	-2.91**	36.15
Village Dummy					
- Bodhial	-45.53	-2.99**	-44.95	-3.66**	0.40
Number of Observations		121		121	
Mean of Dependent Variable		34.92		34.92	
S.D. of Dependent Variable		30.19		30.19	
F-Value	(21,99)	2.43	(9,111)	5.94	
Significance of F-Test		0.00		0.00	
R-Squared		0.34		0.32	
Adjusted R-Squared		0.20		0.27	

Table H-2

Statistical Analysis of Willingness to Pay for a Standard

Piped Water System - Type B2 Villages

Results of Ordinary Least Squares Regression Model

Dependent Variable : Mid-point of Interval in Bidding Game within which Respondent's WTP Bid Falls.

Independent Variables	Parameter Estimate	T-Ratio	Parameter Estimate	T-Ratio	Mean Values
Intercept	124.53	2.37**	103.12	2.40**	
Household Size	4.00	3.07**	4.37	4.12**	6.77
Water Consumption	0.37	1.11	0.43	1.41	25.25
Animals	1.75	1.15			2.33
Proportion of Adult Women	-44.64	-1.71*	-43.04	-1.77*	0.30
Proportion of Children	-33.60	-1.78*	-34.05	-2.11**	0.36
Expenditure per Capita	0.08	2.83**	0.07	2.85**	236.05
Construction Value of House	- 7.57E-6	-0.13			89661.16
Ownership of Land or Property (1 if Yes)	- 3.15	-0.33			0.81
Quality of Alternative Water (1 if Satisfied)	-20.03	-1.09	-18.75	-1.10	0.97
Private Water Source (1 if Yes)	3.96	0.53			0.37
Vendor Usage (1 if Yes)	11.93	0.84	12.71	1.06	0.07
Age	- 0.16	-0.66			51.39
Education	0.57	0.54			8.01
Occupation (1 if Farming)	- 3.21	-0.41			0.41
Meter (1 if Yes)	9.01	1.23	7.89	1.19	0.66
Free Supply (1 if Yes)	- 6.19	-0.44			0.94
External Exposure (1 if Yes)	- 3.46	-0.52			0.53
Awareness of Water Systems (1 if Yes)	- 4.02	-0.59			0.65
Sex (1 if Male)	3.18	0.32			0.86
Distance of Village from Dist. Headquarters	- 1.65	-1.77*	-1.45	-1.88*	36.15
Village Dummy					
- Bodhial	-40.67	-2.15**	-38.54	-2.47**	0.40
Number of Observations		121		121	
Mean of Dependent Variable		56.45		56.45	
S.D. of Dependent Variable		37.21		37.21	
F-Value	(21,99)	2.31	(10,110)	4.88	
Significance of F-Test		0.00		0.00	
R-Squared		0.33		0.31	
Adjusted R-Squared		0.19		0.24	

Tables H-3

Statistical Analysis of Willingness to Pay for a Standard

Piped Water System - Type B1 Villages

Results of Ordinary Least Squares Regression Model

Dependent Variable : Mid-point of Interval in Bidding Game within which Respondent's WTP Bid Falls.

Independent Variables	Parameter Estimate	T-Ratio	Parameter Estimate	T-Ratio	Mean Values
Intercept	-23.43	-0.67	12.09	0.77	
Household Size	1.76	1.71*	1.53	1.97*	7.42
Water Consumption	0.04	0.15			21.23
Animals	- 1.74	-1.30	- 2.13	1.80*	2.02
Proportion of Adult Women	23.89	0.78			0.31
Proportion of Children	5.39	0.27			0.39
Expenditure per Capita	8.94E-3	0.30			192.21
Construction Value of House	7.03E-5	1.88*	7.60E-5	2.42**	101742.65
Ownership of Land or Property (1 if Yes)	9.87	1.14	10.30	1.36	0.88
Quality of Alternative Water (1 if Satisfied)	18.33	1.57	16.76	1.62	0.94
Private Water Source (1 if Yes)	3.04	0.45			0.29
Vendor Usage (1 if Yes)	13.39	1.07	14.17	1.27	0.05
Age	- 9.52E-4	-0.01			54.06
Education	0.01	0.02			7.79
Occupation (1 if Farming)	- 7.56	-1.25	- 8.47	-1.60	0.43
Meter (1 if Yes)	0.93	0.17			0.65
Free Supply (1 if Yes)	- 7.49	-0.82	- 8.37	-1.05	0.89
External Exposure (1 if Yes)	1.41	0.24			0.46
Awareness of Water Systems (1 if Yes)	2.92	0.46			0.74
Sex (1 if Male)	5.77	0.60			0.90
Distance of Village from Dist. Headquarters	0.16	0.42			33.61
Village Dummy					
- Gorakhpur	12.00	0.91			0.36
Number of Observations		136		136	
Mean of Dependent Variable		41.31		41.31	
S.D. of Dependent Variable		29.75		29.75	
F-Value	(21,114)	1.34	(8,127)	3.41	
Significance of F-Test		0.16		0.00	
R-Squared		0.20		0.18	
Adjusted R-Squared		0.05		0.12	

Table H-4

Statistical Analysis of Willingness to Pay for an Improved

Piped Water System - Type B1 Villages

Results of Ordinary Least Squares Regression Model

Dependent Variable : Mid-point of Interval in Bidding Game within which Respondent's WTP Bid Falls.

Independent Variables	Parameter Estimate	T-Ratio	Parameter Estimate	T-Ratio	Mean Values
Intercept	- 4.94	-0.13	- 7.35	-0.37	
Household Size	2.17	1.94*	2.19	2.34**	7.42
Water Consumption	0.24	0.75			21.23
Animals	- 1.90	-1.30	- 2.13	-1.63	2.02
Proportion of Adult Women	17.20	0.51	26.61	1.24	0.31
Proportion of Children	- 5.09	-0.23			0.39
Expenditure per Capita	0.05	1.45	0.06	2.13**	192.21
Construction Value of House	9.84E-5	2.42**	1.09E-4	2.99**	101742.65
Ownership of Land or Property (1 if Yes)	2.44	0.26			0.88
Quality of Alternative Water (1 if Satisfied)	21.59	1.70*	23.02	1.98*	0.94
Private Water Source (1 if Yes)	- 1.27	-0.17			0.29
Vendor Usage (1 if Yes)	5.33	0.39			0.05
Age	- 0.03	-0.13			54.06
Education	0.54	0.61	0.84	1.06	7.79
Occupation (1 if Farming)	- 4.71	-0.72			0.43
Meter (1 if Yes)	0.02	0.00			0.65
Free Supply (1 if Yes)	-13.66	-1.37	-15.27	-1.68*	0.89
External Exposure (1 if Yes)	5.81	0.90	6.55	1.14	0.49
Awareness of Water Systems (1 if Yes)	8.76	1.27	10.33	1.70*	0.74
Sex (1 if Male)	7.29	0.70			0.90
Distance of Village from Dist. Headquarters	- 0.16	-0.38			33.61
Village Dummy					
- Gorakhpur	6.97	0.49	11.28	1.79*	0.36
Number of Observations		136		136	
Mean of Dependent Variable		58.72		58.72	
S.D. of Dependent Variable		34.46		34.46	
F-Value	(21,114)	2.24	(10,125)	4.77	
Significance of F-Test		0.00		0.00	
R-Squared		0.29		0.28	
Adjusted R-Squared		0.16		0.22	

Table H-5

Statistical Analysis of Willingness to Pay for a Standard

Piped Water System - Type A Villages

Results of Ordinary Least Squares Regression Model

Dependent Variable : Mid-point of Interval in Bidding Game within which Respondent's WTP Bid Falls.

Independent Variables	Parameter Estimate	T-Ratio	Parameter Estimate	T-Ratio	Mean Values
Intercept	82.33	3.62**	74.03	4.85**	
Household Size	0.59	0.78			7.52
Water Consumption	0.03	0.20			22.83
Animals	0.40	0.41			2.07
Proportion of Adult Women	-47.03	-1.97*	-42.74	-2.08**	0.31
Proportion of Children	-44.22	-2.73**	-38.10	-2.79**	0.37
Expenditure per Capita	0.03	1.68*	0.03	1.83*	220.62
Construction Value of House	- 4.26E-6	-0.13			84458.65
Ownership of Land or Property (1 if Yes)	1.83	0.42			0.61
Private Water Source (1 if Yes)	- 3.14	-0.41			0.08
Age	- 0.08	-0.60			50.45
Education	0.03	0.04			8.51
Occupation (1 if Farming)	- 4.50	-0.85			0.23
Meter (1 if Yes)	0.15	0.04			0.51
Free Supply (1 if Yes)	2.90	0.50			0.87
External Exposure (1 if Yes)	- 3.14	-0.78	- 4.16	-1.13	0.53
Sex (1 if Male)	- 9.62	-1.30	-10.96	-1.63	0.91
Distance of Village from Dist. Headquarters	- 0.32	-1.41			31.26
Village Dummy					
- Jawa	- 4.95	-0.95			0.30
Number of Observations		133		133	
Mean of Dependent Variable		40.56		40.56	
S.D. of Dependent Variable		21.20		21.20	
F-Value	(18,114)	0.98	(5,127)	2.85	
Significance of F-Test		0.48		0.02	
R-Squared		0.13		0.10	
Adjusted R-Squared		0.00		0.07	

Table H-6

Statistical Analysis of Willingness to Pay for an Improved

Piped Water System - Type A Villages

Results of Ordinary Least Squares Regression Model

Dependent Variable : Mid-point of Interval in Bidding Game within which Respondent's WTP Bid Falls.

Independent Variables	Parameter Estimate	T-Ratio	Parameter Estimate	T-Ratio	Mean Values
Intercept	83.49	3.12**	88.98	4.81**	
Household Size	0.80	0.89	1.03	1.32	7.55
Water Consumption	0.02	0.14			22.77
Animals	1.03	0.90			2.08
Proportion of Adult Women	-28.24	-1.01	-29.15	-1.25	0.31
Proportion of Children	-49.31	-2.58**	-50.63	-3.18**	0.37
Expenditure per Capita	0.03	1.23	0.03	1.61	220.78
Construction Value of House	2.00E-5	0.53			84643.94
Ownership of Land or Property (1 if Yes)	-1.03	-0.20			0.61
Private Water Source (1 if Yes)	1.16	0.13			0.08
Age	-0.25	-1.49	- 0.29	-1.88*	50.58
Education	0.78	0.99			8.51
Occupation (1 if Farming)	-4.51	-0.73			0.24
Meter (1 if Yes)	1.53	0.31			0.51
Free Supply (1 if Yes)	-2.08	-0.31			0.86
External Exposure (1 if Yes)	-6.67	-1.40	- 5.93	-1.37	0.52
Sex (1 if Male)	-6.87	-0.79			0.91
Distance of Village from Dist. Headquarters	-0.12	-0.43			31.16
Village Dummy - Jawa	6.19	1.01	6.13	1.31	0.30
Number of Observations		132		132	
Mean of Dependent Variable		53.14		53.14	
S.D. of Dependent Variable		25.21		25.21	
F-Value	(18,114)	1.17		2.65	
Significance of F-Test		0.30		0.01	
R-Squared		0.16		0.13	
Adjusted R-Squared		0.02		0.08	

Appendix-I

Distribution of WTP Bids:

Tariff Rates, Connection Frequencies, and Revenue Potential

Table I-1

Distribution of WTP Bids for a Public Tap System and a Standard System with House Connections in Villages without Plans for Installation of Public Water Supplies

Mean* Bid (Rs.)	Public Taps No.	Public Taps %	Standard System No.	Standard System %
0	16	13.2	3	2.5
5.0	3	2.5	0	0.0
15.0	20	16.5	8	6.6
25.0	17	14.0	10	8.3
35.0	31	25.6	25	20.7
45.0	12	9.9	10	8.3
55.0	5	4.1	28	23.1
65.0	4	3.3	10	8.3
85.0	8	6.6	15	12.4
100+	5	4.1	12	9.9
Total	121	100.0	121	100.0
No. of Bids > Rs.20	82	67.8	110	90.9
Mean Bid (Rs.)	34.92		55.21	

Note: The following applies to Tables I-1 to I-3.

* Mean bids are the mid-points of the intervals in which the respondent's bids fell (except 0, 5, and 100). All genuine zero bids are included in 0; all bids greater than zero and less than or equal to Rs.5 are included in 5; and all bids equal to or greater than Rs.100 are included in 100+.

Table I-2

Distribution of WTP Bids for a Standard Piped Water System with House Connections in Types A, B1, and B2 Villages

Mean Bid	Village Type					
	A		B1		B2	
(Rs.)	No.	%	No.	%	No.	%
0	2	1.4	1	0.7	3	2.5
5.0	3	2.1	5	3.6	0	0.0
15.0	1	0.7	24	17.1	8	6.6
25.0	47	33.6	31	22.1	10	8.3
35.0	31	22.1	29	20.7	25	20.7
45.0	34	24.3	12	8.6	10	8.3
55.0	10	37.1	10	7.1	28	23.1
65.0	4	2.9	5	3.6	10	8.3
85.0	6	4.3	13	9.3	15	12.4
100+	2	1.4	10	7.1	12	9.9
Total	140	100.0	140	100.0	121	100.0
No. of Bids > Rs.20	134	95.7	110	78.6	110	90.9
Mean Bid (Rs.)	39.07		42.16		55.21	

Table I-3

Distribution of WTP Bids for an Improved Piped Water System with House Connections in Types A and B1 Villages

Mean Bid	Village Type			
	A		B1	
(Rs.)	No.	%	No.	%
0	2	1.4	1	0.7
5.0	3	2.1	1	0.7
15.0	8	5.7	8	5.7
25.0	2	1.4	12	8.6
35.0	35	25.0	19	13.6
45.0	28	20.8	32	22.9
55.0	28	20.0	21	15.0
65.0	10	7.1	5	3.6
85.0	20	14.3	20	14.3
100+	4	2.9	21	15.0
Total	140	100.0	140	100.0
No. of Bids > Rs.20	133	95.0	130	92.9
Mean Bid (Rs.)	51.18		59.44	

Table I-4

**Connection Frequencies and Estimated Revenues:
Provision of Standard Piped Water System with House Connections
in Types A, B1, and B2 Villages**

Monthly Tariff	Village Type					
	A		B1		B2	
(Rs.)	Households Connected (%)	Estimated Revenues (Rs./100 hhs.)	Households Connected (%)	Estimated Revenues (Rs./100 hhs.)	Households Connected (%)	Estimated Revenues (Rs./100 hhs.)
0	100.0	0	100.0	0	100.0	0
5.0*	98.6	493	99.3	497	97.5	488
15.0	96.5	1448	95.7	1436	97.5	1463
25.0	95.8	2395	78.6	1965	90.9	2273
35.0	62.2	2177	56.5	1978	82.6	2891
45.0	40.1	1805	35.8	1611	61.9	2786
55.0	15.8	869	27.2	1496	53.6	2948
65.0	8.7	566	20.1	1307	30.5	1983
85.0	5.8	493	16.5	1403	22.2	1887
100+**	1.5	150	7.2	720	9.8	980

Note: The following applies to Tables I-4 to I-6.

* All bids between Rs.0 and Rs.5 are consolidated in the Rs.5 category.
** All bids greater than Rs.100 are consolidated in the Rs.100 category.

Table I-5

Connection Frequencies and Estimated Revenues: Provision of Improved Piped Water Systems with House Connections in Types A and B1 Villages

	Village Type			
	A		B1	
Monthly Tariff (Rs.)	Households Connected (%)	Estimated Revenue (Rs./100 hhs.)	Households Connected (%)	Estimated Revenue (Rs./100 hhs.)
0	100	0	100	0
5.0	98.6	493	99.3	497
15.0	96.5	1448	98.6	1479
25.0	90.8	2270	92.9	2323
35.0	89.4	3129	84.3	2951
45.0	64.4	2898	70.7	3182
55.0	44.4	2442	47.8	2629
65.0	24.4	1586	32.8	2132
85.0	17.3	1471	29.2	2482
100+	3.0	300	14.9	1490

Table I-6

Connection Frequencies and Estimated Revenues: Provision of Public Taps and Standard House Connections in Type B2 Villages

	Public Taps		Standard System	
Monthly Tariff (Rs.)	Households Connected (%)	Estimated Revenue (Rs./100 hhs.)	Households Connected (%)	Estimated Revenue (Rs./100 hhs.)
0	100	0	100	0
5.0	86.8	434	97.5	488
15.0	84.3	1265	97.5	1463
25.0	67.8	1695	90.9	2273
35.0	53.8	1883	82.6	2891
45.0	28.2	1269	61.9	2786
55.0	18.3	1007	53.6	2948
65.0	14.2	923	30.5	1983
85.0	10.9	927	22.2	1887
100+	4.3	430	9.8	980

Appendix-J

Comparative Statistics of the Three Environmental Zones

Table J-1

Comparative Size of Rural Localities in the Three Environmental Zones by Population Size (1981)

Z O N E	TOTAL NO. OF RURAL LOCALITIES	% OF RURAL LOCALITIES BY POPULATION SIZE: 5000 & OVER	2000 TO 4999	1000 TO 1999	500 TO 999	200 TO 499	BELOW 200	UNINH-ABITED
Pakistan	45,167	3.2	17.0	22.0	20.6	18.7	14.1	4.4
Punjab	25,266	3.1	18.0	24.4	22.8	17.4	10.2	3.9
(% of population living in village size category)		(16.6)	(40.4)	(25.7)	(12.1)	(4.5)	(0.7)	-
Sweet Water Zone								
Sheikhupura District	1,090	5.0	21.1	23.4	19.9	15.0	8.6	6.9
(% of population living in village size category)		(26.1)	(40.1)	(20.9)	(9.2)	(3.3)	(0.5)	-
Sheikhupura Sub-District	284	11.3	44.4	24.6	12.7	5.6	0.4	1.1
Brackish Water Zone								
Faisalabad District	1,350	4.6	55.5	25.6	7.5	3.2	2.7	0.9
(% of population living in village size category)		(13.9)	(66.5)	(16.6)	(2.4)	(0.5)	(0.1)	-
Faisalabad Sub-District	259	15.4	65.6	15.4	2.3	0.4	0.8	0.0
Arid Water Zone								
Rawalpindi District	1,177	1.4	9.3	20.6	25.2	22.9	11.9	8.9
(% of population living in village size category)		(12.5)	(28.9)	(29.4)	(19.5)	(8.3)	(1.3)	-
Rawalpindi Sub-District	362	1.4	8.3	18.5	28.7	27.9	11.9	3.3

SOURCE: Handbook of Population Census Data, Pakistan Census Organization, Statistics Division, Government of Pakistan, 1985. Population Census, 1981.

Table J-2

Sources of Water and Light in the Three Environmental Zones (1981)

(% of Housing Units with Access)

ZONE	SOURCE OF DRINKING WATER: INSIDE HOUSE			OUTSIDE HOUSE					
	PIPED	HAND PUMP	WELL	PIPED	HAND PUMP	WELL	POND	SPRING/ RIVER/ STREAM ETC.	ELECTR-ICITY
Punjab	3	37	5	3	15	16	4	17	15
Sweet Water Zone									
Sheikhupura District	2.1	72.0	0.8	0.5	19.1	5.2	0.0	0.4	23.6
Brackish Water Zone									
Faisalabad District	2.0	64.4	0.6	0.8	18.1	2.8	9.2	2.1	16.7
Arid Water Zone									
Rawalpindi District	3.2	1.1	4.6	2.7	0.4	62.3	0.1	25.4	16.7

SOURCE: Housing Census, 1980. Population Census, 1981.

Table J-3

Occupational Profile of the Three Environmental Zones

	SWEET WATER ZONE (SHEIKHUPURA DISTRICT)	BRACKISH WATER ZONE (FAISALABAD DISTRICT)	ARID WATER ZONE (RAWALPINDI DISTRICT)
Total Working Population (age 10 years and above)	516,838	920,700	245,440
Percentage of Total Working Population Engaged in:			
- Agriculture	54.0	54.9	52.9
- Manufacturing	16.9	13.7	5.8
- Construction	4.4	4.2	5.4
- Trade	6.1	6.6	6.7
- Transport	3.4	3.0	5.1
- Services	13.4	12.2	17.6
- Others	1.8	5.5	6.5

SOURCE: Population Census, 1981.

Table J-4

Financial Cost* to an Average Household of Different Service Options

(Brackish Water Zone)

	Service Option	Total Capital (Rs.)	Monthly Capital (Rs.)	Monthly O & M (Rs.)	Total Monthly (Rs.)
(1)	Handpump[1]	1000	13	5	18
(2)	Domestic Connection[2]	600[3]	6	12[4]	18
(3)	Electric Motor[5]	1500	20	20	40
(1+2)	Handpump and Domestic Connection	1600	19	17	36
(1+3)	Handpump and Electric Motor	2500	33	25	58
(1+2+3)	Handpump, Electric Motor and Domestic Connection	3100	39	37	76

Not included in the above estimates are average capital costs of indoor plumbing often associated with service options (1+2), (1+3), and (1+2+3): Overhead Tank - Rs.500; Indoor Piping - Rs.500; Flush Toilet + Septic Pit Rs.4,000 to Rs.10,000.

1 Assumes an economic life of 10 years; 10% real interest. Includes cost of shallow well.
2 20 years; 10% interest.
3 Connection fee - Rs.100; Connection costs - Rs.500.
4 Monthly tariff paid by household for an unmetered connection.
5 10 years; 10% interest.

* There is a lot of variation in the cost depending upon the size of the septic tank and whether soak pit included.

Table J-5

Households' Choice of Service Level by Socioeconomic Characteristics

(Villages with Piped Water Supply)

Service Level	Sweet Water Zone: Value of House (Rs.)	Sweet Water Zone: Years of Education (Most Educated Member of Household)	Brackish Water Zone: Value of House (Rs.)	Brackish Water Zone: Years of Education (Most Educated Member of Household)
Handpump	48,500	6	62,100	5
Handpump and Domestic Connection	96,100	9	112,400	7
Handpump and Electric Motor	137,500	12	115,000	8
Handpump, Electric Motor and Domestic Connection	208,500	12	145,200	10

Table J-6

Costs of Village-Level Water Supply Options

Service Option	Total Capital (Rs.)	Monthly Capital (Rs.)	Monthly O & M (Rs.)	Total Monthly (Rs.)
	Typical Village with 5000 population[1] (Brackish Water Zone)			
1) Piped Water System (100% of Households Connected)				
- Cost to PHED	1,500,000[2]	13,500[3]	3,800[4]	17,300
- Cost to Households	281,000[5]	2,500[3]	--	2,500
- Total				19,800
2) Actual Current Water Expenditures	1,084,000[6]	14,100[7]	9,800	23,900
62% - Handpump and Electric Motor 38% - Handpump Only				
3) Summation of Households' Willingness-to-Pay Bids				22,500
4) Estimated Revenue Based on Tariff of Rs.25 per Month, 78% households connected, and Rs.80 connection fee.	45,000	400[8]	11,000	11,400
5) Cost of Piped Water System to PHED for 78% Households	1,170,000	10,500[3]	2,900[4]	13,400

1 562 houses at 8.9 inhabitants per household.
2 Based on tubewell at Rs.300 per capita capital costs.
3 Assumes an economic life of 25 years, 10% real interest rate.
4 Assumes annual operation and maintenance costs equal to 3% of total capital costs (based on cost data from PHED).
5 Rs.500 connection costs per household.
6 Cost of electric motor - Rs.1500; Cost of handpump - Rs.1000.
7 Assumes an economic life of 10 years, 10% real interest rate.
8 Computed over 25 years at 10% real interest rate.

Table J-7

Comparative Features of the Three Environmental Zones[1]

	Sweet Water Zone	Brackish Water Zone	Arid Water Zone
Averge Village Size[2] (No. of Inhabitants)	5778	10229[3]	1085
Monthly Household Income[4] (Rs.)	1995	1679	1409
Monthly Household Expenditure per Capita (Rs.)	--	216	227
Construction Value of House ('000 Rs.)	86	134	103
Household Size	9	9	7
Percentage of:			
- Adult Women in Household	26	28	30
- Children in Household	41	37	38
Age of Head of Household (Yrs.)	50	51	51
No. of Years of Education of Most Educated:			
- Member of Household	8	9	8
- Woman in Household	4	4	3
Households Involved in Farming (%)	27	18	31
Households Owning Animals (%)	--	45	72
Households with Land or Other Property (%)	63	52	75
Households with External Exposure (%)	33	37	50

1 Sample statistics except where indicated.
2 Population of sample villages from Population Census, 1981.
3 There is one very large village in the sample (Pop. 20,586). The average excluding this village is 8157.
4 Source: Household Income and Expenditure Survey, 1984-85. The values are the average rural household incomes for the three study districts. The comparative values for Punjab and Pakistan are Rs.1533 and Rs.1545, respectively.

Table J-8

Comparative Water-Related Characteristics in the Three Environmental Zones*

	Sweet Water Zone	Brackish Water Zone	Arid Water Zone
Monthly Tariff for Domestic Connection to Piped Water System (Rs.)**	10	12	20
Percentage of Connected Households in Villages with Piped Water Systems	55	75	96
Essential Water Consumption (Liters/Person/Day)			
- Villages with Piped Water	19	31	23
- Villages without Piped Water	24	32	23
Water Consumption of Animals (Liters/Animal/Day)			
- Villages with Piped Water	--	48	36
- Villages without Piped Water	--	58	43
Households that Believe Water should be Supplied Free (%)	44	52	88
Households that Believe Water can be Supplied Free (%)	38	27	67
Households that Favor Metering of House Connections (%)	54	81	61
Households that Believe Water Supply Systems should be Managed by PHED (%)	71	66	78

* Sample statistics except where indicated.
** Source: PHED

Table J-9

Mean Willingness-to-Pay Bids for Monthly Tariff of Piped Water Systems with House Connections in the Three Zones

	Sweet Water Zone (Current Tariff= Rs.10 per month)	Brackish Water Zone (Current Tariff= Rs.12 per month)	Arid Zone (Current Tariff= Rs.20 per month)
Villages with Piped Supply			
- Mean WTP Bid for Standard System[1]	--	16	39
- Mean WTP Bid for Improved System[2]	15	33	51
Villages without Piped Supply			
1. (but which had a piped system in the past)[3]			
- Mean WTP Bid for Standard System	17	--	--
2. (and in which households know a piped system will be installed in the near future)			
- Mean WTP Bid for Standard System	--	41	42
- Mean WTP Bid for Improved System	--	58	59
3. (no piped system in the past, no piped system planned)			
- Mean WTP Bid for Standpipe System	--	--	35
- Mean WTP Bid for Standard System	21	37	55
- Mean WTP Bid for Improved System	--	51	--

1 Standard system refers to the kind of piped water system with house connections which has been installed by the PHED in Punjab.

2 In the sweet water zone the improvement consists of the supply of an extra 4 hours of water per day from the standard system. In the other two zones it consists of a continuous water supply with improved pressure and reliability.

3 No systems are planned to be installed in the sweet water zone. One village has an inoperative system.

Table J-10

Actual and Hypothetical Frequency of Connection to Piped Water Systems with House Connections in the Three Zones

	Sweet Water Zone (Current Tariff= Rs.10 per month)	Brackish Water Zone (Current Tariff= Rs.12 per month)	Arid Zone (Current Tariff= Rs.20 per month)
Villages with Piped Supply			
- Percent of households actually connected at current tariff	55	75	96
- Percent of households who say they would connect at the current tariff if the piped system were improved[1]	60	95	94
Villages without Piped Supply			
1. (but which had a piped system in the past)[2]			
- Percent of households who say they would connect to a piped system at current tariff	84	--	--
2. (and in which households know that a piped system will be installed in the near future)			
- Percent of households who say they would connect to a piped system at the current tariff	--	97	87
3. (no piped system in the the past, no piped system planned)			
- Percent of households who say they would connect to a piped system at the current tariff	85	90	94
- Percent of households who would subscribe to a standpipe system at Rs.15 per month	--	--	84

1 See footnote 2, Table J-9.
2 When the system was operative, 69% of the households were connected.

Table J-11

Households' Willingness to Pay for Connection to Piped Water System by Socioeconomic Characteristics

(Villages without Piped Water Supply)

	Sweet Water Zone		Brackish Water Zone		Arid Zone	
	Percent of Sample	Mean WTP Bid (Rs. per Month)	Percent of Sample	Mean WTP Bid (Rs. per Month)	Percent of Sample	Mean WTP Bid (Rs. per Month)
Education						
No. of Years of Education of Most Educated Member of Household						
0 - 8	44	15	38	36	48	44
9 - 12	41	21	41	40	48	53
> 12	15	33	21	47	4	55
Construction Value of House (Rs.)						
0 - 49,000	38	14	9	33	25	44
50,000 - 99,000	40	20	22	36	31	41
100,000 - 149,000	10	21	19	38	21	56
≥150,000	12	35	50	44	23	56
Occupation						
Non-Farming	75	21	79	40	58	53
Farming	25	17	21	41	42	43
Ownership of Animals						
Yes	N.A.	N.A.	49	41	80	48
No			51	39	20	53
OVERALL MEAN		21		40		49

20

20

[DRAFT]

RETHINKING RURAL WATER SUPPLY POLICY IN THE PUNJAB, PAKISTAN

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The World Bank
Infrastructure and Urban Development Department

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INTRODUCTION

At first glance a visitor walking around the large agricultural villages in the Sheikhupura and Faisalabad districts of the Punjab in Pakistan might think life there was pretty much the same as it was twenty years ago. Women can still be seen in the fields threshing wheat by hand. Buffalo dung is still the primary source of fuel for household cooking, and drying patties cling to the walls of both mud and red brick houses. Horse-drawn carts and rickshaws still fill the streets.

But many changes quickly become obvious. Almost all large villages in these two districts now have electricity, and television antennas can be seen on many roofs. Mechanized wheat threshers and tractors are at work in the fields. The community well is no longer used and is likely to be filled with trash. Plastic, fiberglass, and cement water tanks of various shapes and sizes are perched on the rooftops of many houses. And in the large villages in the Faisalabad district, perhaps the most surprizing thing is the noise. Seemingly on every block one can hear the sound of power looms coming from inside single-story red brick buildings. From the outside these small textile enterprises often look like other houses on the street, but inside are small factories with five, ten, or more power looms weaving "gray" cloth for export.

Large villages in the Faisalabad district, and to a somewhat lesser extent in the Sheikhupura district, are being rapidly integrated into a dynamic, export-driven regional economy. Despite their traditional outward appearances, villages are becoming small towns with more diversified economies. More than fifty percent of households are now primarily engaged in nonagricultural activities. Migrants from other parts of Pakistan are moving to these districts in search of work in textile manufacturing, and often settle in large villages where land and housing prices are cheaper than in urban centers. People from the villages often shop in the nearby cities, and enterpreneurs based in the large urban areas such as Faisalabad subcontract work to enterprises in the villages. As a result, village economies are becoming much more closely linked to urban centers.

The emergance of this Sheikhupura-Faisalabad growth corridor as a major center of economic activity in Pakistan is widely recognized, but the extent to which the economic growth in urban areas has transformed life in the villages in these districts (and the extent to which village-level economic activities have contributed to urban and regional growth) has perhaps not been as well-understood, nor has the importance of these developments for infrastructure investment policy been recognized.

The objective of this paper is to examine the implications for water supply policy of the rapid economic development of large villages in the Sheikhupura and Faisalabad districts of the Punjab. Although the pace of economic development in these districts has not been matched throughout the Punjab, many other districts have also much larger history than this! (KN Raj).

experienced rapid growth, fueled in large part by the agricultural productivity gains made possible by the Green Revolution and by remittances from the Middle East. Thus, although the large villages in Sheikhupura and Faisalabad districts, which are the focus of this study, are not typical of all villages, they are at the cutting edge of the economic transformation of the irrigated areas of the Punjab and are likely to be indicative of future developments. The situation in the large villages in Sheikhupura and Faisalabad districts thus assumes a special importance from a policy perspective because what is now happening in these villages will likely occur in many villages throughout the irrigated parts of the Punjab in the near future.

In order to study the existing water supply situation in these districts, and to assess households' willingness to pay for improved water services, indepth interviews with 756 households were conducted in 1988 in eleven villages: five in Sheikhupura and six in Faisalabad district. In each district some of the villages already had piped water distribution systems installed, and some did not. Table 1 shows the number of interviews completed in each of the study villages, as well as the 1981 population estimates and selected socioeconomic and demographic characteristics of the sample households.

Our analysis indicates that the demand for improved water services is high, and that many households are not waiting for public sector interventions to meet their needs. Even where government water systems are installed, many households continue to rely on privately-provided water sources because the public piped distribution systems are so unreliable. The high level of demand and the ensuing household expenditures on private sector solutions suggest that many villages can afford and are willing to pay much more than the current tariffs for a connection to a piped water distribution system, but that they will not do so unless reliability is dramatically improved.

CURRENT WATER SUPPLY SITUATION IN THE STUDY VILLAGES

Over the last two decades a transformation has occurred in village water supply arrangements in the irrigated areas of the Punjab. Historically most households relied on community wells, shallow ponds, or irrigation canals for all their domestic water needs, and the task of fetching water from sources outside the home was a standard part of women and children's daily routine. Today community wells have been largely replaced by private handpumps which are located inside a household's dwelling or courtyard. In the study villages in both Sheikhupura and Faisalabad districts 99 percent of the households interviewed had their own handpump, purchased from and maintained by private sector vendors.

The villages in Sheikhupura district are all located in what is known are the "sweet water" zone of the Punjab where groundwater is of high quality and can be used for drinking and other purposes. Groundwater is found at shallow depths and, since almost everyone has their own well and private handpump, there is no need for households in the sweet water zone to collect water from any source outside the home.

The villages in Faisalabad district are located in the "brackish water" zone. Here the existing water supply situation is more complicated. Water from private handpumps is not usually used for drinking or cooking purposes because it is too salty, but it can be used for other household uses such as washing and bathing. Private handpumps are still a valuable convenience to households in the brackish water zone (as evidenced by the fact that almost everyone has one), but not to the same extent as in the sweet water zone. In the brackish water zone women and children usually collect water from outside the house for drinking and cooking purposes. Women and children often walk to handpumps located outside the village where sweet water can be drawn from alongside irrigation canals, or water may be obtained directly from irrigation canals. Some households purchase water from vendors who haul sweet water from canals or handpumps and deliver it directly to the house.[1]

The transition from community wells to individually-owned handpumps is now virtually complete in Sheikhupura and Faisalabad districts, as well as in many other irrigated areas of the Punjab, but a second transition is now well underway. Households in both the sweet water and brackish water zones are now demanding better water services than can be provided with a private handpump, and are

1 The price of a 20-liter container of water delivered to a house is Rs.1 (US$1 = Rs.21 in 1990). So?

installing electric motors on their own wells, pumping water into overhead tanks, and then using this water for a variety of water-related amenities such as indoor plumbing, toilets, and showers. In effect, households are making investments which replicate the services available from a public piped water distribution system.

In the sweet water zone, electric motors enable households to enjoy the conveniences of indoor plumbing; private handpumps already provide an almost equally convenient source of drinking and cooking water. In the brackish water zone electric motors permit water to be raised from lower depths, which in many places reduces the salinity of the water withdrawn. Thus, in the brackish water zone, electric motors not only enable a house to install indoor plumbing, but may also increase the quality of water provided, and thereby eliminate the need to fetch drinking and cooking water from outside the house.

The extent of this quality differential in the brackish water zone between groundwater from increasingly deeper levels varys in different locations. Moreover, different households perceive the significance of this quality differential differently. Some households may judge an improvement of a given magnitude as sufficient to elminate the need for collecting sweet water from outside the home for drinking and cooking. Others may not. Generally speaking, however, the installation of an electric motor is more valuable to households in the brackish water zone than to households in the sweet water zone because of this improvement in water quality which may be possible.

Table 2 shows the percentages of sample households with different combinations of water service options. In villages in the sweet water zone without a piped water system, 70 percent of the sample households had only a handpump. Thirty percent had a handpump and an electric motor. In the sweet water zone, in villages with piped water systems, 45 percent of the population were not connected to the system (41 percent had a handpump only and 4 percent had a handpump and electric motor). Forty seven percent had a handpump and a private connection, and 7 percent had all three options: a handpump, electric motor, and a connection. Only 1 percent of the households had only a private connection. The fact that households are significantly less likely to have electric motors in villages where a piped water supply is available clearly indicates that households consider these improvements in service to be substitutes for each other.

In the brackish water zone, in villages without piped water systems, only 38 percent of the households had just a handpump. Sixty two percent had installed an electric motor, over twice the percentage in the sweet water zone. In villages with piped water systems, only 25 percent of the population were not connected (21 percent had a handpump only and 4 percent had a handpump and electric motor). Forty percent had a handpump and a connection. Perhaps most surprizingly, in villages with piped water systems in the brackish water zone, 29 percent of the sample households had all three options: a handpump, electric motor, and a private connection.

Just as one would expect, the households with multiple water service options are better educated and have a higher socioeconomic level (measured by the construction value of their house) than households which have only a handpump. For example, in the sweet water zone in villages with piped water systems, in households which have only a handpump, the average education of the most educated member of the household is 6 years. In households with a handpump, an electric motor, and a private connection, it is 12 years (see Table 2). The average value of the house of respondents which have only a handpump is Rs.49,000; for households with a handpump, an electric motor, and a private connection, it is Rs.209,000.

Not only are households in the study villages replicating the services available from a public water system by installing electric motors and overhead storage tanks, but over the last few years another development has begun: households are rapidly installing pour-flush toilets. Of course, all the study villages lack water-borne sewerage systems. The conventional wisdom is that people defecate in the fields and open areas around the village. However, as villages grow, this practice becomes less and less convenient, and many households in the study villages use "latrines" in their compounds and pay private cleaners Rs. 10-20 per month (US$1 = Rs.21 in 1990) to remove the excrement.[2] Children often defecate in the open drains which generally line both sides of a street or lane.

The pour-flush toilets which are now being installed are

2 The term "latrine" is something of a misnomer. These are not pits, but simply an isolated, enclosed area of the house or compound.

connected to "septic" tanks which are typically built outside the house in the street. The tanks are made of cement and may be at either ground level or above ground. There is no proper septic field associated with these systems, and many do little more than transfer the excrement from inside the house to the open drains outside. The nightsoil collects in the tank and the liquid effluent spoils out into the open drain in the street. Because the installation of these systems is so recent, there is little experience on how often the tanks will need to be emptied. Most systems with a pour-flush toilet and septic tank probably cost about Rs.3000-4000.

The installation of a pour-flush system is not dependent on the house having an electric motor and indoor plumbing because water from the handpump can easily be used to flush the WC. However, typically a household would purchase in a WC and septic tank system after the installation of an electric motor and indoor plumbing because for most households the latter would be a higher priority investment. The villages elites are typically the first in a community to install pour-flush systems with a septic tanks, and these are something of a status symbol. This has important implications because the behavior of local elites is generally emulated by the general population as resources become available to other households. Exact estimates are not available on the number of households in the study villages which have installed pour-flush toilets with septic tanks, but it varys from about 10 to 20 percent depending on the village, and is growing rapidly.

EXISTING INSTITUTIONAL RESPONSIBILITIES IN THE RURAL WATER SECTOR

At the Federal level, the Ministry of Planning and Development (Planning and Development Division, Physical Planning and Housing Section) is the key policy-making body with the primary responsibility for incorporating rural water supply objectives into overall development plans. The Ministry of Housing and Works (Environment and Urban Affairs Division) has the major responsibility for providing technical oversight of rural water supply programs.

At the Provincial level, the Public Health Engineering Department (PHED) is the agency responsibile for the construction and the initial operation of most rural water systems. The local government authorities (District and Union Councils) are supposed to be responsible for the operation and maintenance of public water supply systems. In principle, the District or Union Councils are supposed to take over responsibility for running their own piped water systems after a two-year "demonstration period." In fact, this delegation of responsibility rarely does occurs, and the PHED continues to operate the system (and incurr the operation and maintenance expenses).

RURAL WATER SUPPLY POLICY IN PAKISTAN

As in many developing countries, rural water supply policy in Pakistan is based on the assumption that households in rural areas cannot afford to pay the full costs of improved water systems, and that central government subsidies are required in order to increase "coverage." The Government of Pakistan's Sixth Five-Year Development Plan (1983-1987) identified rural water supply as a "neglected sector," and announced an objective of doubling coverage from 22 percent of the rural population to 44 percent by the end of 1988. A tentative coverage target of 75 percent has been set for the end of the Seventh Five-Year Plan in 1993.

Rural water supply investments are justified as poverty allievation programs, not as infrastructure necessary to support economic development. Because of the presumption that all capital costs must be met by the central government, the Goverment of Pakistan has set criteria to determine how the available federal budget resources should be allocated among communities and regions of the country. These criteria have generally been based on central planners' perceptions of the need of communities for improved water supplies. Little effort has been made to determine what services people themselves want and are prepared to pay for.

The brackish water areas of the Punjab are considered a high priority for improved water services by central planners because of the poor quality water supplied by private handpumps. The current policy is for villages in brackish areas with populations over 5000 to be provided with a piped distribution system with house connections. It is not considered cost effective to provide villages with populations less than 5000 with house connections, and in such cases government policy is to construct a distribution system with public taps located throughout the village. Public water systems are not being constructed in the sweet water areas of the Punjab based on the belief that private handpumps already meet basic human needs.

If a village is selected to receive a piped water distribution system, little is expected of households in terms of cost recovery. With rare exceptions, the government bears 100 percent of the capital costs of public water supply projects, and often most of the operation and maintenance costs. For systems with individual connections, households are expected to pay a monthly tariff of between Rs.10 to Rs. 12. This tariff is simply a flat monthly charge, and is not based on the volume of water used. Connections are not metered and households can take as much water as they wish. In addition to the monthly tariff, households are expected to pay a one-time connection fee of about Rs. 80 and must bear the costs of connecting their house to the distribution system (which would vary with the distance of the household to the water line, but would typically cost about Rs. 500).

The collection of the tariff is uneven. In some areas most households who are connected pay; in other areas compliance is much lower. Data on compliance rates in the Punjab are not available, but probably something on the order of 60 percent of the connected households pay the monthly tariff. Households which do not pay are rarely disconnected from the system.

For systems with public taps, households are supposed to pay Rs.5 per month. However, this is rarely collected, in part because people generally want house connections and are disappointed when they are provided with with public taps.

Despite the official allocation criteria, rural water supply projects remain a politically attractive form of central government largess, and there is still ample room for political determinations of which communities receive centrally-funded water projects.

FINANCIAL COSTS TO A HOUSEHOLD OF ALTERNATIVE WATER SUPPLY OPTIONS

Table 3 presents the financial costs to an individual household of different water supply options. The total capital costs of a private handpump and the construction of a shallow well are about Rs.1000. Maintenance expenses probably average about Rs.5 per month. Assuming an economic life of 10 years and a real interest rate of 10 percent, the total monthly cost to a household of owning a private handpump is about Rs.18.

With the existing tariff and connection fee, the total monthly cost to a household of a private connection to a piped distribution system is about the same as for a handpump. The upfront costs (connection fee plus costs of running a water line from the house to the distribution line) are about Rs.600. The monthly tariff (in the brackish water zone) is Rs.12. Assuming an economic life of 20 years and a real interest rate of 10 percent, the total monthly cost of a private water connection is about Rs. 18.

The cost to a household of installing an electric motor on its private well is about Rs.1500 (over twice the cost of a private connection); the monthly operation and maintenance (including electricity) is about Rs.20. Assuming an economic life of 10 years and a real interest rate of 10 percent, the total monthly cost to the household of an electric motor is about Rs.40. This does not include the cost of an overhead tank (about Rs.500) or of indoor plumbing (about Rs.5000).

The monthly costs of water to the household obviously increase significantly when the costs of these service options are added together. The monthly costs for both a handpump and a connection to a piped distribution system would be Rs.36; for a handpump and an electric motor the monthly cost would be Rs.58. Households with all three service options--a handpump, an electric motor, and a private connection--pay about Rs.76 per month for water.

HOW MUCH ARE HOUSEHOLDS WILLING TO PAY FOR IMPROVED WATER SERVICES?

Respondents in both the sweet water and brackish water zones were asked a series of structured questions designed to determine how much they would be willing to pay for improved water services.[3] Households in villages without piped water systems were asked how much they would be willing to pay per month for a private connection to a water system with standard reliability and to a system with improved reliability (i.e., which provided water four hours a day more than the standard system). Households in villages with piped water systems were asked how much they would pay for a connection to a system with improved reliability. Table 4 presents the mean responses for households in villages without a piped water supply system for different subgroups of the sample in both the sweet water and brackish water zones.

Not surprizingly, respondents in the sweet water zone bid much less than those in the brackish water zone (a mean of Rs.21 versus Rs.40). In both the sweet water and brackish water zones, households with more educated members gave consistently higher willingness-to-pay (WTP) bids than those with less educated members. Also, respondents who lived in more expensive, better quality houses consistently bid higher than those living in less expensive houses.[4]

3 See Willingness to Pay for Water in Rural Areas: Report on Research in the Punjab, Pakistan, by Mir Anjum Altaf and Harron Jamal. June, 1990. [DRAFT] World Bank Discussion Paper. The World Bank, Washington D.C.

4 These relationships are consistent with the results of multivariate analyses of the determinants of the WTP bids. See Altaf and Haroon, 1990, and Altaf, Haroon, Liu, Smith, and Whittington, 1990.

There are two groups of households in villages with piped water systems: those with a private connection and those without. Both groups were asked how much they would be willing to pay per month to be connected to a more reliable system. In the sweet water zone about 50 percent of the households in both groups bid more than the existing tariff of Rs.10.[5] Of those households that bid more than the existing tariff, the mean WTP bid for a connection to a more reliable system was Rs.20 per month for households already connected and Rs.19 for households not already connected.

In the brackish water zone households in villages with and without piped water systems were also asked about their willingness to pay for a more reliable system. The mean WTP bid for households in villages without piped water systems was Rs.56 (compared to Rs.40 for a standard system). Households in villages with piped water systems in the brackish zone only bid Rs.33 on average. This large difference is probably due to the fact that households who already had private connections were generally dissatisfied with the performance of the water system and may not have found the possibility of a more reliable system credible.

5 Thus, about half of the presently unconnected households would connect to an improved system if the tariff remained at Rs.10 per month.

THE ECONOMICS OF VILLAGE-LEVEL WATER SUPPLY OPTIONS

The efforts by households to provide themselves with improved water supplies through the purchase of services from the private sector entail substantial expenditures in the aggregate. Table 5 presents an estimate of the amount of money being spent on private provision of water services by households in a typical village in the brackish water zone with a population of 5000 (562 households assuming 8.9 people per household) without a piped water system. Assuming 62 percent of the households in the village have a handpump and an electric motor and the remaining 38 percent have only a handpump, households in such a village have already invested over Rs.1 million in private handpumps and electric motors. The operation and maintenance costs of these privately-provided water systems is estimated to be about Rs.9800 per month. The total monthly costs are about Rs.23,900. or ___ per capita

Based on data from the PHED in the Punjab, a new piped distribution system for such a village would cost about Rs.1,500,000 (Rs.300 per capita). If 100 percent of the households in the village connected and each paid Rs. 500 to connect their house to the distribution system, the total capital costs of the system would be approximately Rs.1,780,000. According to PHED estimates, the monthly operation and maintenance costs of such a piped distribution system would be about Rs.3800, and the total monthly cost would be Rs.21,600.

Given the approximate nature of these cost estimates, the total costs of a piped distribution system are essentially the same as the amount households are already spending for handpumps and electric motors. This comparison must, however, be interpreted carefully. The costs of the piped distribution system are based on the historical experience of the PHED in building and operating water systems with low reliability. Such systems would not replace households' need for private handpumps; for some households such systems would not even replace their desire for electric motors. Increasing the reliability of such systems would increase their costs, so that a piped distribution system that would actually serve as a substitute for handpumps and electric motors could cost considerably more than households are spending now.

On the other hand, the cost estimates for the piped water system assume that 100 percent of the households would connect, and thus the number of households serviced by a system better than a handpump would be greater than with the current situation. Moreover, the cost estimates for handpumps and electric motors do not include the costs of the time households spend collecting drinking and cooking water from outside the house, or the money paid to water vendors. In this sense the cost estimates presented for the existing situation are an underestimate of the real resource costs.

On average, households in villages in the brackish water zone without piped water supplies said they would be willing to pay Rs.40 per month for a connection to a standard piped water system. If every household connected and paid Rs. 40 per month, the monthly revenues to the water utility would be about Rs.22,500--almost the same as our estimates of the total monthly costs of a piped distribution system and of current water expenditures.[6] However, Rs. 40 per month is the mean WTP bid; not every household would be willing to pay this amount. The frequency distribution of willingness-to-pay bids indicates that if the monthly tariff were set at Rs. 25 per month (compared to the existing tariff of Rs.12 per month in the brackish water zone), about 80 percent of the households would decide to connect to a new piped distribution system (see Figure 1). The total monthly revenue associated with a tariff of Rs.25 would be about Rs.11,700. This would be over three times the monthly operation and maintenance costs of the system to the PHED, and about two thirds of the total monthly costs (including the capital costs).

If system reliability is improved, tariff levels can be raised even more, and revenues can be significantly increased. An analysis of households WTP bids suggests that if the reliability is improved, 80 percent of the households would be willing to pay Rs.35 per month for a connection. This would generate monthly revenues of more than Rs.16,000. Given the approximate nature of these estimates, such revenues are close to the total monthly costs of the piped distribution system. These calculations suggest that tariff levels in the brackish water zone could easily be doubled or even tripled if reliability were improved, and that the revenues generated could pay

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Note, however, that our estimate of the total monthly costs included the costs of connecting the household to the distribution line. The water utility would not need revenues to cover these costs.

for the operation and maintenance costs of the system and make a major contribution to the capital costs.

? It is not clear from this example whether households in the brackish zone would, in fact, be willing and able to pay for the full costs of a piped water system. However, these calculations are only meant to be illustrative and to provide a sense of the order of magnitude of the likely costs and revenues, not to determine the level of subsidies required for the construction of rural water systems.

In the sweet water zone the costs of a water supply system are essentially the same as in the brackish water zone, but households are are on average only willing to pay about half as much as in the brackish water zone. Full cost recovery is thus not feasible in most villages in the sweet water zone at this time. However, households in the sweet water zone do place a premium on obtaining reliable service, and revenues can be increased by increasing reliability.

Press, what about net?

The results of this study illustrate that households in both the brackish and sweet water zones are demanding increasing levels of water and sanitation services, and some households are already paying surprizingly large amounts for such services. For example, almost thirty percent of the households in the brackish water zone in villages with piped water systems already have a private handpump, an electric motor, and a private connection, and are paying about Rs.76 per month for water services. When most of the households in a village can afford this level of expenditure for a reliable piped water system, full cost recovery should be possible.

PROBLEMS WITH EXISTING GOVERNMENT POLICY

An necessary question to ask is whether the existing policies of the Government of Pakistan in the rural water sector in fact create any major difficulties. After all, many households appear to be meeting their water needs through private sector initiatives without reliance on government-subsidized projects. Even if government policies are based on the unfounded assumption about households are unable to pay very much for improved services, are there any reasons to think the existing policies are causing significant harm? We believe that there are in fact three main problems with existing government policies in the rural water sector in the irrigated areas of the Punjab.

1. FAILURE TO RECOGNIZE THE COMMON PROPERTY NATURE OF GROUNDWATER EXTRACTION AND THE EXTERNALITIES ASSOCIATED WITH IMPROVED SANITATION AND DRAINAGE

Relative to irrigation?

First, existing government policy does not adequately address the consequences of the increasing and unregulated use of ground water by households and small firms acting independently of each other. The groundwater aquifer is a common property resource which will soon be overexploited. The present private sector solution of everyone drilling their own well and pumping groundwater is not sustainable; water tables have already fallen significantly in many villages. As increasing numbers of households install electric motors and indoor plumbing, water usage will increase and the problem will grow worse. Many households already have to regularly rebore their wells in order to reach water.

Not only does reboring add considerably to the costs of the private sector option, but in many villages the groundwater is rapidly approaching a level at which it will not be technically possible to lift water with the type of simple, inexpensive handpumps now prevalent in the Punjab. When this point is reached, villages will face a new kind of water crisis. Poor households may not be able to afford the expense of both reboring and the installation of either an electric motor or a more costly, heavy-duty handpump required for the increased lifts. Such households may well have to purchase water from wealthier neighbors who can afford such systems. As the water table continues to fall, the economics of village water supply systems will shift dramatically in favor of collective solutions.

Moreover, existing government rural water policy does not pay adequate attention to sanitation and drainage issues. The increased water usage associated with the installation of electric motors and indoor plumbing facilities has increased drainage problems in most villages. When people shifted from the community well to private handpumps inside the home, household water use undoubtedly increased, but not nearly as much as when electric motors and indoor plumbing are installed. The open drains which line both sides of most streets carry sullage water and raw sewage, but they often stagnant and overflow, creating public health problems.

Most village drainage systems empty into a sewage pond at the edge of the village, but these ponds are rapidly filling up as flows increase due to increased water use, installation of WCs, and population growth. Additional land for new waste disposal ponds is often not readily available as land prices rise and agricultural land at the edge of the village is converted to urban uses.

In both the sweetwater and brackish water zones, the drainage situation will become increasingly worse as the trends to install electric motors and WCs with septic tanks continue. Private sector solutions to these kind of drainage problems are not easy to envisage. Collective action at the community level is necessary to install drainage systems where they do not exist, to keep existing drains clean, and to find solutions to the problems associated with diminishing capacity of sewage ponds. This does not necessarily mean that large subsidies need to be provided by the central government for construction projects, but the PHED certainly has a role to play in providing technical assistance to communities in the areas of sanitation and drainage planning.

2. INEQUITABLE DISTRIBUTION OF GOVERNMENT SUBSIDIES

Second, current policy results in large subsidies to those villages in the brackish water zone which receive government-provided piped water systems. Government policy justifies these subsidies on the grounds that villages in the brackish zone are in greatest need of improved water. It is certainly true that villages in the brackish zone need improved quality water more than villages in the sweetwater zone, but it does not follow that because a village is in need of improved water that it is poor. Many of the villages in the brackish zone which receive government subsidies are relatively high-income communities, particularly those near Faisalabad district engaged in textile enterprises. In fact, in our study households in villages in the brackish water zone were significantly better off than those in the sweet water zone.

Households in the brackish water zone have demonstrated a high willingness to pay for improved water systems, both in terms of their current expenditures on electric motors and in their responses to direct questions. Since many villages in the brackish water zone appear to be able to afford the a substanital portion of the capital costs of reliable piped water systems, there would appear to be no reason on equity grounds why systems in such relatively high-income communities should be so heavily subsidized by the government.

3. LACK OF SUPPORT FOR ECONOMIC DEVELOPMENT

Third, government policy is not adequately supporting economic development in the irrigated areas of the Punjab. The results of this study show that in some large villages people are prepared to pay a much larger portion of costs of piped water supply systems if the service is reliable, even though they already have private handpumps. In the brackish water zone, although the official government policy is to promote the provision of piped water systems, in practice few villages receive such systems because of the limited capital available to subsidize their construction. It makes no sense to delay providing service to communities in the brackish zone which do not require subsidies just because the central government does not have sufficient resources to subsidize 100 percent of the capital costs. Moreover, if some communities in the sweet water zone do not require subsidies, it makes no sense to deny them service just because their basic needs are being met by private handpumps.

The problem with current government policy is that it effectively denys the services of a piped water system to households and small firms in one of the most dynamic economic regions of Pakistan. Water services are an important factor input for many small scale manufacturing and commercial enterprises. Providing reliable piped water supplies to communities in the irrigated areas of the Punjab which are prepared to pay the costs of such services is a sound economic investment and will further spur the rapid ongoing development of such communities.

POLICY RECOMMENDATIONS

The findings from this research effort suggest several specific ways in which the Government of Pakistan's rural water policies can be improved. People are prepared to pay substantial amounts for a private house connection, but only if the service is reliable. Households in the irrigated areas of the Punjab have several options with respect to what source of water they use, and unless a piped distribution system provides good service, many households will not connect to the system. If they do connect, the private connection with standard reliability will only provide a second or even third level of service. Despite the fact that incomes are quite high in our sample villages in relative terms, households were not willing to spend more than 1-2 percent of their income for a private connection.

first time mentioned here

A manager of a public water authority must therefore compete for households' patronage. The most effective way to compete is not through subsidized tariffs, reduced connection fees, or low-cost financing of connection costs, but rather by providing a service which is better than households' other alternatives. Our findings indicate that the service characteristic of most concern to households is reliability.

Our analysis shows that households are willing to pay as much as

Define unreliability — Reasons? Electricity?

40 percent more per month for reliable service than for the existing (unreliable) service. Equally important, more households will connect to a reliable system than to an unreliable system. The combination of both higher connection rates and higher tariffs associated with improved reliability means that revenues to the utility can be increased significantly if reliability is improved (see Figure 2). Cost recovery and customer satisfaction thus both depend upon increasing the reliability of piped water systems. How can this be done?

$ costs?

The government-financed water systems built in the Punjab have been designed based on an estimate of per capita water use of 40 liters per day. This estimate is much too low when the marginal cost of water to the household is zero, in part because humans are not the only users of the piped water. Many households in the villages own animals which live in their dwellings or compounds (in the brackish zone, 40-50 percent of the sample households in a given village reported owning animals). Water buffalos in particular need large amounts of water to stay cool. Traditionally water buffalos were taken to a pond outside the village to cool off and drink, but this is a time consuming activity. When a piped system is installed in a village, most people find it much more convenient to simply hose down their water buffalos in the street. Because the connections are unmetered, households have no incentive to conserve water.

In addition to watering animals, households find many other uses for water when it is available free. This high demand for water in a hot arid climate when the marginal cost to the household is zero, coupled with the low capacity of the systems, means that water must be rationed by curtailing service. This entails chronically low pressure. When water systems are operational, they typically run for just three or four hours a day.

The Public Health Engineering Department and the community are thus caught in a kind of low-level equilibrium. Since water connections are not metered, people demand more water than the system can provide. In order to ration supplies, the PHED reduces the number of hours of service. Because the systems are unreliable, people must still invest in alternative private arrangements; the piped system becomes at best a supplemental water source. This means that households are not willing to pay very much for the service. Because households are not willing to pay much for the service, the PHED does not collect sufficient revenues to properly manage and run the system, and reliability deteriorates further.

The way out of this trap is to install metered connections and charge higher prices for water. The higher prices will enable the PHED to collect higher revenues, which must be used to provide better management and more reliable service. The results of our survey suggest that this would be a popular policy change. The majority of respondents in both the sweet water and brackish water zones favored metering of private water connections. At first glance, this might seem unreasonable because households now pay only the subsidized tariff. But although the tariff is low, households are only too aware that the service is poor. Often they must pay the tariff even though the system is down and they have not received any water. Households perceive metering to be a much more equitable arrangement: you pay for what you get (and you do not pay for what you do not get!).

To summarize, a sound rural water policy for the irrigated areas of the Punjab should be based on the following principles:

1. Improved reliability is the key to customer satisfaction and high connection rates. The provision of subsidized credit to cover household connection costs is not necessary.

2. Private connections should be metered and prices should be set to cover a much higher proportion of the capital and operating costs of supplying water.

3. Piped distribution systems should not be built unless projected revenues are sufficient to cover the costs of providing much more reliable service.

4. Systems should not be designed on the basis of a 40 liter per capita per day standard. Information is required on how much water households will consume with metered connections and realistic prices.

5. Villages with populations of less than 5000 should not be prohibited from obtaining piped water distribution systems, provided that they can pay for the costs of supply.

6. Water systems based on distribution by public taps can rarely be economically justified in the irrigated areas of the Punjab. They should only be constructed when there is clear, demonstrable evidence that this is the service level desired by the community and that people are prepared to pay for the costs of the system.

7. The PHED should focus its efforts on communities where the problems of declining groundwater levels are most emminent.

8. Villages in the sweet water zone should not be precluded from obtaining piped water distribution systems, provided that they are able and willing to pay for the costs of supply.

Incentives to PHED?

CONCLUDING REMARKS

The existing government policies for the rural water sector in the irrigated areas of the Punjab in Pakistan need to be reevaluated in light of the strong and growing household demand for improved services, consumer dissatisfaction with the low reliability of existing piped water supply systems, and the emerging problems of declining groundwater levels and wastewater disposal. The Government of Pakistan has an important role to play in facilitating and financing community investments in water and sanitation infrastructure. The current government policy of subsidizing 100 percent of the capital costs of water systems is not justified given households' high willingness to pay for improved services.

However, public sector agencies should not assume that households in large villages in the irrigated areas of the Punjab which have not yet received piped water systems have been waiting patiently for a government rural water supply system to arrive. On the contrary, because the demand for improved services is high, the private sector has provided many people with alternative solutions to their water needs. This means that the PHED no longer has carte blanche to come into a village and decide what service level and system reliability characteristics to provide. For example, there is little demand for public standposts in the study villages and a strong desire for metered connections with reliable pressure.

Planning for improvements in rural water supplies now requires a detailed knowledge of household demand for improved services and active community involvement in the decision making process. Otherwise, services may be provided that households do not want, will not use effciently, and will not pay for.

Perhaps most importantly, the results of this study suggest that circumstances in large villages in the irrigated areas of the Punjab are changing rapidly, and government planning efforts must be better informed about the nature of these changes and their implications for government policy. Both planning and policy must become more responsive to households needs and aspirations, and adapt more quickly to accomodate and support a dynamic private sector economic environment.

Govt of Kerala

Table 1 : SOCIOECONOMIC PROFILE OF SAMPLE VILLAGES

Village	No. of Households Interviewed	Population (1981 Census Estimate)	Average Household Size	Household Expenditures (Rs. per Mo.)	Construction Value of House (000's Rs.)	Percent of Households Involved in Farming	Percent of Households Owning Animals	Education Level of Most Educated... (a) Member of Household	(b) Woman in Household
Sweetwater Zone									
A. Villages with Piped Water Supply									
Jandiala Sher Khan	99	7581	9	N.A.	104	26	N.A.	8	4
Mirza Virkan	45	5630	10	N.A.	51	42	N.A.	7	2
B. Villages without Piped Water Supply									
Kharianwala	58	8990	10	N.A.	98	19	N.A.	9	2
Ghazi Minara	28	4514	9	N.A.	80	21	N.A.	9	4
Bhaddroo Minara	31	2173	9	N.A.	65	29	N.A.	7	4
Subtotal	261								
Brackish Water Zone									
A. Villages with Piped Water Supply									
Manawala	106	20,586	9	1703	125	9	28	8	4
Sudhar	96	8,333	9	1435	90	18	52	7	2
B. Villages without Piped Water Supply									
Akalgarh	106	7,885	9	1665	149	20	49	10	6
Bhalwala	94	11,049	9	1638	143	19	52	9	5
Santpura	52	7,339	8	1483	144	27	50	8	4
Gatwala	41	6,181	10	2284	200	22	42	10	6
Subtotal	495								
Total	756								

Table 2: RELATIONSHIP BETWEEN CHOICE OF SERVICE LEVEL, ECONOMIC STATUS, AND EDUCATION LEVEL OF HOUSEHOLD

Service Level	Percent of Sample Households Selecting Service Option	Average Value of House (000's Rs.)	Average Household Expenditure (Rs. Per Mo.)	Education Level of Most Educated... (a) Member of Household	(b) Woman In Household
Sweetwater Zone					
A. Villages with Piped Water Supply					
1. Handpump Only	41	~~48~~ 49	N.A.	6	2
2. Domestic Connection Only	1	60	N.A.	13	2
3. Handpump and Connection	47	~~97~~ 96	N.A.	8	4
4. Handpump and Electric Pump	4	~~137~~ 138	N.A.	12	7
5. Handpump, Electric Pump, and Connection	7	~~208~~ 209	N.A.	12	7
	100%				
B. Villages without Piped Water Supply					
1. Handpump Only	70	66	N.A.	8	3
2. Handpump and Electric Pump	30	132	N.A.	11	5
	100%				
Brackish Water Zone					
A. Villages with Piped Water Supply					
1. Handpump Only	21	62	1307	~~4~~ 5	2
2. Domestic Connection Only	6	67	1308	~~4~~ 9	2
3. Handpump and Connection	40	~~113~~ 112	1562	~~4~~ 7	3
4. Handpump and Electric Pump	4	115	1787	~~6~~ 8	3
5. Handpump and Electric Pump and Connection	29	145	1822	~~5~~ 10	5
	100%				
B. Villages without Piped Water Supply					
1. Handpump Only	38	108	1363	8	4
2. Handpump and Electric Pump	62	181	1928	~~9~~ 10	6
	100%				

3

Table J-~~4~~

Financial Cost to an Average Household of Different Service Options

(Brackish Water Zone)

	Service Option	Total Capital (Rs.)	Monthly Capital (Rs.)	Monthly O & M (Rs.)	Total Monthly (Rs.)
(1)	Handpump[1]	1000	13	5	18
(2)	Domestic Connection[2]	600[3]	6	12[4]	18
(3)	Electric Motor[5]	1500	20	20	40
(1+2)	Handpump and Domestic Connection	1600	19	17	36
(1+3)	Handpump and Electric Motor	2500	33	25	58
(1+2+3)	Handpump, Electric Motor and Domestic Connection	3100	39	37	76

Not included in the above estimates are average capital costs of indoor plumbing often associated with service options (1+2), (1+3) and (1+2+3): Overhead Tank - Rs.500; Indoor Piping - Rs.500; Flush Toilet + Septic Pit - Rs.10,000.

[1] Assumes an economic life of 10 years; 10% real interst. Includes cost of shallow well.
[2] 20 years; 10% interest.
[3] Connection fee - Rs.100; Connection costs - Rs.500.
[4] Monthly tariff paid by household for an unmetered connection.
[5] 10 years; 10% interest.

Table: 4 HOUSEHOLDS' WILLINGNESS TO PAY FOR CONNECTION TO PIPED WATER SYSTEM BY SOCIOECONOMIC CHARACTERISTICS

(Villages without Piped Water Supply)

	Sweetwater Zone		Brackish Water Zone	
	Percent of Sample	Mean WTP Bid (Rs. Per Mo.)	Percent of Sample	Mean WTP Bid (Rs. Per Mo.)
<u>Education</u>				
No. of years of Education of Most Educated Member of Household				
0 - 8	44	15	38	36
9 - 12	41	21	41	40
>12	15	33	21	47
<u>Construction Value of House (Rs.)</u>				
0 - 49,000	38	14	9	33
50,000 - 99,000	40	20	22	36
100,000 - 149,000	10	21	19	38
≥150,000	12	35	50	44
OVERALL MEAN		21		40

Table 5

Service Option	Typical Village with 5000 population[1] (Brackish Water Zone) Total Capital (Rs.)	Monthly Capital (Rs.)	Monthly O & M (Rs.)	Total Monthly (Rs.)
1) Piped Water System (100% of Households Connected)				
- Cost to PHED	1,500,000[2]	15,000 ~~13,500~~[3]	3,800[4]	18,800 ~~17,300~~
- Cost to Households	281,000[5]	2800 ~~2,500~~[3]	--	2,800 ~~2,500~~
- Total				21,600 ~~19,800~~
2) Actual Current Water Expenditures	1,084,000[6]	14,100[7]	9,800	23,900
62% - Handpump and Electric Motor 38% - Handpump Only				
3) Summation of Households' Willingness-to-Pay Bids FOR STANDARD SYSTEM				22,500
4) SUMMATION OF HOUSEHOLDS' WILLINGNESS-TO-PAY BIDS FOR IMPROVED SYSTEM				31,500
5) ESTIMATED REVENUE FROM A STANDARD SYSTEM (BASED ON A TARIFF OF Rs.25 PER MONTH, 80% OF HOUSEHOLDS CONNECTED, AND Rs. 80 CONNECTION FEE)	36,000	400[8]	11,300	11,700
6) ESTIMATED REVENUE FROM AN IMPROVED SYSTEM (BASED ON A TARIFF OF Rs.35 PER MONTH, 80% OF HOUSEHOLDS CONNECTED, AND Rs. 80 CONNECTION FEE)	36,000	400	15,800	16,200
7) COST OF PIPED WATER SYSTEM TO PHED IF 80% OF HOUSEHOLDS CONNECTED	1,200,000	12,000	3,000	15,000

1 562 houses at 8.9 inhabitants per household.

2 Based on tubewell at Rs.300 per capita capital costs.

3 Assumes an economic life of ~~25~~ 20 years, 10% real interest rate.

4 Assumes annual operations and maintenance costs equal to 3% of total capital costs (based on cost data from PHED).

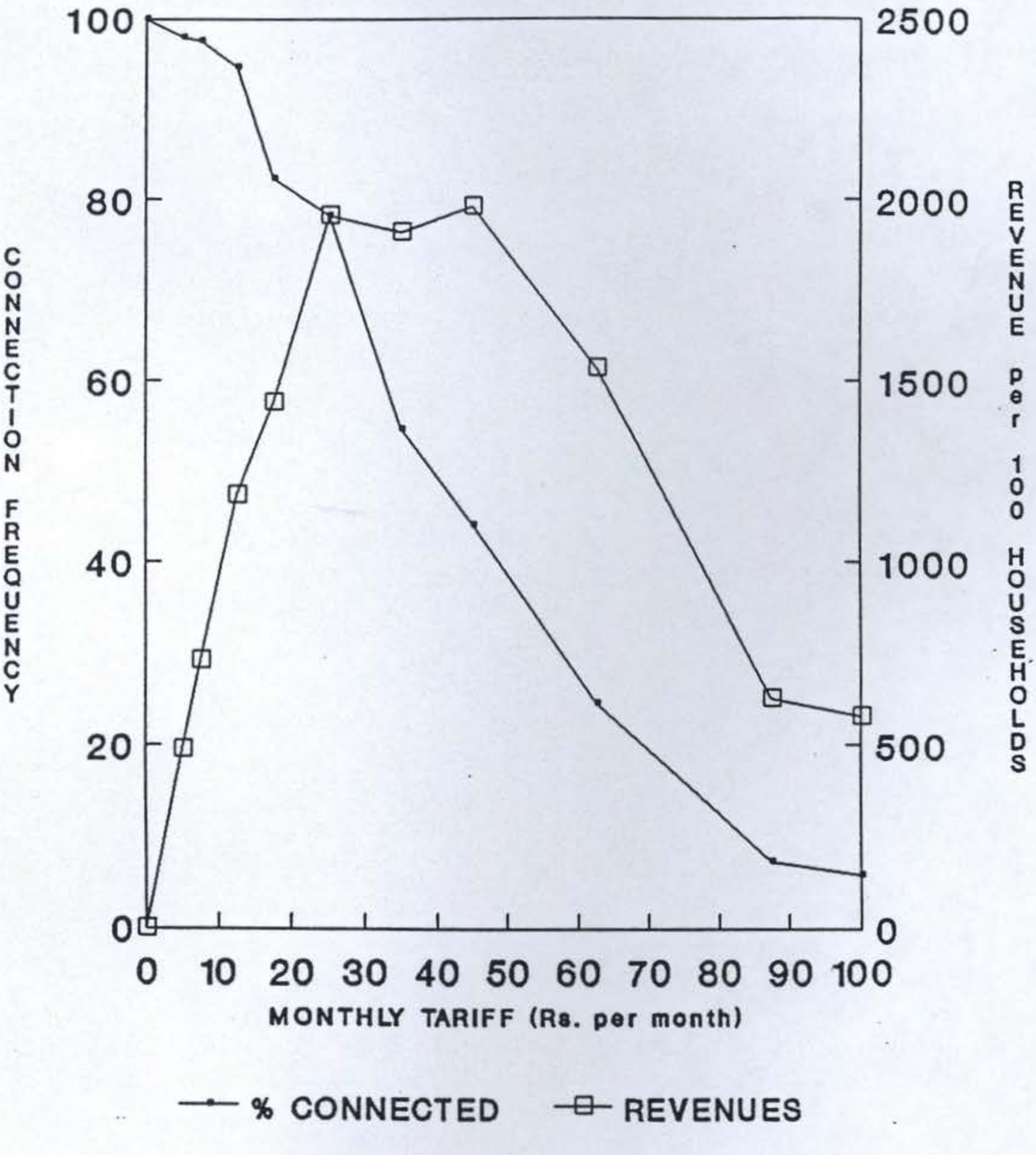
5 Rs.500 connection costs per household.

6 Cost of electric motor - Rs.1500; Cost of handpump - Rs.1000.

7 Assumes an economic life of 10 years, 10% real interest rate.

8 Computed over ~~25~~ 20 years at 10% real interest rate.

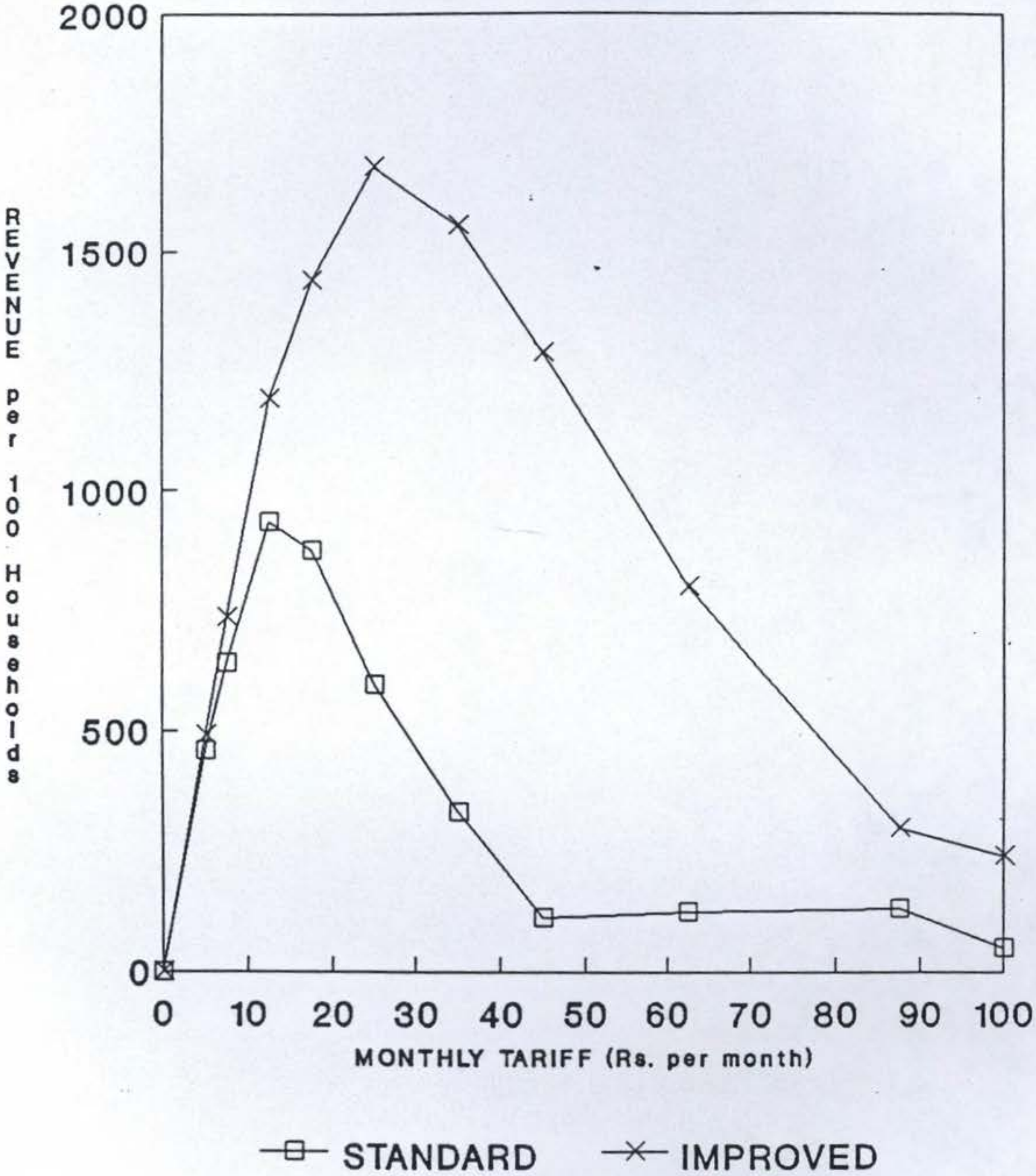
CONNECTION FREQUENCY AND REVENUES
VS. MONTHLY TARIFF



Brackish Water Zone
Villages Without Piped Water Supply
Standard Reliability

Figure 2

REVENUES VS. MONTHLY TARIFF



Brackish Water Zone
Villages With Piped Water System

21

21)

"Existe disposição a pagar por água em comunidades rurais, e quais são as suas implicaçoes políticas? -- resultados preliminares do Brasil"[1]

Paulo F. de Castro
John Briscoe
Wilton Bussab
Orján Olsen[2]

1 - Introdução e Objetivos da Pesquisa

A melhoria na qualidade e na quantidade de água usada pela população rural dos países em desenvolvimento tem sido deficiente em dois aspectos principais: os sistemas construídos são frequentemente mal utilizados e/ou mantidos inadequadamente, e a ampliação dos serviços tem sido muito lenta. Por outro lado, estima-se que os recursos atualmente disponíveis, em escala mundial, são insuficientes para atender, em prazos razoáveis, a demanda de 30% da população mundial (cerca de 1,5 bilhoes de pessoas) por água não contaminada.

Vários fatores concorrem para explicar este resultado. Dentre esses, sem dúvida, destaca-se a precária informação que se possui sobre a possível resposta dos usuários à oferta de novos serviços. De um modo geral, o planejamento de ações em saneamento rural, baseando-se em hipóteses bastante simplificadas sobre o comportamento do beneficiário, tem sido elaborado na pressuposição de que as pessoas não apenas demandarão os novos sistemas, desde que o custo mensal pela utilização dos serviços não ultrapasse 3% a 5% da renda familiar, como também tenderão a consumir quantidades idênticas àquelas de usuários de sistemas similares. Esta regra simples tem ocasionado alguns problemas na determinação do nível de serviços, que ora pode ser muito baixo (os usuários não valoram o serviço melhorado e portanto não pagam por ele), ora pode ser muito elevado (há preferência pelos serviços mas não ao

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1. Trabalho apresentado no I Seminário Internacional de Saneamento Rural, realizado no Rio de Janeiro, entre 16 e 17 de Setembro de 1988.

2. Os autores são, respectivamente, do Instituto de Planejamento Econômico e Social do Ministério do Planejamento do Brasil, do Banco Mundial, da Universidade de São Paulo (Brasil), e do Instituto de Opinião Pública e Estatística (Brasil).

preço que deveria ser cobrado), conforme atestam as avaliações de diferentes agências internacionais sobre projetos em saneamento rural[3].

Por outro lado, informações incorretas sobre o uso da água podem afetar desfavoravelmente toda a concepção do projeto em termos da escolha tecnológica, do nivel de serviço, dos prazos e escala do aumento de capacidade, da estrutura tarifária e dos arranjos financeiros. Com efeito, os recursos podem ser alocados ineficientemente e a viabilidade financeira dos sistemas melhorados de abastecimento de água rural pode ficar comprometida. É comum, em projetos de saneamento rural, a ocorrência de receitas insuficientes e o não atingimento de metas de recuperação de custos. O resultado é que a operação e manutenção são precárias, e os sistemas terminam sendo, muitas vezes, abandonados.

Assim, a eficiência dos investimentos em ações de saneamento rural tem sido tradicionalmente baixa: estima-se, a partir de várias experiências internacionais, que pelo menos 25% dos sistemas existentes não estão em operação e que, entre os que funcionam, a maioria não gera receita suficiente para custear uma manutenção reparadora, quanto mais para expansão e melhoramento dos serviços. Ademais, as avaliações sobre os resultados da maioria dos projetos executados são pessimistas. Em um projeto típico[4], por exemplo, os custos efetivos normalmente excedem em 25% os custos previstos e leva 75% mais tempo do que o esperado para ser concluído; o volume de produção previsto para o sexto ano de operação é atingido em 11,5 anos, enquanto as vendas previstas para o sexto ano são concretizadas apenas após 14 anos de operação. As conseqüências são o aumento do custo incremental médio efetivo por metro cúbico produzido e vendido em cerca de duas vezes e meia e três vezes do custo esperado, respectivamente.

Neste sentido, a viabilidade dos projetos em saneamento rural pode ser melhorada através de avanços metodológicos que incluam informações sobre a valoração dos diversos niveis de serviço, como também a prática de tarifas que ao menos cubram os custos de operação e manutenção dos sistemas. Aqui, um conceito fundamental é aquele da "disposição a pagar"[5] que, indicando como os usuários valoram um novo serviço, serve

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3. Ver, por exemplo, Saunders and Wardord, 1977; IBRD, 1986 e 1987; Australian Development Assistance Bureau, 1983; Federal Republic of Germany, 1983; Canadian Internacional Development Agency, 1983; European Economic Community, 1983.

4. Ver Briscoe,J.. 1986.

5. "Disposição a pagar" é conceitualmente equivalente a "demanda" por um bem econômico. Dois aspectos são relevantes nesta conceituação: a disposição total e a disposição marginal. A disposição marginal por pagar é, por exemplo, o montante que um consumidor está propenso a pagar por uma unidade adicional de água a qualquer nivel dado de consumo corrente, enquanto a disposição total mede a soma das disposiçoes marginais entre diferentes níveis de consumo. Analiticamente, a disposição total por pagar é a área abaixo da curva de demanda.

de guia para definir os arranjos financeiros e técnicos mais adequados aos desafios do saneamento rural.

A pesquisa objetivou, primeiro, consolidar e desenvolver os enfoques metodológicos para estimar a disposição a pagar dos indivíduos por serviços de água em comunidades rurais, e, segundo, testar no campo uma dessas metodologias para determinar sua aplicação como um instrumento prático de planejamento. Especificamente, a partir de informações coletadas em três distintas situaçoes econômico-ambientais em áreas rurais de seis países, pretendeu-se analisar, para serviços melhorados de abastecimento de água com características peculiares (em termos de nível do serviço, preço, confiabilidade e qualidade da água), qual a proporção da população que escolheria utilizar o serviço e qual seria a quantidade usada.

A Secção 2 apresenta uma discussão sucinta dos principais enfoques metodológicos para estimar a disposição a pagar, enquanto a Secção 3 relata as experiências no âmbito da pesquisa em diversos países. Finalmente, na Secção 4, são apresentados alguns resultados parciais da pesquisa a partir de dados brasileiros, discutindo-se algumas implicações para a definição de políticas de saneamento rural.

2 - Questões metodológicas na estimação da disposição a pagar por serviços de água rural

Os estudos sobre demanda por água têm sido baseados em sua maioria em dados relativos a comunidades urbanas, voltando-se principalmente para questões de determinação da quantidade demandada a vários preços e da estimação das elasticidades (renda e preço) da demanda. Podem ser considerados de pouca utilidade para o estudo de comunidades rurais, notadamente em países em desenvolvimento, onde as questoes são mais complexas, envolvendo não apenas a determinação de quantidades demandadas, mas também a probabilidade de adesão dos usuários aos novos sistemas de abastecimento de água.

É pertinente, portanto, resumir uma estrutura teórica que permita entender como os padrões de utilização da água variam quando um novo sistema é instalado em uma comunidade rural. Antes de uma discussão mais aprofundada, vejamos inicialmente as questões práticas enfrentadas pelo planejador/engenheiro do novo sistema.

Suponhamos que há uma proposta para a instalação de um novo sistema de abastecimento de água em uma comunidade rural, em substituição ao uso tradicional de várias fontes poluídas de água. Suponhamos, também, que a comunidade deverá contribuir financeiramente para o empreendimento, dadas as limitaçoes orçamentárias do governo. Neste contexto, deve-se perguntar o que exatamente precisa conhecer o planejador para minimizar equívocos? Em primeiro lugar, ele deve saber, para o caso de ligaçoes domiciliares, quantas famílias estarão dispostas a usar o novo sistema. A seguir, para os que conectaram, é preciso conhecer a taxa de consumo de água. Então, o planejador seria capaz, dado os custos, de determinar se as receitas provenientes do novo sistema seriam suficientes para cobrir os custos, além de definir o nível de serviço desejado. Finalmente, seria importante estabelecer critérios para selecionar a tecnologia apropriada e a tarifa a ser cobrada.

Essas questões também se colocam, similarmente, para diversos outros tipos de abastecimento de água (chafarizes e bombas manuais, por exemplo).

Há várias maneiras de equacionar esses problemas. Uma seria através da aplicação da análise custo-benefício: se os benefícios do novo sistema pudessem ser aproximadamente estimados, poder-se-ia escolher a tecnologia e o preço que maximizassem os benefícios líquidos. De qualquer modo, o planejador precisaria contar com informações suficientes para medir as conseqüências prováveis do projeto e poder compará-las com os custos.

Neste sentido, é preciso conhecer melhor como as pessoas usam água e como as escolhas das fontes de abastecimento são feitas. Essa é uma questão relevante para o desenho do projeto, uma vez que, em comunidades rurais, o novo sistema de abastecimento de água estará competindo com as alternativas tradicionais. Reduz-se, portanto, a conhecer como a comparação entre o novo sistema e o tradicional é feita. Em princípio, essas fontes de abastecimento de água podem ser comparadas em vários aspectos: qualidade, conveniência, confiabilidade e custos reais do recurso (tempo e dinheiro). E, claramente, o problema poderia ser equacionado a partir da teoria da demanda do consumidor. Como um dos maiores benefícios do novo sistema é a economia de tempo em relação à situação anterior, a aplicação da teoria do consumidor deve incorporar esta variável como um fator na decisão individual de adesão ao novo sistema. A teoria deveria incorporar, também, a partir de algumas observaçoes empíricas, o fator distância na escolha do usuário, não obstante o tipo de serviço ofertado (ligação domiciliar vs. chafariz ou bomba manual) parecer ser um determinante da quantidade de água utilizada mais importante que qualquer outra relação entre o uso de água e distância possa sugerir.

2.1 modelo de função de produção familiar

Uma maneira de se determinar os efeitos de um novo sistema no comportamento das pessoas em termos de utilização da água seria observar uma situação onde tal sistema tivesse sido instalado e determinar o número das famílias que o usam, bem como a quantidade de água consumida. Se pudermos estimar relaçoes funcionais consistentes nesta situação, poderíamos então estimar um "modelo" de comportamento sobre a utilização da água que poderia, eventualmente, servir para predizer os impactos da instalação de um novo sistema de abastecimento de água em uma comunidade rural.

Considere a estimação de um modelo em uma comunidade que já dispoe de um sistema público de abastecimento de água. Vários fatores devem influenciar o comportamento do usuário, de modo que, formalmente, teríamos que estimar simultaneamente um sistema de funções de demanda por água nas fontes tradicionais e no domicilio. As informações necessárias para uma estimação mais completa e acurada deste modelo são onerosas e de difícil obtenção. Um enfoque mais prático para modelar as relações de demanda por água ao nível da comunidade assumiria as seguintes hipóteses: em qualquer tempo dado, uma família utiliza apenas uma única fonte para um uso específico; e, uma família usa toda a água para uma dada categoria de uso no domicílio,e não na fonte.

Então a demanda por água no domicilio pode ser estimada por um modelo com uma única equação:

$Q_d = f(SP, y, S)$,

onde Q_d é a quantidade de água demandada, SP é o preço-sombra da água, y é a renda do domicílio e S é um vetor de preferências determinado pelas caracteristicas sócio-econômicas da família. Considerando uma forma funcional linear, a função-demanda poderia ser escrita como:

$Q_d = a_0 + a_1\ SP + a_2\ y + a_3\ S + e$,

onde e é um termo aleatório.

Se o preço-sombra da água pode ser calculado, este modelo poderia ser estimado por uma "cross-section" de famílias na comunidade.

Este modelo, lamentavelmente, não tem tido muito sucesso para explicar as variaçoes no comportamento das pessoas em termos de água rural[6]. É, contudo, relevante para formar a base para o modelo discreto-contínuo descrito a seguir.

2.2 modelo discreto-contínuo de demanda por água

Este modelo propicia uma estrutura para explicar a probabilidade de que uma família escolheriá uma fonte particular (uma variável discreta) como função das características das fontes disponíveis de água (incluindo preços, distância e outros atributos), das características sócio-econômicas da família (renda, estrutura etária, educação, ocupação, entre outras), e uma variável aleatória. Há duas partes principais neste procedimento. A primeira, que trata da escolha discreta, pode ser descrita como:

$Prob_{hj} = f(W_{hi}, y_h, S_h)$,

---

6. O que não surpreende, uma vez que várias observaçoes empíricas mostram que a quantidade de água consumida é invariante à distância quando as pessoas necessitam carregar água para o domicílio.

onde $Prob_{hj}$ é a probabilidade da família h escolher a fonte j, W_{hi} são as características da fonte i (i = 1,2,...,n) percebidas pela família h, y_h é a renda familiar e S_h são as características sócio-econômicas da família h.

Uma vez estimado este modelo, que prevê quantas famílias escolherão o novo sistema, a quantidade de água a ser consumida em função dos preços (tarifa e custo de conexão) a serem cobrados poderia ser encontrada através das seguintes funçoes de demanda:

(i) para as famílias que escolheram a fonte j (digamos, o sistema novo)

$$Q_{hj} = g_j (Wh_j, y_h, S_h),$$

onde Q_{hj} é a quantidade de água demandada pela família h condicional da decisão de usar a fonte j.

(ii) para as famílias que escolheram a fonte i (digamos, umas das fontes tradicionais)

$$Q_{hi} = g_i (W_{hi}, y_h, S_h)$$

Em princípio, espera-se que as características das fontes como variáveis explicatórias mais relevantes são: qualidade percebida da água, preço monetário tanto para ligação como para uso por unidade, e confiabilidade. As características da família que provavelmente terão um papel mais importante como variável explicatória são: renda (monetária e em espécie), tamanho e composição da família, tempo de residência, posse do imóvel, educação dos membros da família, padrões de gasto, e o valor do tempo.

Por outro lado, como as decisões são independentes (da fonte a ser utilizada e da quantidade consumida), os erros são correlacionados e a estimação por mínimos quadrados resulta em estimadores inconsistentes e viesados. Este problema pode ser contornado pela estimação dos modelos em duas etapas ("two-step estimation procedure"), que tem mostrado ser prático e fornecer estimadores satisfatórios dos parâmetros[7].

2.3 Fonte dos dados para estimação

Os resultados empíricos sobre a demanda por água no meio rural esbarram na dificuldade de obtenção de dados confiáveis para a análise e interpretação estatística. De um modo geral, existem duas fontes principais de informações: o enfoque "indireto", baseado em comportamento observado, através da coleta de dados efetivos sobre as fontes utilizadas e as quantidades consumidas, e o enfoque "direto",

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7. Ver Lee and Trost, 1978; Maddala, 1983; Haneman, 1984.

baseado em comportamento presumível, a ser detectado através de respostas a questões hipotéticas.

O enfoque "direto" consiste em coletar dados sobre a disposição a pagar perguntando diretamente ao indivíduo qual é a sua disposição. Na literatura econômica é conhecido como "contigent valuation method", e tem produzido bons resultados quando aplicado em situações de valoração de bens públicos, em países desenvolvidos[8]. Sua aplicação em países em desenvolvimento e, em particular, em comunidades rurais, é recente, embora com resultados satisfatórios[9].

O principal problema na utilização desse procedimento talvez seja o fato de que, por várias razões, o entrevistado pode não responder acuradamente as perguntas, não revelando assim a sua "verdadeira" disposição a pagar pelos sistemas melhorados de abastecimento de água. Há vários viéses que podem surgir na aplicação desta metodologia. Dentre esses, os mais importantes são: "viés hipotético", "viés estratégico" e "viés do ponto-de-partida", cuja presença podem dificultar, ou até mesmo invalidar, a análise dos resultados.

O enfoque "indireto" consiste em obter informações sobre o comportamento efetivo das pessoas quanto as quantidades de água consumida para os diferentes usos, o tempo dispendido em coletar água nas diferentes fontes, a percepção da qualidade dessas águas, além daquelas relativas às características sócio-econômicas da família. Embora promissor à primeira vista, este procedimento tem algumas limitações. Em primeiro lugar, o interesse maior do ponto de vista do planejamento é sobre comunidades sem sistemas melhorados de água. Assim, os resultados precisam ser extrapolados além dos intervalos fornecidos pelos dados observados. Em segundo lugar, pode haver uma discrepância entre o valor revelado do bem e o pagamento efetivo quando o bem estiver disponível. Ademais, em muitas circunstâncias, este procedimento pode não ser útil devido ao fato das variáveis, especialmente preço, não terem variação suficiente para a análise estatística.

3- O desenvolvimento da pesquisa em seis países

Ao longo do ano anterior, foram coletados dados em comunidades rurais de seis países (Brasil, Nigéria, Tanzania, Zimbabwe, Paquistão e India) escolhidas de comum acordo com as equipes nacionais em função da sua adequação aos propósitos da pesquisa. A escolha das comunidades foi baseada na necessidade de se ter elementos para comparar as metodologias descritas na secção anterior. Neste sentido, foram procuradas três

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8. Ver, entre outros, Randall et. al., 1978; Freeman, 1979; Cummings, Brookshire, and Schulze, 1986; Mitchell and Carson, 1986.

9. Ver Whittington, D. et. al.. 1987.

áreas em cada país, com pelo menos duas comunidades que exibissem as seguintes caracteristicas:

(i) tipo A - com sistema público de abastecimento de água e tarifação; existência de outras fontes de abastecimento; parte dos domicílios conectados e parte não conectada ao sistema público.

(ii) tipo B - sem sistema melhorado, mas com previsão de instalação (para teste posterior); várias fontes alternativas, com distâncias variadas, de abastecimento de água; comparabilidade demográfica e cultural à comunidade do tipo A.

Como esperado, houve uma grande diferença entre as experiências nesses países. Para mencionar alguns exemplos:

— quanto à escolha das comunidades:

No Sul do Brasil (Paraná), relativamente desenvolvido econômicamente, foi difícil encontrar comunidades do tipo A, uma vez que, dada a ligação gratuita, a baixa tarifa mensal, renda relativamente elevada e boa qualidade dos serviços, a maioria das famílias escolhe o sistema público de abastecimento de água. Em contraste, foi relativamente fácil localizar o tipo B, dado que a Companhia Estadual de Saneamento estava ativamente estendendo seus serviços ao meio rural. Por outro lado, no Nordeste brasileiro (Ceará), relativamente pobre, foi fácil encontrar o tipo A, mas extremamente difícil identificar comunidades do tipo B (desde que não havia planos para construção de sistemas em futuro próximo).

— familiaridade com a noção de pagar por água.

A familiaridade com o pagamento por serviços de abastecimento de água estava bem estabelecida no Brasil (onde tem sido uma prática padrão), foi de algum modo problemática na India (onde oficialmente existe, embora na prática nem sempre ocorra) e estava menos presente no meio rural do Zimbabwe (onde núnca houve pagamento por serviços de água).

— variáveis-chave

Esperava-se que, na maioria dos países estudados, os fatores mais importantes (as "variáveis de política"), os quais poderiam ser posteriormente modificados, seriam preço e nível de serviço. Este foi o caso do Brasil. Na India, entretanto, com um nível de serviço muito precário, essas variáveis tiveram que ser suplementadas com uma que medisse a qualidade do serviço.

Por outro lado, algumas consistências importantes foram detectadas nos resultados preliminares da pesquisa. Em todos os países estudados, os pesquisadores estavam inicialmente cépticos quanto à possibilidade de se usar questões hipotéticas (isto é, se o preço de uma ligação domiciliar fosse US$10 por mês, voce escolheria ligar ou continuaria a usar a fonte tradicional? E se o preço fosse US$5, etc.). Em todos os casos estudados, os entrevistados rapidamente compreenderam o "leilão" e forneceram respostas sérias e razoáveis.

Encontrou-se, também, em todos os países, um número substancial de entrevistados que estava disposto a pagar muito acima do preço corrente por um sistema melhorado que ofertasse um serviço confiável.

Até a data, as primeiras duas fases do projeto de pesquisa - concepção do estudo e coleta de dados - estão terminadas. A terceira, relativa à análise dos dados, está sendo iniciada, esperando-se completá-la em alguns poucos meses. Não obstante ainda não haver análises definitivas para nenhuma comunidade em qualquer país dado, apresentamos a seguir algumas exploraçoes preliminares dos dados coletados no Estado do Paraná (Brasil).

4- Alguns resultados preliminares

No Brasil, ao longo do ano anterior, foram aplicados questionários em várias localidades rurais nos Estados do Paraná, Ceará e Minas Gerais, visando a obtenção de um conjunto razoável de informaçoes para testar a disposição a pagar dos usuários por sistemas melhorados de abastecimento de água. No Paraná, por exemplo, foram realizadas 492 entrevistas, sendo que 192 relativas à comunidade do tipo A e 300 relativas à comunidade do tipo B. Essas localidades foram selecionadas em comum acordo com a empresa de saneamento local e, tendo em vista as dificuldades já relatadas para a identificação dos tipos ideais, tanto as comunidades do tipo A quanto do tipo B foram compostas por várias localidades para atingir o número pretendido de entrevistas, conforme o Quadro a seguir:

TIPO	MUNICIPIO	LOCALIDADE	NUMERO DE DOMICILIOS	NUMERO DE ENTREVISTAS
A1	Ortigueira	Periferia e distrito de Natingui	369	152
A2	Palmeira	Papagaios Novos	124	40
B1	Lapa	Canoeiro	68	46
B1	Rio Negro	Sítio dos Rauen	79	54
B2	Palmeira	Queimados de Baixo	114	100
B3	Reserva	Faxinal Fino	75	41
B3	Ortigueira	Pinhalzinho	43	26
B3	Ortigueira	Sapé	58	33
TOTAL			930	492

As comunidades do tipo A são aquelas onde existe um sistema de água encanada, sendo que foram aplicados dois questionários diferentes. Um, em domicílios que estavam ligados (ou em fase de ligação) ao sistema de água; outro, em domicílios que, embora com acesso ao sistema, ou não estavam conectados ou estavam com as ligaçoes canceladas. As comunidades do tipo B são aquelas onde não existe um sistema de água encanada. Nessas foram aplicados três questionários distintos, a saber: — B1: localidades onde a população sabe que será construído um sistema público e qual a tarifa a ser praticada;

— B2: localidades onde a população sabe qual o tipo de sistema a ser construído, mas ignora a tarifa que será cobrada;

— B3: localidades onde nem o tipo de sistema nem a tarifa estão definidos.

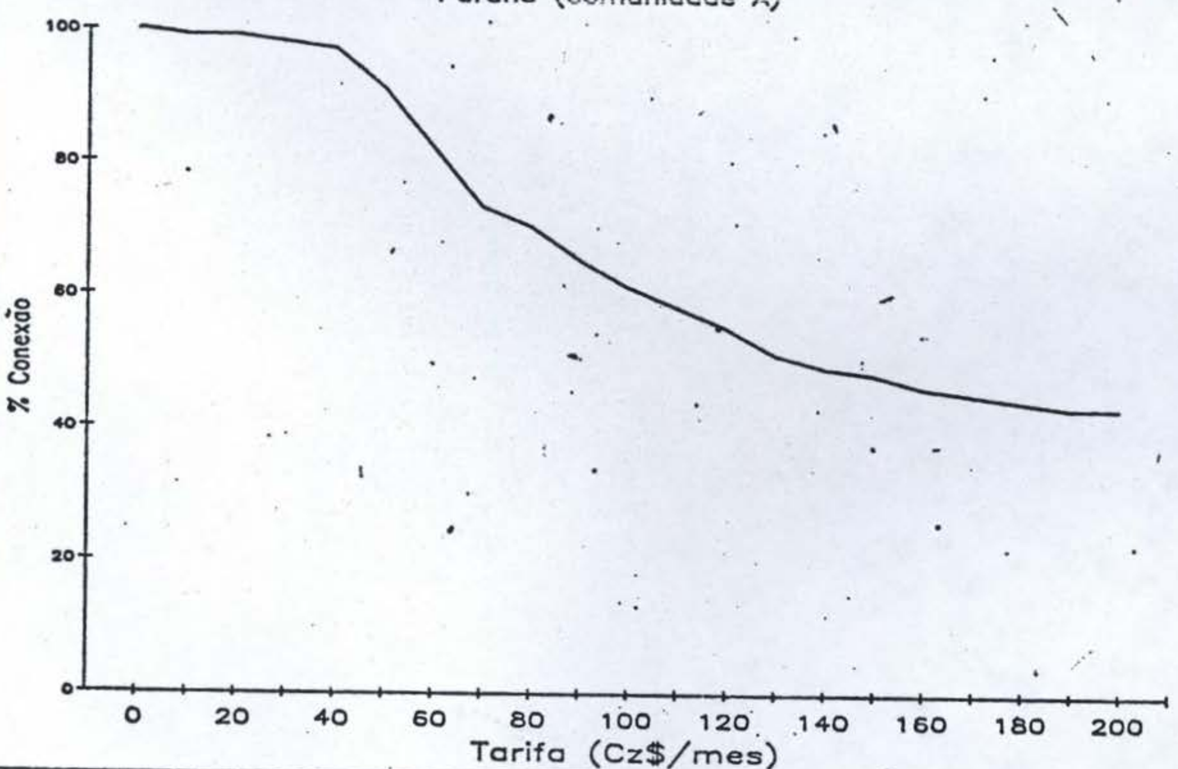
A amostra foi selecionada da seguinte maneira: para cada uma das localidades pesquisadas, foi dado um número a cada domicílio e as casas foram sorteadas aleatóriamente por uma tabela de números igualmente prováveis. Dada a "soma" de várias localidades para compor um tipo, cada uma das localidades teve um número de entrevistas estabelecido de acordo com a proporção existente entre o número de domicílios daquela localidade e o total dos domícilios que seria usado para aquele tipo particular de comunidade. Do total de 192 domícilios do tipo A, 27% tinham acesso ao sistema mas estavam desconectados. A percepção dos entrevistadores foi de que o "leilão" funcionou relativamente bem em todas as localidades, embora em alguns casos alguns respondentes hesitaram em manifestar um preço mais elevado com receio dos possíveis efeitos da inflação.

Preliminarmente, as seguintes questões podem ser equacionadas a partir dos resultados obtidos com dados brasileiros:

<u>Questão 1: Quanto estariam dispostos a pagar por ligaçoes domiciliares (torneira no quintal) os usuários rurais no Paraná?</u>

A Figura 1 mostra a relação entre o preço a ser cobrado mensalmente e o percentual das famílias ligadas ao sistema público no Paraná - Comunidade A. (A tarifa mensal ao tempo da realização da pesquisa era de Cz$40, aproximadamente US$1.50). Para os conectados, foi perguntado o que fariam caso as tarifas aumentassem, enquanto que, para os não conectados, foi perguntado o que fariam caso elas fossem mais baixas. Como revela a Figura 1, o número de famílias conectadas ao sistema diminuiria com a elevação das tarifas, mas o efeito seria moderado. Por exemplo, se a tarifa dobrasse, menos de 20% dos entrevistados deixariam de estar conectados. É interessante observar que cerca da metade dos usuários continuaria a usar os serviços mesmo na eventualidade de a tarifa aumentar mais que cinco vezes em relação ao valor atual.

Figura 1
Efeito das tarifas sobre taxas de conexão
Paraná (comunidade A)

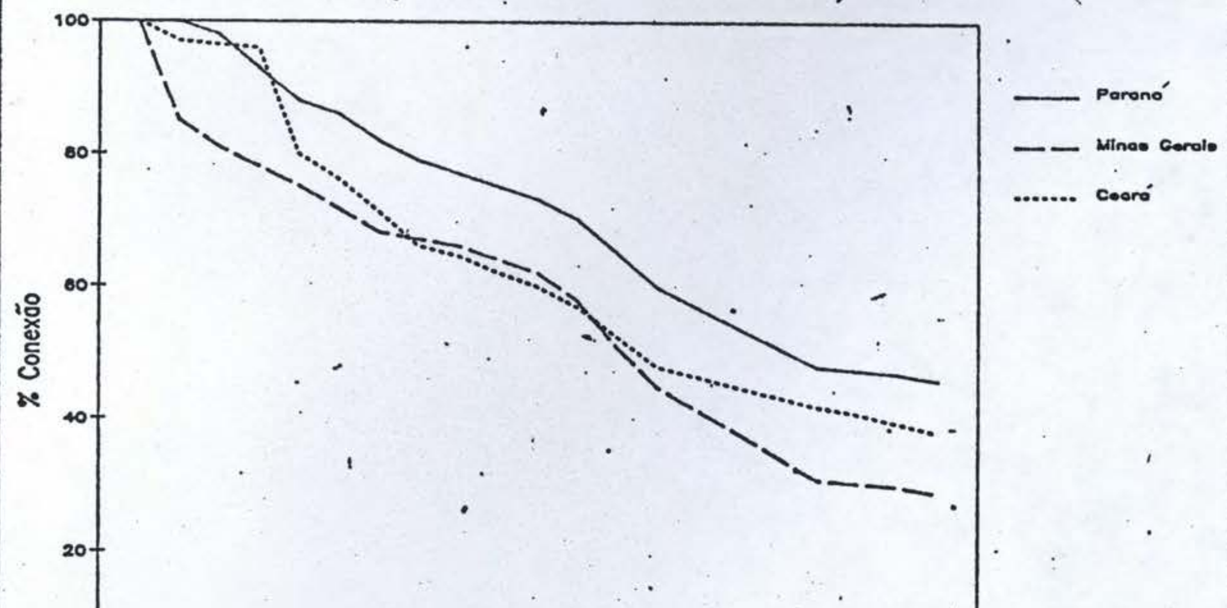


Questão 2: Quais as diferenças notadas entre a disposição a pagar nas comunidades rurais localizadas no Nordeste (pobre e com problema de seca) com as localizadas no Sul (rico e sem problema de estiagem prolongada)?

A Figura 2 compara os níveis declarados de disposição a pagar no Nordeste (Ceará e Nordeste de Minas Gerais) com os do Sul do Brasil (Paraná). Para tarifas inferiores a Cz$100 ao mês (duas vezes e meia o valor da tarifa à época da pesquisa), a proporção que ligaria a qualquer tarifa dada era cerca de 10% menor no Nordeste que no Sul. Uma explicação para esta observação talvez resida no fato de que as populaçoes estudadas no Nordeste, embora substancialmente mais pobres que as do Paraná, enfrentassem alternativas de abastecimento de água bem menos desejáveis (fontes superficiais e poços poluídos e precários nos leitos dos rios) que as do Paraná (poços no quintal com boa qualidade).

A partir de Cz$100, entretanto, as baixas rendas do Nordeste predominam e as curvas na Figura 2 divergem. Ao nível mais alto (de Cz$200 ao mês), o número que ligaria no Nordeste é cerca da metade dos que ligariam no Sul.

Figura 2
Efeito das tarifas sobre taxas de conexão
(Paraná, Minas Gerais e Ceará)

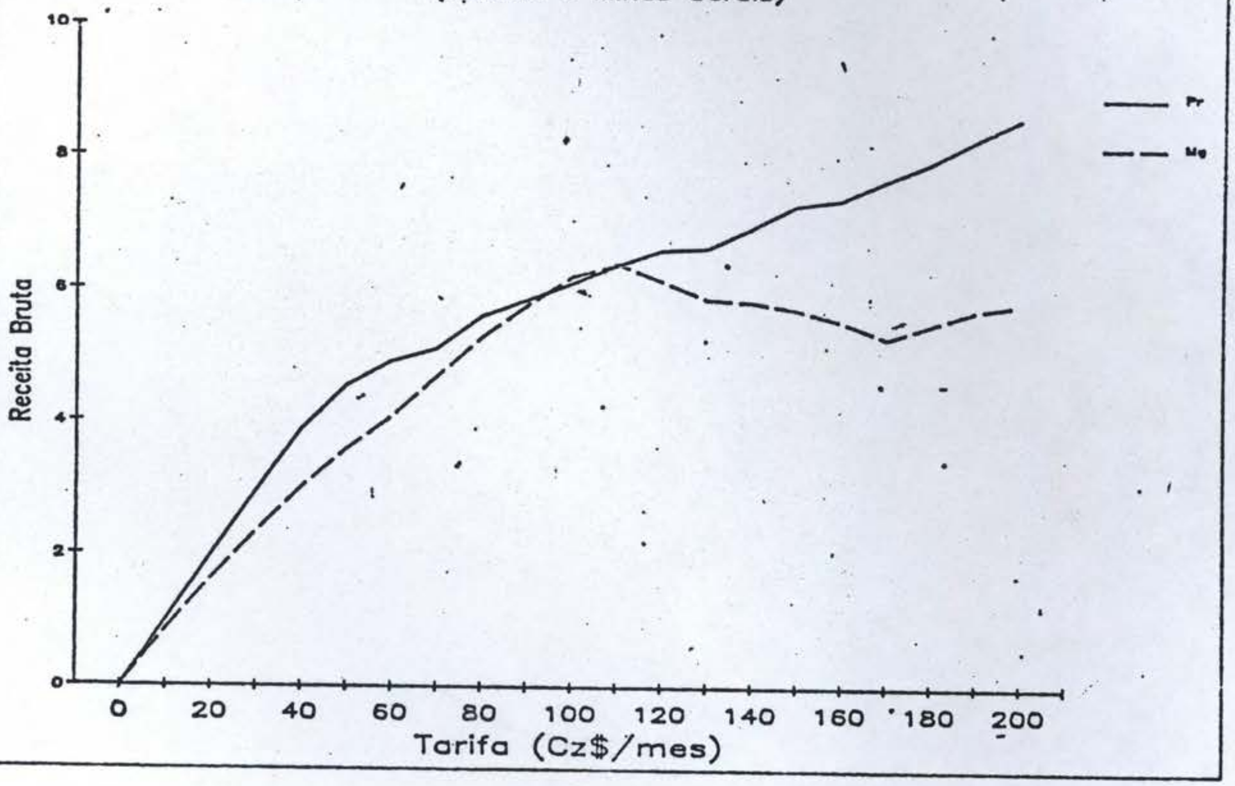


Questão 3: Quais as implicaçoes para uma empresa de água?

É interessante ver como esses resultados analíticos, não obstante serem bastante preliminares, podem ser usados para avaliar diferentes políticas tarifárias. As Figuras 3 e 4 mostram os efeitos de diferentes tarifas sobre as receitas brutas que uma empresa de água poderia obter no Paraná e no Nordeste de Minas Gerais. Pode-se observar que, no caso do Paraná, se o objetivo de implementar um sistema melhorado de água fosse maximizar a receita, a tarifa a ser cobrada poderia ultrapassar ainda mais o máximo (o qual é cinco vezes maior que o valor corrente), enquanto que no Nordeste a receita seria maximizada ao nível de cerca de Cz$110 por mês.

Na realidade, claramente, o objetivo de desenvolver um sistema financeiramente viável deve ser contraposto com o objetivo primário, que é o de ter o maior número possível de famílias usando o novo sistema.

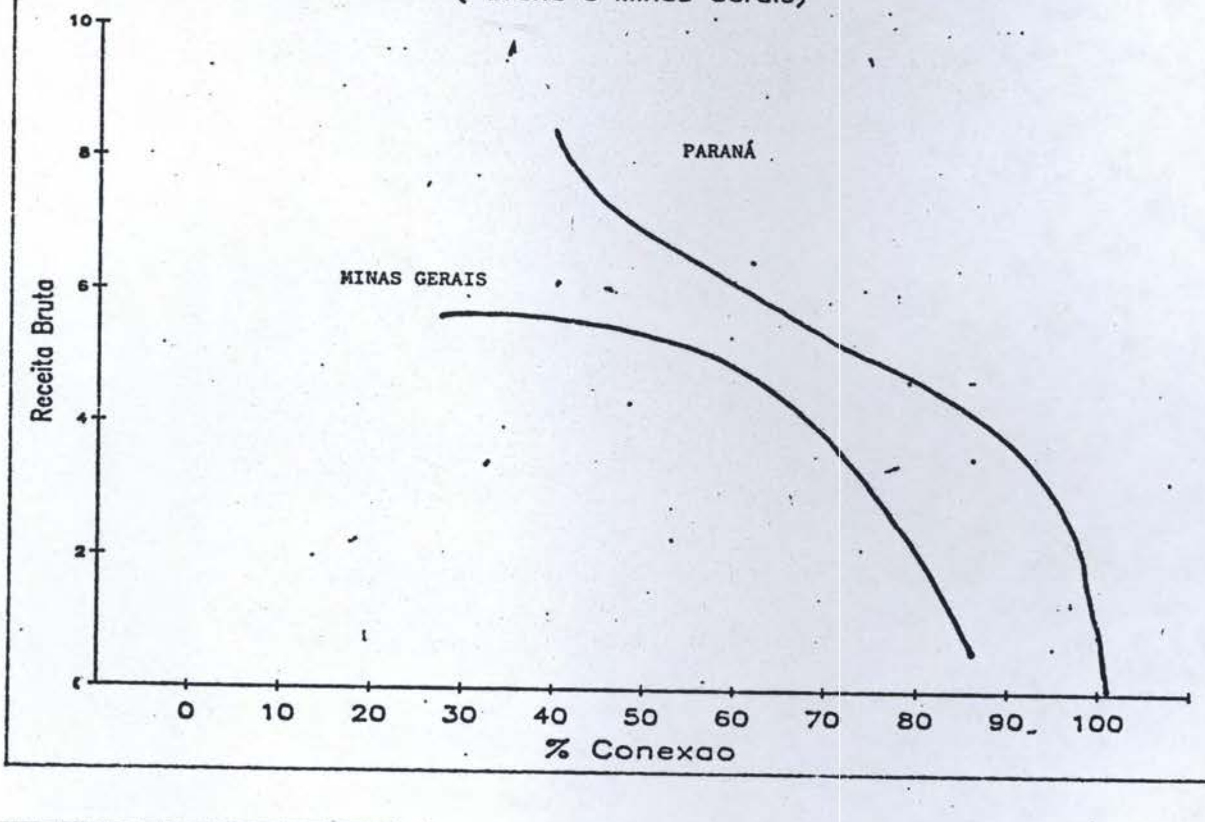
Figura 3
Relação entre Receita Bruta e Tarifa
(Parana e Minas Gerais)



A Figura 4 mostra a relação entre receita e taxas de ligação. No Paraná, parece que uma cobertura de cerca de 70% (correspondente a uma tarifa de Cz$80, ou aproximadamente três vezes o valor corrente) seria uma opção razoável[10]. Isto corresponde ao ponto de inflexão na Figura 4: o aumento da proporção dos ligados (de 70% para 80%) resultaria em perda substancial de receita, afetando portanto a viabilidade financeira do sistema, enquanto a diminuição da proporção dos ligados (de 70% para 60%) teria resultados bastante adversos (10% não estariam usando os serviços) para aumentos relativamente pequenos na receita.

É interessante notar que, apesar dos níveis da disposição a pagar serem substancialmente mais reduzidos no Nordeste, a Figura 4 parece indicar que o nível apropriado de cobertura não seria muito diferente: a redução do nível de cobertura para menos de 70% resultaria apenas em pequenos aumentos na receita, enquanto uma elevação acima de 70% resultaria em grande perda de receita.

Figura 4
Relação entre Receita Bruta e Taxa de Conexão
(Parana e Minas Gerais)



10. Evidentemente uma análise mais aprofundada levaria em consideração outros fatores, inclusive os custos da oferta em áreas diferentes.

Questão 4: Que fatores parecem influenciar a disposição a pagar por ligação domiciliar: análise preliminar dos dados do Paraná

Análise bivariada:

Os efeitos de variáveis "independentes" específicas (tais como renda, educação e ocupação) sobre a probabilidade de conexão ao novo sistema foram investigadas nas análises iniciais dos dados do Paraná. Os resultados mostraram que os efeitos tinham os sinais esperados, sem considerar o problema das correlaçoes entre as variáveis independentes. Assim, por exemplo, a qualquer preço dado, a probabilidade de ligação aumenta com o crescimento da renda e da escolaridade, e à medida que a ocupação seja em setores mais "modernos" — serviços e indústria — do que em setores mais "tradicionais" — agricultura.

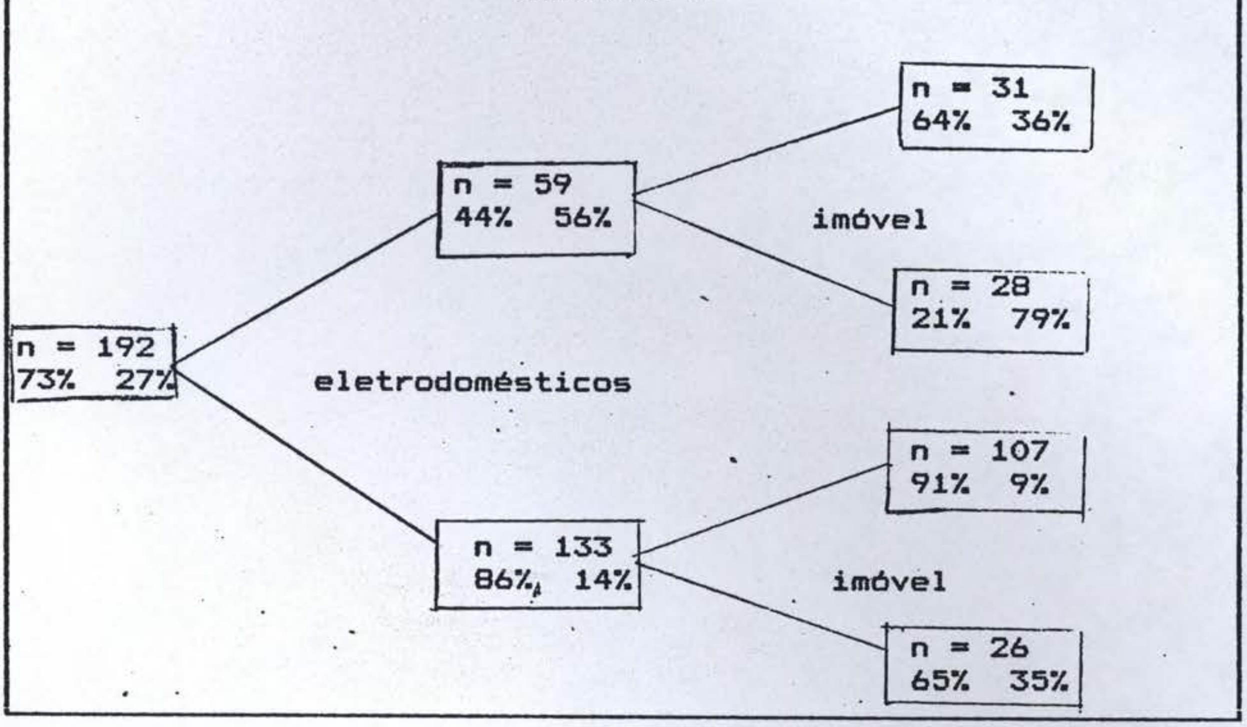
Análise multivariada

Atualmente estão sendo explorados vários procedimentos de análise estatística para determinar os efeitos das "variáveis independentes" sobre a probabilidade que uma dada família escolha conectar ao sistema melhorado de abastecimento de água. Embora as análises sejam ainda bastante preliminares e parciais, alguns resultados são mostrados a seguir no sentido de indicar o caminho que está sendo seguido.

(i) Análise de Agrupamentos

Nesta análise está sendo examinada um grande número de variáveis independentes potenciais, visando identificar indicadores específicos para medir os principais componentes de comportamento (tais como renda, educação e ocupação). Até a data foram feitas análises preliminares dos dados relativos ao Paraná (Comunidade A). Foram definidas variáveis categóricas, através da análise de agrupamentos, que identificassem sete principais características de cada família. A seguir, foi tentado identificar os determinantes principais da decisão de conectar através de sucessivas partiçoes dicotâmicas hierarquizadas (empregou-se o método AID — "Automatic Interaction Detection"). Das 192 famílias, 73% escolheram estar conectadas, enquanto 27% preferiram não estar (ver Diagrama a seguir). O indicador "posse de eletrodomésticos" foi o de maior poder explicativo: 44% daqueles com "poucos" e 86% daqueles com "muitos" eletrodomésticos escolheram o sistema público de abastecimento de água. O processo foi então repetido para cada um dos grupos. Em ambos os casos, a variável seguinte em poder explicativo foi "posse do imóvel". Nesta etapa, 3 grupos distintos surgiram: no grupo 1 (não proprietários com poucos eletrodomésticos), apenas 21% escolheram estar conectados; no grupo 2 (proprietários com poucos eletrodomésticos ou não proprietários com muitos eletrodomésticos), 65% estão ligados; e, finalmente, no grupo 3 (proprietários com muitos eletrodomésticos), 91% escolheram estar ligados.

DIAGRAMA 1



(ii) Análise de regressão

Paralelamente, os dados do Paraná estão sendo investigados através de análises de regressão. Inicialmente, a variável dependente foi especificada como sendo a taxa mensal mais elevada que uma família estaria disposta a pagar pelos serviços do sistema de água, enquanto as variáveis "independentes" foram renda per-capita, ocupação e educação. Encontrou-se, como esperado, que:

— as famílias de maior renda estão dispostas a pagar substancialmente mais (e estatisticamente significante) que famílias com renda mais baixa por sistemas melhorados de água

— as famílias nas quais a dona de casa tem um nível mais elevado de escolaridade estão dispostas a pagar quantias mais elevadas (e estatisticamente significante) que aquelas onde a dona de casa tem menos escolaridade

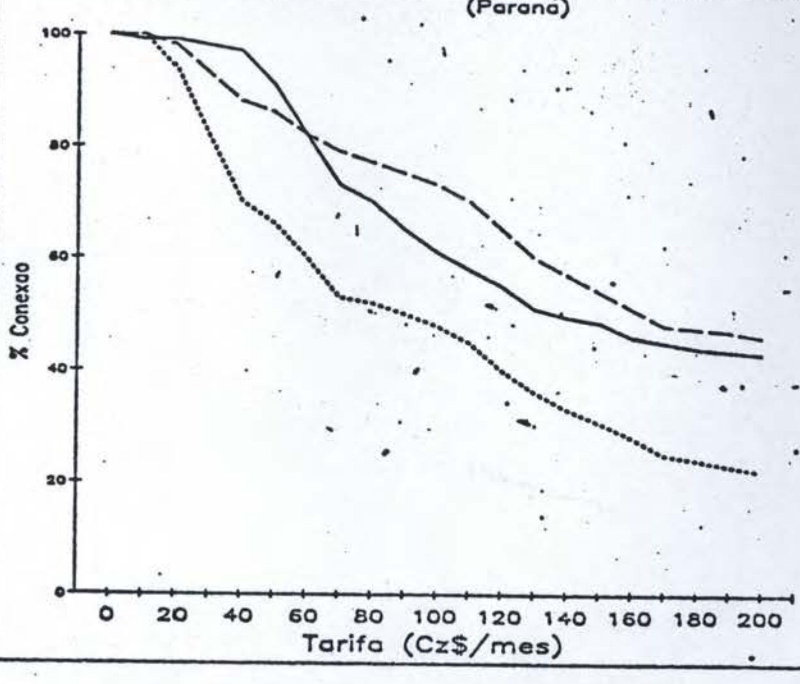
— as famílias cujo chefe tem atividade agrícola estão menos disposta a pagar (e estatisticamente significante) que aquelas cujo chefe está empregado na indústria, comércio ou no setor de serviços.

— os moradores da Comunidade tipo B2 revelaram uma disposição a pagar substancialmente menor (estatisticamente significante) que os moradores das Comunidades tipo A e B1.

<u>Questão 5: Como os resultados dos métodos "direto" e "indireto" podem ser comparados?</u>

A Figura 5 compara os resultados de observações baseadas em comportamento efetivo (Comunidade A) com as derivadas de comportamento hipotético (Comunidade B). Como já mencionado, as comunidades B foram selecionadas de modo a terem uma certa comparabilidade com as de tipo A, e, portanto, as diferenças observadas não devem refletir diferenças nas características sócio-econômicas entre as comunidades estudadas. (Esta hipótese ainda será testada em um estágio posterior da pesquisa). Como também já notado, os sistemas públicos de água no Paraná estão sendo implementados com diferentes arranjos institucionais. Na Comunidade B1, por exemplo, as pessoas sabem que um sistema público de água está sendo instalado e conhecem qual a tarifa a ser praticada. Presumivelmente, portanto, teriam pouco incentivo em agir "estrategicamente" ao responder o questionário (na esperança de que tal comportamento pudesse beneficiá-las na forma de tarifas mais baixas). Assim parece ter sido, uma vez que, para qualquer preço dado, a proporção das famílias que aderiria foi similar à proporção verificada na Comunidade A.

Figura 5
Disposição a Pagar: Comparação entre indireto (A) e direto (B)
(Paraná)



Na Comunidade B2, por sua vez, a situação teve um gráu maior de incerteza: as pessoas sabiam que um novo sistema seria construído e que a ligação seria domiciliar, mas a tarifa ainda não estava estabelecida (seria determinada pela comunidade ao invés de pela companhia estadual de água). Nestas circunstâncias, poder-se-ia esperar a ocorrência de comportamento "estratégico" no sentido de que as pessoas subestimariam suas respostas sobre a disposição a pagar na esperança de diminuir as tarifas. A Figura 5 sugere que tal tenha de fato ocorrido, uma vez que no intervalo de preços investigado a proporção indicando que conectaria foi 10% a 20% menor que na Comunidade A.

5- Conclusões preliminares finais

Essas análises preliminares e iniciais dos dados coletados no Brasil sugerem que:

— No Sul, onde os níveis de renda e de educação são relativamente mais elevados (fatores que devem influir positivamente na disposição a pagar) mas onde existem fontes alternativas de melhor qualidade (um fator que tende a diminuir a disposição a pagar), muitas famílias se declaram dispostas a pagar um preço maior que o praticado atualmente;

— no Nordeste, onde os níveis de renda e educação são menores e as fontes alternativas são mais raras e de pior qualidade, a disposição a pagar é de algum modo menor que no Sul, embora muitas famílias estejam dispostas a pagar um valor mais elevado que o atual;

— em ambas as situações, considerando-se os efeitos de tarifas acrescidas sobre a proporção dos que estão ligados e sobre a receita, temos que o nível apropriado de cobertura é similar (cerca de 70%).

— quando o gráu de incerteza sobre as políticas a serem praticadas é pequeno parece haver pouco "comportamento estratégico", mas a presença de incertezas faz com que as pessoas subestimem sua disposição a pagar por sistemas melhorados de abastecimento de água.

Novamente deve ser salientado que esses resultados derivam de análises ainda bastante preliminares e parciais, podendo ser modificados à medida que novas análises sejam elaboradas. Os planos futuros são no sentido de:

— estender a análise de agrupamentos para completar a análise dos dados do Paraná (Comunidade B) e investigar os dados de Minas Gerais e do Ceará (incluíndo outros indicadores no conjunto das variáveis "independentes"; e,

— especificar e estimar modelos econométricos que possam medir os efeitos de variáveis sócio-econômicas e da qualidade das fontes alternativas sobre a disposição a pagar por sistemas melhorados de abastecimento de água.

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WILLINGNESS TO PAY FOR RURAL WATER

THE ZIMBABWE CASE STUDY

National Action Committee
Harare

World Bank
Washington

PREFACE

This "Preliminary Draft" has been prepared at the request of the National Action Committee to overcome the problems engendered by the delays encountered in the statistical part of the study (see Section 3.5).

As there is econometric work still to be done, the numbers in the final version of this report may well be different, but are not expected to change the thrust of the main conclusions and policy directions identified.

The Appendices are rather lengthy and have not been copied for the Preliminary Draft. Comments and criticisms will be welcomed and should be addressed to Peter Robinson at Zimconsult, telephone 302496 or 35947, postal address P O Box A228 Avondale and telex 22041 zimcon zw.

CONTENTS

PART II : POLICY IMPLICATIONS

PART I : DESIGN, EXECUTION AND ANALYSIS OF THE STUDY

CHAPTER 1 : BACKGROUND

1.1 Study Context

This study into the willingness of rural communities to contribute financially to the provision of clean water was initiated by the Policy and Research Division of the Water and Urban Division of the World Bank. The Bank has in recent years considerably increased lending for rural water supplies. With growing experience of projects in the rural water supply sector, the Bank has become increasingly aware of the tendency for these to go awry, mainly because account has not been taken of what communities really want.

Both as a measure to promote budgetary stability and as a means to ensure the full involvement of the village communties in planning and implementing projects, cost recovery through user charges is being encouraged by the Bank. In this context, research on what users might be willing to pay for different levels of improved supply of water becomes critical. This study was formulated to explore these issues in a number of countries and, in particular, to try out a new methodology for measuring willingness to pay (WTP) for services such as water supply. Besides Zimbabwe, the countries involved are India, Pakistan, Tanzania, Nigeria and Brazil.

In the Zimbabwe context, cost recovery is one of the major issues under discussion in the National Action Committee for Water and Sanitation (NAC). While many of the recommendations of the 1985 National Master Plan for Rural Water Supply and Sanitation (NWMP) have been implemented, despite the Plan not yet having been formally accepted by Government, those relating to the raising of charges for the use of boreholes and wells have not been.

Maintenance demands from the old stock of handpumps, together with those from the newly provided primary water supplies (PWS), are growing rapidly. Government has allocated increased budget provisions to District Development Fund (DDF) to establish the three tier operation and maintenance (O&M) system recommended in NWMP, but national budgetary pressures are such that the question of cost recovery has become pressing if the O&M system is to be adequately funded. While not countering the Bank's hypothesis that communities directly contributing to costs will result in a greater commitment to projects and thus to sustainability of water supply programmes, local financing is also bound up in Zimbabwe's move towards a substantive degree of decentralisation in its local Government structure. Planning of projects and cost recovery mechanisms are thus to be explored in the context of decentralisation.

1.2 Zimbabwe Case Study

Amongst donors that have supported Zimbabwe's rural water supply programme, Norway has been prominent; and when the Norwegian Agency for International Development (NORAD) was approached by the Bank for funding for the African part of the study, NORAD suggested that Zimbabwe be included as one of the case studies. For the reasons given above, this suggestion was acceptable to the NAC.

When the detailed Terms of Reference (TOR) for the study came to be scrutinised, however, the somewhat divergent requirements of the Bank and the NAC with respect to the WTP study became evident. For the Bank, out of a multi-country study it was hoped that common conclusions could be drawn about methodologies for assessing willingness to pay and the rapid design of delivery systems for rural water supply. By contrast, the NAC's objectives were more direct, namely to obtain information relevant for policy-making in Zimbabwe, particularly in the area of cost recovery.

The original Terms of Reference, dated August 1987 and running to 15 pages (Appendix 1), were prepared by Dr John Briscoe of the Policy and Research Division of the Water and Urban Division of the World Bank. In view of the different orientation of the NAC, certain changes were recommended and accepted on both sides; the details are recorded in Section 2.1 below. Chapter 2 and the remainder of Chapter 3 summarise the main features of the modified TOR, while the rest of Part I deals with the execution of the studies, analysis of the results and conclusions to be drawn. Part II, entitled "Policy Implications", attempts to set the study within the broader framework of developments within the sector, national economic and spatial planning and the policy on decentralisation. In order to enable them to be read independently of each other, there is some overlap between the two parts. It is suggested to readers primarily interested in the detailed studies but who are not familiar with the water and sanitation sector and broader development issues in Zimbabwe, that they consult Part II before reading Part I in detail.

1.3 Results and Conclusions from the Master Plan

Volume 3.4 of NWMP is the *Water Tariff Study*. This volume gives a comprehensive analysis of the then prevailing water tariff policy of the Ministry of Water and recommends on an appropriate tariff structure and price. It deals with the relevant economic theory, water supply costs, existing tariff policy, and proposals for both primary and piped supplies. The most important recommendations are that:

- PWS: Local communities should be responsible for day-to-day maintenance and simple repairs. In addition, small cash payments, initially Z$1/household/annum should be collected from all members of the community. It is estimated that these contributions could reduce government's direct maintenance costs by two-thirds (page S/19).

- Piped supplies: Water should only be supplied through shared group connections. It is proposed that the general rate of 50 cents/cu m should be charged but that the concessionary volume should be increased to 10 cu m for the first family (ie the family which has the connection outside its house) plus 4 cu m/month for every additional household registered as a member of the group (page S/17).

Except where a piped scheme is the only supply possibility, no more village water supplies should be constructed until revenue collected from existing piped supplies covers 60% of their recurrent costs. This may be achieved only by the successful introduction of the group-owned connection policy and if this policy is not tried, or proves a failure, at village supplies, the 60% figure is unlikely to be attained. In this case, the construction of piped village supplies should not recommence until the entire rural population has access to a satisfactory improved primary supply (page S/19).

The main Water Tariff volume has two supporting annexes, the first reporting on *Rural Willingness to Pay for Water Supplies* and the second on a *Piped Village Water Supply Study.* The analysis in these annexes is based on the two socio-economic surveys undertaken during NWMP, one a large, national survey by the CSO and the other a small, in-depth study by the consultants, together with a study of two piped schemes. The work carried out and the results obtained are documented in detail, while the results themselves were used in formulating the policy recommendations given in the main volume.

CHAPTER 2 : OBJECTIVES OF THE STUDY

2.1 General Objectives

The overall objectives of the study may be summarised from the TOR as follows:

- building on the basis laid by the NWMP, to develop empirical information on how rural people in several different socio-economic and environmental settings respond to different types of services at different prices;

- to investigate growth point policy, particularly in relation to the provision of infrastructure (especially piped water) as an inducement to investment, but for which some degree of direct cost recovery is expected;

- to assess the consequences of the information collected for key policy choices, such as the level of service, tariff structures and cost recovery targets in both rural schemes and growth points;

- to determine whether relatively simple, rapid and yet valid surveys can be conducted to obtain similar information in a wider range of econo-environmental settings in Zimbabwe and other countries.

2.2 Specific Objectives - Methodology

With respect to improved PWS's in a rural setting, the TOR for the study call for an examination of the effect, both on the decision to use the improved source and the quantitites of water used, of the following factors:

- social, demographic and economic characteristics of the family;

- characteristics, including distance, reliability and water quality of alternative sources;

- corresponding characteristics of improved source, together with price.

Willingness to pay is to be determined both directly, from answers to hypothetical survey questions, and indirectly, by drawing inferences from actual practices.

Previous attempts to measure willingness to pay for water in developing countries have generally been based on methodologies well established only for industrialised countries and have in many cases led to misleading results. This study is to make use of recent methodological advances in respect of developing hypothetical markets in a "contingent valuation" approach. For each level of service, the respondent is to be asked whether the improved source would be used and if so how much water would be used, or failing that level of precision, what activities would continue to be carried out at the traditional source.

The influence on the results of different types of bias are also to investigated. Three major types of bias have been identified in the background documents to the study:

- *Hypothetical bias* arises because the individual may not understand or perceive correctly the characteristics of the good being described by the interviewer.
- *Strategic bias* arises when the respondent thinks that she can influence the provision of services in her favour by not answering questions truthfully.
- *Compliance bias* arises when the respondent gives answers which are influenced by a desire to please the interviewer.

Through taking account of these forms of bias in the design of contingent valuation surveys in other settings, it is believed that bias has been reduced to a minimum.

2.3 Relation to the National Water Master Plan

The TOR note that the present study is to build on related work in the NWMP, with the following additions and extensions:

- the sample sizes are considerably larger than those in the NWMP willingness to pay study;
- inferences are to be drawn both from actual practices and (as was done in the previous study) from hypothetical willingness to pay questions;
- the design of the hypothetical part of the study is to draw on recent methodological advances ("contingent valuation") and is, specifically, to be designed to assess the seriousness of certain types of biases;
- the current study is to benefit from the detailed experience of the comparable studies being conducted in other countries;
- an integral part of the current study is to be to assess the validity of the willingness to pay method by a) comparing the results with actual behaviour in similar settings, and b) comparing the predicted behaviour with actual behaviour once the improved systems are installed (this requiring a second phase of fieldwork 12-18 months after Phase I);
- analysis is not to be restricted to bivariate analysis but is to assess the independent contribution of different factors to willingness to pay for water.

CHAPTER 3 : REQUIREMENTS OF THE TERMS OF REFERENCE

3.1 TOR Changes Agreed

As noted in Section 1.2, the Bank and the NAC had somewhat differing concerns with respect to the study, leading to modifications being made to the Bank's original TOR (Appendix 1). The main changes were as follows:

piped vs primary water supplies & number of households

The original TOR called for 1 200 households to be interviewed, half having or about to have piped supplies, the other half having or about to have improved PWS. In view of the emphasis in NWMP on PWS, the NAC argued strongly for the emphasis to be put on PWS at the expense of piped supplies. While noting that the importance of cost recovery is much greater for a piped scheme and there are more interesting willingness to pay issues to be explored in relation to piped schemes, the Bank agreed to this change. In respect of PWS, a target of 800 households to be interviewed was set, to be divided equally between 2 sets of sites in each of 2 communal lands in different natural regions.

inclusion of methodologies other than formal questionnaires

At the initiative of the consultants, who felt that the household questionnaire methodology may not yield the information required, observational studies at water points and in households, and focus group discussions involving business owners and female and male community members in different age groups, were included.

growth point component

In view, on the one hand, of the difficulty of finding rural piped water sites which would meet the particular requirements of the cross-country study, and, on the other, of the pressing need felt by Government to review cost recovery policies in respect of infrastructure in growth points, it was agreed that the study should address itself to the problem of providing infrastructure to growth points. The basic question which it was agreed should be addressed relates to how cost recovery can be implemented without negating the objective of providing infrastructure and services to growth points in order to attract economic activity and create employment opportunities. To answer this question, the study had to be broadened to look at other elements of infrastructure besides water and the underlying socio-economic factors determing the development or otherwise of designated growth points.

3.2 Responsibility for the Study and Team Composition

There are three main institutions involved in the Zimbabwe study - the NAC, the World Bank and the consultant (Zimconsult). The responsibilities of these institutions are as follows:

National Action Committee

The NAC is the primary client for the policy aspects of the study. A subcommittee has been constituted to which the consultant has reported and through which assistance from the Government side has been obtained.

The World Bank

The Bank is responsible for financing the study, contracting the consultant, providing technical assistance, and verifying the work is being carried out as required. The Bank is the primary client for the methodological aspects of the study.

Zimconsult

The consultant has exclusive responsibility for all logistical aspects of the study and primary responsibility for the scientific aspects (including design, execution, data management, analysis, report writing and dissemination).

Although there are specific human resource requirements laid out in the original TOR, the final composition of the study team was left to the consultant. The main change which was made was to create a full time position by amalgamating parts of the sociologist, fieldwork supervisor and data manager roles. This approach was adopted in view of the availability of a highly qualified and motivated person to assume these reponsibilities during and after the fieldwork. With the questionnaire design and fieldwork taking place at the end of the University of Zimbabwe academic year, the field interviewers were recruited from just qualified university graduates. The full list of team members for Phase I of the study is as follows:

Frances Chinemana	Sociologist & Fieldwork Co-ordinator
Nathan Manyara	Sociologist & Fieldwork Supervisor
Paula Mukodzi	Interviewer
Claudia Sabeta	Interviewer
Wengai Sasa	Interviewer
Caesar Vundule	Interviewer
Mthuli Ncube	Econometrician
Peter Robinson	Economist & Team Leader

3.3 Tasks to be Performed

The principal tasks which the consultants and, in the case of statistical and cross-country analysis, the Bank are required to perform are as follows:

Site Selection

For the PWS component, half of the households should be in a relatively dry region and half in a relatively wet region. In each case, the sample is to be further subdivided into "Site A" and "Site B" categories:

Site A being areas where households have access to an improved PWS, have themselves to decide whether or not to use the improved source and where between 20-80% actually do so;

Site B being areas where households do not have access to improved PWS, but where improved supplies are to be introduced within the next 12 months.

In Phase I of the study, the modified TOR require that 200 households be interviewed at each of the 2 Site A locations (giving information on actual practices) and each of the Site B locations (giving rise to "contingent valuation" assessments). In Phase II, to be implemented after the villages in Sites B have received the imoroved supplies, *ex-post* information is to be collected on frequency of use of the improved sources and quantitites of water used.

Sociological Studies

These include site reconnaissance, follow-up at chosen sites, observation studies at water points and of water use in households and the holding of focus group discussions with selected groups of community members.

Questionnaire Development

Questionnaires are required for A and B sites for the rural PWS component and for interviews with resident or potentially resident households and entrepreneurs in growth points. The questionnaires for the PWS component are to be structured around independent and dependent variables to facilitate statistical analysis, but should also allow a wide range of general questions about the sample to be answered.

Data Management

Data is to be available in a form for use on IBM personal computer compatible equipment, with a copy of the raw data being sent to the World Bank and to the NAC.

Statistical Analysis

The specification of the models to be estimated and the econometric analyses to be performed is to be done jointly by Zimconsult and the collaborating World Bank team. Experiments are to be carried out to determine whether it would be possible in similar studies to simplify the questionnaires and reduce sample sizes while still producing relevant results. The final specification of the models to be used in the Zimbabwe study is to be made by Zimconsult.

Study Report

The Zimbabwe study report is to be prepared by Zimconsult and commented on by the appointed sub-committee of the NAC and the World Bank. The report is to consist of two main parts. Part I will report on the design, execution and analysis of the study. Part II is to discuss the policy implications of the study, focussing on the implications for technical choices (including level of service and size of water supply systems) and financial choices (such as tariffs, cross-subsidization schemes and cost recovery targets).

Multi-Country Analysis

Primary responsibility for the multi-country study report is to lie with the World Bank.

Dissemination

In addition to the report to the NAC and the World Bank, the consultant is encouraged to publish scientific papers in national and international journals.

3.4 Anticipated Products

The TOR anticipate that the study will provide to national policy makers:

- information on how people in the study areas respond (in terms of connection frequencies and quantitites of water used) when improved water supplies of certain characteristics (including level of service and price) are made available;
- the implications in the study areas for key rural water policy issues (such as level of service, cost recovery targets, and cross subsidy mechanisms);
- the implications in the study areas of different revenue collection mechanisms;
- the level and standard of utilities required to attract economic activities to growth points, together with indications about cost recovery policies which will minimise government's financial outlays while achieving the growth objectives;
- a rapid, valid and practical method for use in routinely assessing demand factors in the design of both piped and primary rural water projects in Zimbabwe.

3.5 Timeframe

Questionnaire development was initiated with the assistance of Dr Briscoe in November 1987. Following piloting of the questionnaires, site selection and initial sociological studies, the Phase I fieldwork itself was completed on schedule by the end of March 1988. The intention was then that the econometric analysis would be started during the University of Zimbabwe May/June vacation, and continued in Washington with the World Bank collaborating team during August, leading to a draft report in early September. The Phase I report would then be finalised once feedback had been received from the NAC and other Zimbabwe researchers and perspectives from the other country case studies had been included.

In the event, the initial econometric work took longer than expected and was completed at a time when team members were involved in other commitments, resulting in the initial write-up of the results being delayed until November. At the same time, the key econometrician recruited by the Bank to work on the data in Washington resigned before starting work on the Zimbabwe data, with the result that the Bank has postponed the participatory work planned for August until the first quarter of 1989.

The study would clearly have little value for Zimbabwe if the report were to be delayed until 1989, and it is with this perspective in mind that the current draft report is being submitted. It should be noted, however, that this draft has not benefitted as the TOR anticipates from an input on the statistical side from the World Bank team, nor have there been any significant results from the other country studies to use in analysing the Zimbabwe case. The final version of the Phase I report, which now seems likely only in mid-1989, should be richer for the inclusion of these items.

Although the delay between the fieldwork and this draft report is considerable, the Team Leader has made the major policy conclusions of the study known through presenting a paper to the Blair Laboratory lunchtime series on water and sanitation issues (on 21 July), the ZERO conference on Rural Electrification (on 28 July) and the Ministry of Energy and Water Resources and Development conference on Water Resources, Conservation and Development (on 30 September 1988). The constructive comments from the participants are gratefully acknowledged and have been incorporated in the elaborated version of the paper which constitutes Part II of this report. Key members of the team are presently involved in the evaluation of NORAD support to the water sector, and perspectives from the Harare interviews and fieldwork in Manicaland and Mount Darwin are being included in the WTP work.

Phase II of the study, involving fieldwork in the "B" site areas to obtain *ex post* information following the installation of the improved PWS's, is tentatively scheduled for July to November 1989.

Status?

CHAPTER 4 : SITE SELECTION

4.1 Introduction

The TOR call for the PWS component of the research to be carried out in two different rural areas, one relatively wet and the other relatively dry. To test the thesis that community involvement brings a commitment from the project benficiaries, it was decided to choose areas where rural water supply projects had been carried out by agencies emphasizing community participation. In such areas, willingness to pay would be expected to be at the highest levels, while WTP would be expected to be lower in areas where more rapid, less community-involving approaches had been adopted. After considering various alternatives, detailed site selection work was carried out in Chihota (wet) and Buhera (dry), where Save the Children (UK) and Christian Care had respectively been executing projects with considerable community participation. These areas are described in some detail in the following two sections.

As regards piped schemes, it proved extremely difficult in practice to identify any piped water sites in Zimbabwe where the basic conditions required for the study are fulfilled. These are that there be a situation where households are able to choose, on the basis of a range of factors, including prices, whether or not to connect to a piped system and then how much water to use. In most areas where piped water is available, connection is a requirement of occupancy of houses. In addition, employees of Government and sometimes of parastatals and private companies may have both the connection fee and a substantial proportion of the monthly charge for water paid by the employer, making it very difficult to ascertain how households would behave in the absence of such subsidies. An interesting area of research would have been to examine the group connections recommended in NWMP, but unfortunately none had yet been implemented.

Initially the team considered the possibility of carrying out research in Epworth, an area unique in urban Zimbabwe for having been established by the residents themselves, without reference to formal planning and accepted infrastructure and housing standards. The area is close to Harare and grew from a small settlement on a mission farm to a significant township during the later years of the liberation struggle. At present, the 40 thousand or so Epworth residents draw their water from traditional wells, together with improved boreholes and protected wells installed and maintained directly by the Blair Laboratory. It is intended, however, that a piped water system be installed, with each stand being required to have a connection. The piped water will be part of a package of infrastructural services being provided prior to the formal incorporation of Epworth into the City of Harare.

The intention is that residents will have to pay for the package of services, although amounts had yet to be fixed. What charges should be raised is a difficult question, not least because Epworth households have widely differing socio-economic status. The team suggested that by applying the WTP methodology to Epworth, it might have been possible to have provided the authorities with information useful for decision-making about the level of charges to be levied. An undertaking was given that politically sensitive topics such as intermediate water supply options (eg shared standpipes) would be avoided, as the policy of stand connections had already been decided upon and restarting debate on other possibilities was considered highly counterproductive at that time.

In the event, the NAC rejected the Epworth option, not on the grounds of its containing some potentially sensitive areas of investigation, but that the major decisions had already been taken for Epworth. By contrast, in the case of growth points located in the communal areas, Government policy on cost recovery remained uncertain and it was felt that the resources being made available through the study could be usefully deployed in carrying out research in a growth point. It was made clear that Government's concern was that $17 million had already been spent on infrastructure in the growth points, with there being very little to show by way of returns so far. Government outlays could be offset by raising charges, but this should not be done if the effect would be to negate the original objective of stimulating investment and growth in these areas. To investigate these issues, the Murehwa growth point was chosen for the field work, with more details being given in Section 4.4.

4.2 Chihota

Chihota is located approximately 50 km south of Harare, in Mashonaland East Province. The water table is very high, with water typically being struck within two metres of the surface. This makes the area very suitable for well sinking and the SCF programme has concentrated on improving and protecting existing hand-dug wells. Ready availability of water from perrenial shallow wells dug in gardens also makes possible small-scale market gardening, and this has become the dominant form of economic activity, despite the poor, sandy soils which require extensive fertilisation.

The Save the Children Fund (SCF) programme has concentrated on improving existing high-yielding wells, and linking this with the building of Blair Ventilated Improved (BVIP) latrines. On the water side, the community is asked to identify and deepen a suitable well and fit liners; the agency only assists with this if rock-blasting proves necessary. SCF then supplies a bucket pump, assists in the construction of headworks and trains a pump minder, who is also community builder for BVIPs. The pump minder is a member of the immediate community and is a beneficiary of the improved water source. As such, the pumpminder does not get paid for their pump maintenance work, but does receive small payments from the households concerned for building BVIPs.

Site reconnaisance encompassed 3 "A" sites, where water from improved wells was already available and the majority of families had BVIPs, and 5 "B" sites, where improvements were planned but not yet executed (results of site reconnaisance in Appendix 2). The main alternative sources to the improved wells are unprotected wells in or near gardens, plus water from rivers and small natural dams. In one B village, an improved protected well with a bucket pump, about one and a half kilometres away, is used in the dry season.

4.3 Buhera

Buhera is in a far drier part of the country as compared with Chihota, lying in the low rainfall part of Manicaland Province. The southern part is particularly dry and has a very deep water table, requiring that boreholes be sunk to obtain water. In the northern zone, the water table is often high enough for shallow wells to provide a reasonable supply of water. In recent years, successive severe droughts in the area have made water an overriding concern amongst local communities. Community members tend to engage in a diversity of economic activities, based on cropping and livestock rearing, but including horticulture, local part-time wage employment and beer brewing.

The Christian Care water programme aimed at building a total of 80 boreholes and 200 wells, all being fitted with modified Bush Pumps. Sanitation was not included as a component of the project and the population figures in each area were not carefully enumerated, leading to a situation where water points serve varying numbers of people. The agency has been involved in training pumpminders nominated from their respective communities, but these pumpminders are now employees of DDF, which has assumed responsibility for pump maintenance. Pumpminders are each responsible for three wards. At the village level, the Village Water Committees in the area are generally composed of two women, responsible for cleaning the surroundings and making sure that the pump is not abused, and one man, responsible for tightening the bolts and greasing the bearings.

Site reconnaisance encompassed 5 "A" sites, where water from protected boreholes or wells was already available, and 4 "B" sites, where new water sources were planned but not yet executed (Appendix 3). The main alternative sources are unprotected wells, springs, dams and rivers; during very dry periods, water has to be collected from distant boreholes and from mafuku (temporary wells dug in dry river beds).

4.4 Murehwa

The definition of what is and what is not a "Growth Point" in Zimbabwe varies according to context; this is discussed in Chapter 11 in Part II. For this study, the requirement was that a resource-based growth point with a track record of, and further potential for, expansion be identified. Following a field visit, Murehwa growth point was chosen, partly because of its positive growth record in recent years, despite not being included on the original list of designated growth points, and partly on more practical considerations of the limited time available for the growth point fieldwork as a result of its inclusion at a late stage. It was felt necessary to keep open the possibility of returning to Harare to modify questionnaires and Murehwa, among suitable growth points, was close enough to permit this.

Murehwa is located about 87 km east of Harare along the Harare-Nyamapanda road in Murewa Administrative District within Mashonaland East Province. The area surround the town is largely mountainous. The growth is supplied with water from a dam which has the capacity to cater for 20 000 people. The current estimate of the population, including the hospital and mission school, is roughly 15 000 people.

The employed population of Murehwa can be broadly divided into the following subgroups, estimates of the numbers in each group being given in brackets (total of 2 200) - government and council (360), parastatals (390), non-government (1 000), business owners (180) and informal petty traders and other self-employed (270). Economic activities currently taking place at the growth point are largely commercial in nature, eg 56 general dealers, 15 bottle stores, 26 butcheries. There is very little petty manufacturing taking place, but the following examples can be given: carpentry (7 workshops), welders making scotch carts and other items (2) and dressmakers (4). Other businesses provide services such as panel beating, cycle repairs, motor vehicle spares and repairs, petrol stations, taxi services, shoe repairs and grinding mills.

Recent growth at Murehwa seems to have derived principally from three sources. Growth in commercial activity has come from the patronage of travellers, especially big transporters of the PTA ferrying goods bound for Malawi which have been routed through Nyamatanda and the convoy through Tete Province of Mocambique. This traffic will be dramatically reduced once the railway line linking Malawi to the port of Nacala has been reopened, but at present the security situation in that part of Mocambique rules out use of the Nacala corridor. Within Murehwa itself, the opening of the Grain Marketing Board Depot has created many jobs and has resulted in local farmers, both commercial and small scale, bringing in their crops to the Murehwa depot and doing their shopping at the growth point. Finally, the linking of Murehwa to the electricty grid in July 1986 opened up a range of new possibilities, in terms of both production and recreation activities.

5.1 Questionnaire Design - Chihota and Buhera

The questionnaires for the PWS component of the study (Appendix 4 for A-PWS and Appendix 5 for B-PWS) were drawn up using those from previous water studies in Zimbabwe and the Brasil questionnaires from the present study. Researchers at the Zimbabwe Institute of Development Studies and the Central Statistics Office (CSO) provided useful comments on early versions. The key modules of the questionnaires are given below. The main differences are the inclusion for the "A" sites of detailed questions (Sections C & D) about what alternative sources would be used if the improved source were not available (or were to be priced out of reach). For the "B" respondents who envisage using the improved sources once they have been installed, it is necessary to ask for what purposes, this being a proxy for the quantities to be used (it was found to be too hypothetical and difficult to ask directly about quantities).

APWS - Primary Water Source Available

A - Characteristics of Water Sources Used in Wet or Dry Seasons

B - Improved Sources - Contributions and Links with Health

C - Characteristics of Source which would be used if <u>all</u> improved sources were not available

D - Characteristics of Secondary non-improved source

E - Family Characteristics

F - Bargaining Game

G - Interviewer's Comments

BPWS - Primary Water Source Planned

A - Characteristics of Water Sources Used in Wet or Dry Seasons

B - Level of Knowledge of Improved Water Sources and Links with Health

E - Family Characteristics

S - System Description

F - Bargaining Game

N Purposes for which Improved Source would be used

G - Interviewer's Comments

It is in the "bargaining game" that the questionnaires are somewhat innovative, in that perspectives from recent "contingent valuation" literature are incorporated. The bargaining game seeks to establish a cut-off or breakeven point at which the respondent is just willing to pay while continuing to use the improved supply. At a price that is any higher, the improved supply will be abandoned in favour of traditional unsafe sources. In contrast to earlier approaches where the interviewer suggested a starting point and increased the amount uniformly, one obvious feature of the bargaining game developed in this study is that the bids are structured in a "spiderweb", starting at a low figure, then jumping to a high figure and zig-zagging back and forth until the respondent has agreed on a maximum willingness to pay for the improved source. By confronting the respondent with contrasting values, this approach is thought to break a patterned way of thinking about the issue and thus to give a more accurate response. It may also reduce "compliance bias" (respondent giving answers which are influenced by wanting to please the interviewer), as it may be less clear what level the interviewer may be expecting from the respondent.

It was found that the sequence of questions required to implement the bargaining game were more easily summarised in a diagram than a series of statements (see Figure 1). Respondents are asked whether they would pay a certain annual charge and continue to use the improved source: if "yes", the interviewer completes the line to the next high figure, if "no" to the next low figure. One of the limited number of discrete answers (0, 25 cents, $1, $2, $3, $5, $7, $10) soon emerges as the maximum that the household is willing to pay; a check question allows the respondent to give a somewhat higher figure, so that the final result is not limited to one of those discrete amounts.

The rationale for phrasing the question in terms of paying only for *maintenance* of the improved source is discussed in some detail in Section 6.6 below (one of the points to be examined in Phase II is whether the communities understand the difference between maintenance and repair and whether they consider DDF to be responsible only for the latter following breakdowns). Piloting of the questionnaires, which was carried out in Chiweshe, Chiduku and Tanda, indicated that the likely range of values would lie within 0-$10, but with a preponderance of responses at the lower end. For that reason, the "spiderweb" concept was modified to allow a sub-game based around $3, rather than jumping directly from 25 cents to the maximum of $10 after the first "yes" response (Figure 1).

5.2 Focus Group Discussion Guidelines

As mentioned in Section 3.1, the consultants were from the start concerned about whether some of the information required could in principle be obtained from household questionnaires and proposed including in the study [redacted] It was felt, too, that it would be difficult to comment on bias in the questionnaire responses without having information from other sources. This is not to say that the responses from the group discussions were to be taken as "accurate" in some sense, as they would clearly have biases of other kinds, but that through such discussions and informal [redacted] a broader picture could be built [redacted] This would then be the context in which an assessment could be made of the validity of the questionnaire responses.

The focus group methodology was considered appropriate for the discussions because, with a good facilitator and well chosen groups, fairly detailed information on topics relevant to the particular group can be obtained. The focus group approach has been found useful and appropriate in previous fieldwork in rural Zimbabwe. It is particularly important when a discussion between women would yield useful information; in a general group discussion involving a cross-section of the community rather than a carefully chosen sub-group, the men would dominate and the women would remain silent.

After the pilot phase in Domboshawa and Buhera, the list of suggested topics for the focus discussion groups was finalised and is reproduced as Appendix 6. Besides questions relating to ownership, maintenance and payment, topics included the role and efficacy of local structures, links between water and health and aspects of community satisfaction or dissatisfaction over the water points.

Six focus group discussions per site were conducted as follows:

1 meeting with VIDCO members, other community leaders, including village water/health committee members and VHW
1 meeting with local business owners
1 meeting with older male community members (45+ years)
1 meeting with female members of a project group
1 meeting with older female community members (45+ years)
1 meeting with younger female community members

With 6 meetings per site, there were 12 per area and 24 meetings for the two districts. It should be pointed out that other formal and informal meetings were held at the discretion of the field supervisor.

5.3 Observational Studies

It was agreed that to enrich the study, other data collection instruments were also to be utilised.

Water source observations

Actual behaviour of subjects at water points is a significant measure of water usage and attitudes. Tables for recording behaviour at water points were designed (Appendix 7). Information collected using these water point observation sheets includes:

- sex of subject drawing water
- time of arrival and departure from water point
- containers and quantities drawn
- use of water at the water point
- behaviour at water point

Household observations

Water usage within the household area was recorded using data sheets which captured the following information (Appendix 7):

- main water source for domestic use
- amounts of water used for different activites and the household members involved
- number of trips to collect water
- water storage facilities
- general levels of sanitation.

Observations:

A total of 8 days observations of water sites (2 days per site) were made. Household observations amounted to 12 days, this being 3 households for one day each at the four sites.

5.4 Community Liason and Execution of the Studies

Extensive communication had to be established prior to the survey with the hierarchy within the study areas. These ranged from the District Administrators, Local Government Promotion Officers, DDF personnel, other government officers, executive officers of District Councils, councillors, ward and VIDCO leaders, local traditional leaders, church leaders, village health workers, agricultural extension officers, various political leaders, field personnel of donor agencies and other interested parties.

Primarily the community liaison activity involved detailed explanation of the research objectives and activities, seeking permission to conduct such research and identifying local leaders to be contacted to inform the ordinary members. Such activity required tact and general sensitivity to the local communication etiquette.

In the formal part of the exercise, in each site 200 household questionnaires were administered making a total of 400 for each area and 800 for the whole study. No attempt was made to use any specific sampling method, the main criteria being those set for the two different sites as a whole. Within the villages meeting those criteria, selection of households was random, although in most cases almost total coverage had to be achieved in order to reach the required target of 200, even when this was spread over several villages. The group discussions and observation studies were carried out while the household interviews were being administered, which was not perhaps an ideal situation, but a practical one given the time that the field team was available. Group meetings were organised at the convenience of the participants. The PWS fieldwork was carried out over the period [illegible] January to 4 March [illegible]

5.5 Growth Point Questionnaires

In view of the orientation given by the NAC, fieldwork for this part of the study was designed to answer the following questions:

- What level and standard of utilities is required to attract economic activities to growth points?
- What complementary policies are needed to justify making the consequent investments?
- What cost recovery policy (for water in particular) should be implemented to minimise Government's financial outlays while achieving the growth objective?

In order to elicit views from as wide a spectrum of the population at the growth point as possible, four questionnaires were developed, with questions tailored to suit each category. The four questionnaires were for business entrepreneurs, government employees (including council employees and parastatals), non-government employees (and other residents) and the rural communities within the immediate surround of the growth points.

Pilot studies were conducted at Juru business centre which is less than 45 km from Murehwa growth point. The four different types of questionnaires were pre-tested and alterations were effected to those sections that were inappropriate to the respondents. The final versions of the questionnaires are given as Appendices 8-11. As an example, the basic structure of the business owner questionnaire is as follows:

M3 - Business Owners, Murehwa

A - Business and Family Situation

B - Accommodation and Facilities

C - Growth Points

Bargaining Game - Business Owner Residential Use

Bargaining Game - Business Owner Business Use

Any Other Comments

The bargaining game for Murehwa is necessarily more complex than that for the PWS, due to there being both a connection fee aspect and a monthly payment aspect. In order to obtain information on the willingness to pay in each aspect, repondents had to be asked to reply to two bargaining games in sequence, with the starting point in each defined by whether the respondent already had piped water in the house and if so whether they were paying a flat monthly charge for water or a volumetric based tariff (see Figure 2). With the business owners, there was the additional complication of some living within their business premises, others having separate housing, in which case two sets of bargaining games were administered.

5.7 Fieldwork process in Murewa

The fieldwork exercise in Murewa covered the following sample sizes:

- rural households surrounding Murewa	100
- business owners	28
- government, council and parastatal employees	35
- non-government employees and other residents	25

The fieldwork was conducted over a period of eight days in March 1988. A wide spread of ministries was achieved amongst civil servant respondents: Ministries of Health, Construction, Roads, Local Government, Justice and Parliamentary Affairs, Water (DDF), and council employees. Under parastatals, employees from the Grain Marketing Board and the Post Office Savings Bank were interviewed. Non-government employees included workers in local shops (eg, Bata, Express etc), and petty market traders. Business owners covered retailers and wholesalers, services such as transport operators and hairdressers, and small-scale manufacturers, such as owners of carpentry workshops. The rural questionnaires were conducted in the surrounding villages, these being selected from all the sides of the growth point in order to get a representative sample. The following villages were covered:

RIMBI	ZIHUTE	MVUMBI	CHINAKE	MADYAMHURU
MARAMBA	MATONGORERA	HANYANGA	MUSVIPA	GOZO
MANGA	MHONDIWA	NYEWEYEMBWA		

6.1 Demographic Information

Information relating to the sex, age and education status of the respondent and the head of household, to family size, positions in the community and membership of clubs and groups, is summarised for each of the four rural areas surveyed in Table 1. Not surprisingly, while the overhelming majority of the respondents were women (87%-91%), a much smaller proportion of heads of households were women (23%-27% in Chihota, 13%-17% in Buhera). Generally heads of households were older and less well educated than the respondents; the education level in Chihota was mostly higher than that in Buhera. The average of reported household sizes were remarkably small (4,3 to 5,2). Approximately one quarter of household members held formal positions in the community. Membership of savings or farmers clubs was quite common in Chihota and Buhera A; in the Buhera B area, nearly all households belonged to a marketing and supply cooperative.

Table 1 : Summary of Demographic Information

	Chihota A	Chihota B	Buhera A	Buhera B
Respondent:				
sex (% female)	87%	87%	89%	91%
av age (years)	38	38	41	37
educ - none	10%	15%	14%	24%
status - pri	72%	74%	77%	68%
- sec	18%	11%	9%	8%
Head of Household:				
sex (% female)	23%	27%	13%	17%
av age (years)	48	44	48	44
educ - none	24%	24%	20%	26%
status - pri	65%	63%	72%	63%
- sec	11%	13%	8%	11%
Family Size:	4,3	4,9	5,2	4,7
% Holding Positions:	25%	24%	24%	17%
M'ship Clubs/Groups:	25% sav 11% IG	29% farm's 29% sav	32% farm's 9% IG	All - M&S Coop

sav = savings club IG = income generating project
farm's = farmer's club

6.2 Economic Status

Information relating to economic status is summarised in Table 2. In the employment of heads of households, Chihota had a smaller proportion involved in agriculture and rural employment (averages of 64% and 4%) than Buhera (70% and 8%), while employment in urban areas was higher (32% in Chihota and 27% average in Buhera). The main income sources in Chihota were monthly remittances, revenue from sale of vegetables and fruit, occassional remittances and finally crop sales. In Buhera, the pattern was less clear cut, with households depending on a greater variety of income sources, but principally local part time wages, monthly remittances, beer and vegetable sales, occassional remittances and finally livestock sales (in the A area) and crop sales (in the B area). Average land holdings were higher in Buhera, but with lower rainful and much smaller expenditures on agricultural inputs, horticultural and crop returns must have been much lower.

Table 2 : Summary of Economic Status

	Chihota A	Chihota B	Buhera A	Buhera B
Employment of HH:				
agriculture	68%	59%	76%	64%
urban employment	29%	34%	27%	27%
rural employment	2%	5%	8%	8%
Access to Land:				
range (acres)	0-27	0-16	0-14	0-20
mean (acres)	3,5	3,2	5,0	4,3
Seasonal Ag Inputs ($)	106	83	39	24
Income Range: ($/month)				
mode	<25	<25	<25	<25
median	53	37	43	25
mean	129	[illegible]	115	52
Assets: (% owning)				
cattle	77%	65%	80%	58%
plough	61%	54%	82%	81%
wheelbarrow	44%	38%	34%	38%
Livestock: (mean no)				
cattle	5,6	4,0	4,2	4,0
goats	1,2	1,3	4,6	5,2
poultry	5,4	5,2	7,2	5,4
Housing: (% asb/tin)	34%	28%	13%	22%

Note: B's much poorer

HH = head of household

Overall incomes reported in response to an "Income Range Card" (Figure 3) were higher in Chihota as opposed to Buhera, and higher within each district in the A area as opposed to the B area. It was expected that Chihota would enjoy considerably higher income levels than Buhera, but the differences were in fact not that large, with median and mean incomes in Chihota B actually being less than those in Buhera A. The actual figures should be treated as being purely indicative, as averages can only be calculated approximately from the unequal range data available. It is significant that in both districts the modal (most frequently mentioned) income range was the less than $25 per month category. Whether or not these figures are accurate (CSO has worked extensively with income range cards and believes that they produce reasonable results), the picture that emerges of widespread poverty in both areas corroborates the observations of the field team.

Asset holdings reflect both accumulated past income streams and, in the case of productive assets, such as livestock and agricultural implements, potential for generating increased income. There was a smaller proportion of households which did not own any cattle in the A areas as opposed to the B, with an average overall in both districts of around 30%. This is considerably better than the accepted national average in communal areas of about 50% of households having no cattle. Despite Buhera being more readily associated with cattle, the largest herd sizes were to be found in Chihota, an indication perhaps of greater wealth within the upper strata of the two districts. By contrast, there was a higher proportion of plough ownership in Buhera, but this could be explained by the greater importance of cropping in Buhera as opposed to Chihota. The quality of housing as judged by the materials used in construction, is certainly higher in Chihota.

6.3 Health Status

Sociological Observations

There was a high level of awareness within the study areas of the strong positive link between clean water and good health. In all the focus group discussions villagers pointed out that waterborne diseases are contracted from unprotected sources. Some of the waterborne diseases that were felt to be less prevalent in areas with protected water include diarrhoea, bilharzia and cholera. This awareness was attributed to the Village Health Workers (VHW), who encourage the use of drinking water from protected sources, or, where such water is not available, the boiling of water for drinking purposes.

It was not clear from discussions with the people that their perception of the link between clean water and health was sufficiently strong to have a direct influence on willingness to pay. However, especially in the 'A' sites where households were already enjoying water from protected sources, it seemed likely that this awareness would have a positive influence on their willingness to pay.

Questionnaire results

Table 3 gives a summary of some quantitative indicators about health awareness and status. Confirming the picture from the focus group discussions, frequent visits by village health workers were reported in all areas and a high awareness of the link between clean water and health was evident in responses to the formal interviews. Despite this, in Chihota A nearly 40% of households reported continuing to use unprotected family shallow wells for drinking. This may well be simply a matter of convenience and habit, but it does reinforce impressions from observations and discussions that health awareness is more easily articulated than acted upon. The relatively low utilisation of improved sources in Chihota A contrasts markedly with Buhera A, where water is much less readily available and where almost all households reported using the protected source, at least for drinking water.

As far as latrines are concerned, it was only in the Chihota A area, where the building of BVIPs had been an integral part of the SCF project, that a significant proportion of the households (66%) had an adequate level of sanitation. At the time of the fieldwork, there was a clear need for a BVIP project to be extended to Buhera.

Table 3 : Health Awareness & Status

	Chihota A	Chihota B	Buhera A	Buhera B
Awareness of Link:	93%	82%	79%	85%
Frequent VHW Visits:	88%	76%	86%	94%
Protected drinking H2O:	60,5%	n/a	99%	n/a
Type of Toilet:				
none	34%	74%	89%	83%
BVIP/other	66%	26%	11%	17%

6.4 Access to and Use of Water

Supporting the general picture developed during the site selection phase (Sections 4.2 and 4.3 above), Table 4 gives information from the questionnaires about access to and use of water. The first section lists the most common sources in the four areas and then gives information about the main source used by the household. In both areas, the main sources reported were the protected wells (in the A areas), unprotected wells (in both A and B), rivers, dams and mufuku. In Chihota, with its high water table, the unprotected garden wells were very significant sources for various purposes, whereas in Buhera households typically have to depend on a wider variety of sources, depending on where their homestead is located. Average distances to the main source were thus found to be lower in Chihota.

The average number of trips per day to the main household water source varied between 2,8 and 3,3, with th [redacted] xcluding gardening and [redacted] capita consumption of about [redacted] The highest average per capita figure was in Buhera B, rather than in one of the areas which had already benefitted from a water project.

In respect of the improved sources in the A areas, households generally considered the improved PWS to be close, and to have abundant water in the wet season. In the dry season, only 67% of households in Buhera A considered their improved boreholes to have abundant water. Alternative sources were less frequently reported to be close and were thought far more likely to prove inadequate in the dry season.

Table 4 : Access to and Use of Water .

	Chihota A	Chihota B	Buhera A	Buhera B
Main Sources:				
source 1	prot well	unprot w	prot well	unprot w
source 2	unprot w	river/dam	river	riv/dam
source 3	river	mufuku	unprot w	mufuku
Preferred Source:				
mean distance (m)	121	287	160	152
quantity used (l/d)	71	72	64	80
mean trips per day	3,3	3,0	2,8	3,0
queueing time (min)	1,5	2,4	6,3	1,5

[redacted] In Buhera, the order was the same if the list is started with beer and gardening is placed after brick-making. About the same proportions of households in the two districts were involved in gardening, but households in Chihota A reported using 80% more water on gardens than those in Buhera A (914 litres as opposed to 505 litres per day). The situation is reversed in the B areas (Chihota B 260 litres, Buhera B 344 litres). The high use of water for gardening in Chihota A is a reflection of the relatively advanced state of vegetable production in that area; the SCF project was targetted to providing clean water for drinking and other domestic uses rather then for vegetable production.

6.5 Community Involvement

Introduction

From the focus group discussions and less formal interactions with community members, a number of themes which have an important bearing on WTP emerged. These relate, on the one hand, to attitudes about different technologies and how sites for improved PWS are to be chosen, and, on the other, to more fundamental questions about the value of water and ownership of water points.

Protected versus unprotected sources

In view of the awareness of the link with health, it was not surprising to have found a universal preference for protected water sources, [redacted] Unprotected sources nonetheless continue to be used, particularly laundry and to a lesser extent for ablutions. In 'B' sites, respondents in focus group discussions indicated that they expect the water from protected sources to be much better than from their current existing unprotected sources. A small group in Chihota expressed the view that their unprotected sources are just the same as the protected ones, save for the pump mechanism on the latter. This sentiment was, however, expressed only when the issue of maintenance of protected sources was raised.

Troughs, surrounds and other facilities

The communities expressed enthusiasm for having cattle troughs as close to their protected source as possible. In Buhera in particular, where cattle depend on protected water when rivers dry up during the dry season, such troughs were said to become indispensible. Less importance was placed on washing stands, except at water points with plentiful, perennial water. People appreciated that concrete surrounds and soakaways prevent the area around the water point getting muddy and thus becoming breeding grounds for various diseases. Fences were also viewed as important as they keep animals from the water point. The building of BVIPs at the waterpoints was also thought to be a good idea, although very few had been constructed at the time of the fieldwork.

Choice of Technology and Community Contribution

At present, NAC is encouraging only two kinds of pumps to be installed in rural Zimbabwe: the modified bush pump and the bucket pump. Limiting choice at a national level to just two pumps is defensible on grounds of making possible the training of fieldworkers and the provision of adequate supplies of spare parts for maintenance. It does, however, imply that community involvement in pump choice is rather stylised, as is the pattern and form of community contribution that is expected during the investment stage. After field trials for each type of pump, the expected contribution is as follows:

> <u>shallow well fitted with bucket pump</u>:
> siting of the well;
> digging of the well (or deepening of existing well), invoving a well-sinker or a Vonderig;
> gathering of gravel for packing;
> putting down of the casing;
> provision of sand, stone & bricks for headworks;
> putting on of the pump and ceremonial handover;
> subsequent first tier maintenance through VWC.
>
> <u>borehole fitted with bush pump</u>:
> siting of the borehole (technical requirements more stringent);
> digging of first 3 metres or until rock is struck;
> subsequent feeding of borehole drillers;
> provision of sand, stone & bricks for headworks;
> installation of the pump and ceremonial handover;
> subsequent first tier maintenance through VWC.
>
> (VWC - village water committee. The proposed 3 tier maintenance system is dicussed in detail in Part II).

In both study areas, a strong preference for boreholes instead of wells was expressed. The major reasons given were that boreholes are deeper and are less likely to dry up in a drought and would be fitted with the pump of choice, the modified bush pump. The alternative of a well fitted with a bucket pump not only implies greater risk of drying up, but also an increased health risk. While community members agreed that the bucket pump is cheaper and easier to maintain and may thus prove more reliable, they argued strongly that the health hazard arises from handling of the bucket by persons without washing their hands, thereby leading to contamination (this point is being thoroughly analysed in field tests by the Blair Laboratory). Another danger noted is that, because the opening is not completely sealed, mischievous persons may poison wells fitted with bucket pumps.

Another important reason given for preferring boreholes over wells was, however, that less community participation is required. Most of the work is done be machine and the community members need only provide food for the borehole drillers, unlike the situation with wells where most of the work is carried out by the community and a larger amount of building materials have to be supplied.

Siting of improved water sources

To ensure equitable access to the improved PWS, the process of location and siting of water sources was evidently of fundamental importance to people within the study areas. In Buhera, Christian Care had been sensitive in their approach to the siting of water points. The people had been asked to choose three preferred sites, with a meeting being called to vote on three sites. It became apparent in the discussions that at times influential leaders within the community had attempted to sway voting in their favour. However, there had not been much disagreement on the final site selected, which had generally been the site with the highest potetial yield, this being determined by a surveyor using vertical electrical sounding on the sites in the order of the community's preference.

Site selection in Chihota took on a different pattern. This is because the bucket pumps were often to be fitted on existing individual wells. The local community nonetheless participated in deciding on which of the existing wells was centrally located. The water yield of such a selected well was also considered, with wells with low yields, but centrally located, being deepened.

Water as a free resource

The age-old belief that water is a free resource in Zimbabwe appeared to persist strongly in the two areas studied. It was apparent in focus group discussions both in Chihota and Buhera that communities regard water as a gift of nature. This belief has serious remifications to any water provision programme in that any payment for provision of water infrastructure and maintenance should not be presented as a charge for the water itself. Communities made it clear that they would not entertain the idea of buying water.

Particularly in view of the promises made to rural people during the liberation war, focus discussions also revealed that provision of clean water is considered a fundamental Government responsibility. Whether an improved PWS had been provided through Government or donor funding, the attitude expressed was one of an improvement to the quality and quantity of a resource that is otherwise freely available.

Conservation

Although water is regarded in one sense as a free resource, in another it is clearly highly valued. Attitudes about the value of water were revealed, for example, in discussions on conservation practices. An awareness of the importance of conserving water was particularly marked in Buhera, because this area is very dry. Water from protected wells is a precious resource since it is unpolluted. People are aware that wells dry up during the dry season and various steps are taken to make sure that nobody misuses or wastes water from protected wells. Some of the conservation strategies observed included preventing small children playing close to these wells, not allowing people to fetch water using plastic bottles with small openings and a ban on using water from certain protected sources for laundry.

In Chihota, although the importance of water is clearly understood, it appeared that the conservation measures were much weaker. This conclusion is drawn from water point observations, where small children, especially school children, were noticed on many occasions playing with water from protected sources, even in the presence of adults. This may have been due to the fact that water is abundant in Chihota and there are many alternative water sources with perennial water.

Ownership of water points

[redacted] the property of either the [redacted] Even in Chihota, where most of the protected wells were formerly individual wells, the community appeared to accept that the well is communally owned, save for the bucket pump mechanism which is taken to belong to SCF or to the Government. In all cases, the original "owner" had had to agree to his well being upgraded to a community well to which all community members would have free access. Although no formal writen agreement is made, this system seems to work well not only in Chihota, but other parts of the country where similar programmes exist.

It has to be concluded that people don't regard the water points as belonging to them in a fundamental sense which would guarantee an unquestioning commitment to maintenance and usage of the improved wells and boreholes. The implications of this finding are discussed at some length in Part II.

6.6 Willingness to Pay

Table 5 gives summary statistics from the bargaining game. The [redacted] Amongst respondents who already have access to improved supplies, in Chihota A the mean price that households said they are willing to pay for access to an improved source is $1,54 per annum. To put this into perspective, $1.54 is about 0,2% of the median reported annual income of about $640, a far cry from the 3-5% "rule of thumb" figure which has been used by planners in other countries to come up with a "reasonable" estimate of what households might contribute by way of cost recovery.

In Buhera, the mean WTP is somewhat higher at $2,51 per annum, presumably reflecting the scarcity of water, as the median of reported annual income is only about $510, so that water charges at that level would constitute 0,5% of income. In the first year, however, some families may well have contributed in kind the equivalent of 3% of income (ie, $15 to $20). Respondents in areas where improvements are planned but not yet implemented gave somewhat higher WTP responses ($3,17 for Chihota B and $2,80 for Buhera B), despite markedly lower median incomes.

Table 5 : Bargaining Game Summary Statistics

	Chihota A	Chihota B	Buhera A	Buhera B
Maximum WTP: ($/annum)				
mode	0	0	0	0
median	5.00		1.00	1.00
mean	1.54	3.17	2.51	2.80

In relating WTP to household and water source characteristics which might affect it, cross-tabulations with individual explanatory variables yield the expected signs. One of the main features of this WTP study as compared with the earlier investigation carried out as part of NWMP, however, is the capacity to go beyond bivariate analysis to assess econometrically the independent contribution of different factors to willingness to pay for water. Appendix 11 gives details of the econometric analysis carried out so far using both continuous and discrete (PROBIT) models. In terms of statistical significance, the results are, unfortunately, disappointing. Besides income variables, WTP appears variously to be a poistive function of labour days contributed to construction, gender and education of respondent, distance to the water source if the improved water source did not exist, total quantity of water collected, and, in Buhera, of quantity of water used for gardening.

Figures 4-6 illustrate the WTP results in a way that allows comparison with similar curves prepared for the Brasil case study. The feature that is immediately striking is that, while the graphs illustrating the Brasilian WTP results are all smooth and predictable, the Zimbabwe ones have some surprising twists and turns, particularly in the case of Chihota B. If that graph were to be ignored, the others would be quite reasonable, with an explanation along the following lines. With water being readily available in Chihota, WTP for an improved supply is much lower than in dry Buhera. An alternative explanation for lower Chihota A figures might be that households recognise that maintenance of a bucket pump should cost less than the Buhera people would expect of borehole maintenance. Nevertheless, even with no charges being levied (the present situation), only 60,5% of households actually make use of the improved supplies (Figure 4).

This is despite the community having a reasonable level of awareness of the link between using water from protected sources and health (see Section 6.3).

When this is translated into revenues per 100 households (Figure 5), the potential revenue from Buhera is much higher than that from Chihota A, despite the lower income levels in Buhera, again reflecting the value of water in a very dry area. Revenue peaks at a tariff of about $3 for Chihota A and $3.60 for Buhera A, but then the Buhera A graph goes into a trough and rises again. The Buhera B graph has a positive slope throughout. It can be argued, though, that the shape of the graphs for the higher tariffs is rather irrelvant for policy purposes, as the basic objective is to have a high usage rate and at even $3 per annum, Chihota A and Buhera A/B are below 60% using the protected source.

Figure 6 shows more clearly the relation between use of the protected source and revenue. For Chihota A, there is an upper limit of 60,5% of households using the protected source, while in Buhera, for usage rates in excess of a target of say 80%, revenue is virtually static. If 80% is taken as a cut-off, then the Buhera graphs give a tariff of $1.40 per annum. Anything higher than that would reduce Buhera usage rates sharply due to the low elasticity of the curves in Figure 4. At a tariff of $1.40, revenue from each of Buhera A and B would be about $119 from Figure 6. Revenue would increase significantly only above a tariff of $4, which would in turn reduce usage rates to below 35%.

With Chihota being limited to a usage rate of at most 60,5%, if a common national tariff is being sought, it would have to be no higher than the NWMP figure of $1 per household per annum (at $1.40, the Chihota A usage rate is an unacceptable 54%). At this level, the usage rates and revenues per 100 households shown in Table 6 would accrue.

Table 6: Usage Rates & Revenues at $1 per household pa

	Usage Rate	*Revenue per 100 Hhs*
Chihota A	60,5%	$60.50
Chihota B	99,5%	$99.50
Buhera A	98,5%	$98.50
Buhera B	99,5%	$99.50

The NWMP figure of $1 per annum would need to be inflated to bring it to 1988 terms, and this would give rise to a figure of more than $1.60. If $1.40 is already questionable from our results, $1.60 would be unacceptable. The implications of this finding are discussed in the conclusions in Section 8.1 below and in the policy recommendations in Part II of the report.

Turning to Chihota B, at face value this looks like a case of "compliance bias" by a community yet to benefit from improved water supplies. The reported WTP and hence revenue is so much higher than Buhera, in a situation in which one would expect the two Chihota samples to be close together, as the Buhera ones are (although there too the B values tend to be higher than the A values, as would be expected). About 40% of the Chihota B sample responded with values for WTP at or above $10 and these have led to the grouped data giving a significantly higher level than is the case for the other samples.

6.7 Additional Information from Sociological Studies

Differences in attitudes between different groups

When talking of "the community" or of "community involvement", it is often implicitly assumed that there is a homogenous entity, not the reality of varied interests, perceptions of problems and differing priorities.

For example, as would be expected, there exists greater willingness to pay for water resources among women than among men. Women are the carriers of water and often have to walk long distances, frequently with children on their backs, to fetch water. In one group, women pointed out that they had started digging a well by themselves because the men had declined to assist. However, the men later joined out of embarrassment at watching their womenfolk digging while they were drinking beer. Discussions with men did indicate that women's problems where water is concerned are appreciated, despite the fact that men do not generally consider a protected source a priority item.

[redacted] show a different level of perception of the importance of payment for water and other resources. Leaders meetings indicated that in most cases they appreciate that there is a need for contributions to be made towards the provision and maintenance of the water points. However, they appeared reluctant to openly support such views to the general members, who would denounce them and refuse to elect them for further terms [redacted]

Business owners and non-business owners appeared different in their perception of their role in the provision of the water points. The business owners have greater awareness of the value of protected water and often appreciate that these services cost money to provide and their rejection of paying for provision of water stems only from their low profits which they argue are due to low patronage and high transport costs. However, they readily express willingness to pay for protected sources if these contribute towards the [redacted]

Community responsibility for water

Water is a community affair in Zimbabwe's rural areas, with the provision, use and maintenance of such water points being of concern to community members, or, more accurately, to particular groups within the community. Eagerness to participate in water related matters is high where there is little demand on the individual in the form of contributing in either physical or monetary terms to construction or maintenance. The discussion of protected sources that would require both labour and financial contributions were found to elicit a lower level of enthusiasm within the communities visited.

Role of VIDCO's and water/health committees

VIDCO's have embraced the role of lobbying for the provision of additional protected sources. Villagers in the study areas on the whole expressed the view that these were the right functionaries to perform such tasks and that so far they had shown competence in dealing with donor agencies and Government personnel involved in water provision. The only dissenting voice was from local business owners who doubted the competence of the VIDCO's, which they felt to have failed so far in representing their requests for piped water schemes at business centres.

Village water committees (VWC) exist in both Buhera and Chihota, but were found to be more active in Buhera. Usually the VWC consists of two women and one man. The man takes care of tightening bolts and greasing the moving parts, while the women members clean the surroundings and monitor the correct use of the pump mechanism. It is felt in some quarters that precisely because it is women who are traditionally responsible for water and sanitation, it should be men who are on the VWC, aas they would then be forced to see and understand the problems that the women face.

Available structures for paying mechanisms

Within the study area, there is no clearly defined structure for paying for the maintenance of primary water supplies. When asked about how payments could be collected, it was suggested that the water committees or the VIDCO could be utilised, along the lines of the way parent-teacher associations collect funds for schools. The committees would select a trusted member as the treasurer, who would collect monies from persons who use the well for deposit in a special bank account.

The funds thus generated would be used for any repairs. The account would have to be audited from time to time, and it was suggested that this be done by experts from the Ministry of Local Government. Others suggested that local councils should collect such monies, but it was pointed out that this would require changes in their by-laws which presently do not allow for the collection of money from the people.

Maintenance, repair and conservation practices

Although the villagers accept that they are the beneficiaries and the users of the new protected sources that are being installed, when the issue of breakdowns is raised, they strongly assert that dealing with breakdowns should be the responsibility of Government or the donor agency.

Villagers within the study area appear to see their role in maintenance as mainly preventative, for example in preventing vandalism of the pump mechanism. The actual repair is seen as the Government's responsibility once there is a breakdown. This view is particularly manifest in Chihota where local people indicated that they we-e never informed that they should pay for any maintenance of the bucket pumps, which they view as SCF or Government property. In Buhera, the village water committees do accept responsibility for primary bolt tightening and greasing. Major repairs are, however, deemed to be the responsibility of Christian Care and the DDF personnel who brought in the technology.

The role of donor agencies and the impact of donor assistance

Donor dependence was found to be deeply entrenched within the people's minds. Donor agencies are often viewed as an arm or department of Government, so that any materials supplied by SCF or Christian Care are viewed as from Government. Although the protected water points are highly appreciated by the communities, they are of the opinion that donor agencies and the Government should provide them with all types of technology without charge.

Community members did say that they would willing to contribute unskilled labour if required, but money for water points they do not have. Business owners in Buhera pointed out that there was an imbalance in the provision of infrastructural services between rural and urban areas. Whilst the latter have highly developed infrastructure subsidised by Government and other donor agencies, the rural areas lag behind in all infrastructure, yet rural people are expected to make financial contributions.

On the other hand a small group of market gardeners in Chihota expressed their appreciation of the enormous demands to Government resources from competing ends. They do not expect the Government or donor agencies to supply them with everything. However, their constraints include the problem of raising the necessary capital or loan and it this that they believe leads to high donor dependency.

Water for income-generation purposes

People expressed the view that they would be more willing to pay for a water source that could be utilised for income-generating activities. Some local farmers in Chihota indicated that they are already paying large sums of money purchasing and maintainaing engines that pump water from their wells to the gardens. They would certainly be willing to make contributions if better supplies were to be made available.

Generally, rural populations in Zimbabwe depend on water mainly because they survive on agricultural production eg garden wells for vegetable production in Chihota and rain-fed crops in Buhera. Focus group discussions in both areas revealed clearly that water can only be utilised for other activities besides domestic use if the quantitites are vast and unlimited. Communities in both study areas have formulated unwritten laws about what the activities for which water from protected wells can be used.

These always include drinking, cleaning utensils and food preparation. Water from protected sources can be used for other purposes such as laundry, if the amount available is viewed as more than sufficient for the basic domestic uses. Besides the dominant income-generating activity of gardening, participants in focus group discussions in the two study areas expressed different needs for which they would use water if it were available in sufficient quantities, these including beer brewing, brick-making and livestock keeping. The dichotomy between domestic use and income-generating activities is particularly marked in Buhera, which suffers from acute water shortage.

Market gardeners in Chihota clearly stated that they do not consider water from a protected source fitted with a bucket pump to have any relevance to market gardening. For this, they would prefer boreholes that must be fitted with diesel engines so that water can be pumped to storage tanks. Pipes would then be connected from the storage tanks straight to the garden. Alternatively, they would consider small dams as a source of water for irrigation. In Buhera, the local people indicated that only small or medium sized dams would be suitable for market gardening.

It is important to point out that the different categories of groups involved in group discussions expressed different needs for water. Business owners would like to use water from protected sources for cleaning their business premises, for their customers to drink, for those with grinding mills that are water cooled, for hotel guests and for brick-making. Members of farmers clubs and other related clubs would require water for projects such as poultry, cattle fattening, brick-making and fruit tree growing for commercial purposes. Older men and women identified market gardening as the main activity but also stressed beer brewing.

Discussants within the two study areas indicated that where a water point is provided for the community, they would discourage individual use for income-generating activities. This is particularly so in the case where all members of the community are participating in maintenance of such a source. If any income generating activities are to be undertaken, they should thus be on a cooperative basis. Such activities would have to be defined clearly, so that they do not affect the overall supply of water to the community. A water point specifically designated for income generating activities would be welcomed, rather than just using one that is intended primarily to satisfy for domestic needs.

7.1 Willingness to Pay

The willingness to pay figures obtained from the fieldwork and reported in Section 6.6 are very modest. More important perhaps than the numerical results is the finding from the sociological work that the rural communities surveyed do not consider the boreholes and wells with bush and bucket pumps as belonging to them, or that they should take primary responsibility for their repair. If taken seriously, this would put a major question mark over the sustainability and replicability of Zimbabwe's entire rural water supply programme. The fact that these findings arose from areas where NGOs sympathetic to community involvement had been responsible for execution of projects, suggests that they should indeed be taken seriously.

These findings are, however, to be seen in the overall context of rural Zimbabwe, some water-related aspects of which were highlighted from the fieldwork findings in Sections 6.5 and 6.7. Firstly, the people's traditions do not allow water to be paid for. Water is a resource which belongs intrinsically to all. Notwithstanding this, it is recognised that improved water supply technologies such as pumps do have to be paid for and while people do not feel able to meet capital costs, there is greater preparedness to accept responsibility for maintenance. Secondly, the rural people were promised a great deal during the liberation struggle, with a secure water supply surely being regarded as one of the most fundamental. While people in towns enjoy highly subsidised piped schemes, rural dwellers are now called upon not only to contribute in kind to the capital costs of improved supplies, but also to pay for their maintenance.

The conclusion to be drawn from the foregoing is not that the rural water supply programme should be halted or drastically curtailed. Zimbabwe will not be littered within a short period of time with wells and boreholes which are not functional. Rural people are right to demand that promises be fulfilled and act rationally when trying to get as much as possible out of the government - donor system, through, *inter alia*, introducing a heavy dose of "strategic bias" (see Section 2.2) into responses to rural survey work which evidently has something to do with Government policy-making. That is not to say, though, that communities do not also recognise that if they don't take the lead in projects, they will not get what they want and need, and if they don't themselves take responsibility for maintenance the pumps will cease to function. It has perhaps taken a few years, but the results from this study suggest that people are increasingly aware that the post-independence reality in the rural areas is very different to that for which they had hoped.

Whether or not such expectations were misplaced is discussed in a wider framework in Part II. Government's policy response at this point is to move towards a significant degree of decentralisation, and in this the water and sanitation sector is in many respects taking the lead. If the serious intentions of Government are pursued to their logical conclusion, the consequences will be profound. No longer will projects be implemented in a top-down fashion, implying, in respect of water, boreholes and wells being to a greater or lesser extent foisted on rural communities, which are then subsequently expected to pay to maintain them. Instead, communities will be empowered to define their own priorities, undertake their own projects and maintain their own infrastructure. This is not to say that there will be no support and back-up from national structures (such as DDF), but that the locus of power and decision-taking will be at the district level, not at the centre as has been the case in the past.

In respect of finances, decentralisation which is oriented to local decision-making and accountability cannot be achieved without districts having direct control over their own finances. Resources in rural areas such as Chihota and Buhera are such that locally raised financing would inevitably fall far short of requirements to provide and maintain even a modest level of infrastructure and services. ~~Mechanisms have to be derived so as to allocate central funds equitably to the districts. Once such a system is in place, it would then be logical and politically much more acceptable for charges to be levied from the users for the provision of services such as water.~~ If it is Government's intention to move in that direction, communities should now be alerted to the fact that they will in future have to make a water payment; without this being included in present community mobilisation efforts, the task of mobilising communities for this will become progressively more difficult in future.

Without real decentralisation being implemented, such charges could still be levied by government fiat, but the expectation that requiring communities to contribute to maintenance of water points would give rise to a greater feeling of ownership and responsibility, would appear, from the results of this study, to be totally misplaced.

7.2 Methodology

A good deal of emphasis is being laid in this study on methodological issues. A brief introduction was given in Section 2.2, where three different types of bias were defined. Having presented the quantitative results, this section discusses the extent to which these results might have been affected by the different types of bias. The comments to be made are necessarily impressionistic, being derived mainly from the overall response of the communities to the study and from the results of the focus group discussion. They do provide, however, a rationale for why the econometric analysis produced little of statistical significance. Finally, some comments will be made about the general study objective of coming up with a simplified survey method which could be used with confidence in the design of rural water projects in a wide range of settings.

~~The previous section makes clear the team's feeling that the quantitative results from Zimbabwe are significantly, perhaps even irredeemably, affected by "strategic" bias.~~ Despite our attempts to downplay the influence of the study, the communities seemed well aware that such exercises provide the basis for policies made at the national level and responses might therefore be biased towards what the community would like to see happen. From this, it could be said that the concern about reported WTP being too low to contribute significantly to pump maintainance may be misplaced. ~~WTP could well be higher, with the strategic bias arising not only from households perceiving that the study may lead to changes being imposed, but from the opportunity being taken to send a message back to the powers that be of the promises made to rural people during the liberation struggle.~~

The other forms of bias can conveniently be discussed in connection with the comparison of the Zimbabwe results with those from the other country studies. To date, only some preliminary results from Brasil have been made available; the WTP graphs (Figures 4-6) were provided to facilitate comparison with those drawn by the Brasil team. The discussion of those graphs in Section 6.6 did make it clear, however, that the Zimbabwe results are not as predictable as the Brasilian ones. Taking a step backwards from the results into the methodological domain, a rather profound scepticism would have to be expressed about the Zimbabwe graphs. They imply that there is a trade-off in the minds of the respondents between charges for water use and the likelihood of using the improved water source, a conscious link which was not at all obvious among community members who took part in focus group discussions.

[redacted] (discussed further in Part II). [redacted] The peculiarities of the Chihota B curves, which were explained in Section 6.6 in terms of "compliance bias", add further weight to the conclusion that the graphs do not make sense in the context of rural Zimbabwe.

This raises a fundamental methodological doubt. [redacted] If it is the community which benefits and is to have responsibility for the water point, then an approach to the community rather than the individual household would seem more appropriate. Of course, there would then be other types of bias with which to contend, but nonetheless some form of community or group dialogue or mobilisation would seem to be more promising for Zimbabwe than the search for a "simplified survey method".

7.3 Phase II of WTP Study

Although aspects of this study have proved disappointing in terms of providing directly usable results, much has been learnt and important policy directions can be identified and justified once the WTP issue is placed in a wider context; this is the objective of Part II of this report.

The original TOR of the study call for the B sites to be resurveyed 12-18 months after the installation of the improved water sources. The information collected *ex post* is then to be compared with that obtained *ex ante*; comparisons with the A sites in each of the study areas is also to be made. These tasks will certainly be carried out in Phase II, but the team would also want to include investigation of a number of issues that have arisen as a result of Phase I and other work being carried out in the sector, the main examples being:

- Why do nearly 40% households in Chihota A not use the protected sources even for drinking, despite a high level of awareness of the link with health?

- Households in Chihota expressed a preference for the Bush pump over the bucket pump, and also for diesel pumps for irrigation. On national equity grounds, it would not be justified to install more expensive technologies where clean water can be made available with bucket pumps, but is the community preference strong enough for the price difference to be made up by the community itself?

- Similarly, are there ways of widening the choices available to communities in Buhera early on in project planning?

- What sort of dialogue with the community would give the right sort of information for project planning, not only in respect of technology choice, but implementation and subsequent operation and maintenance? Would some form of household interview be a useful complement?

- Can the distinction between maintenance of the pupms and repair of breakdowns be more carefully defined so as to maximise the community contribution and clarify the different roles of each tier of the maintenance system in different areas?

- How can the decentralisation concepts being advocated and put into practice in the water sector be put across at the village level?

Comments on this are sought from the NAC and the Bank.

8.1 Rural Households

A total of 100 members of rural households near Murehwa were interviewed. Of these 62% were women, mostly with primary education. Ideas about what a growth point is or is supposed to be were very hazy, but most respondents stated that Murehwa had changed since becoming a growth point. With more shops, buildings, goods and buses available respondents have benefitted, but the lack of significant employment growth is of concern. The employment issue is central to growth point policy and is taken up in more detail in Chapter 11 of Part II. The remainder of this section deals with attitudes to accommodation and services available in Murehwa, particularly in respect of piped water.

The respondents thought that only 72% of people living in the growth point were better off than those in the rural areas due to access to better facilities. Most of the respondents did not themselves want to live at the growth point itself for several reasons. Firstly, they were sufficiently close to have reasonable access to its services. Secondly, any movement to the growth point would have entailed uprooting themselves from their traditional homes and source of livelihood, with all the social costs attached to such a move. Thirdly, they viewed their own homes as being free, while at the growth point they would have to pay rentals or build costly houses because of minimum standards required for such housing. Finally, they would only have moved to take up employment opportunities.

However, despite the above disincentives to moving into growth points, 20% of the respondents indicated their willingness to move into the growth points. Their main motivation appeared to be that they had heard about the "good life" at growth points, this being said to include access to clean piped water, electricity and close proximity to the shopping area.

Electricity appeared to be highly valued by those who might decide to move into a growth point. Some 80% expressed interest in having electricity, prefereably for both lighting and cooking. Estimates of connection charges for electricity were realisitic, ranging from \$50-\$400, as were most of the responses on monthly charges (\$25 to \$35 per month).

Water was also regarded as paramount by would-be migrants, with 70% expressing a preference for in-house piped water. Estimates of connection charges for piped water were relatively lower than for electricity, within the range of \$5 to as high as \$250. Monthly payments envisaged for water use varied between 10 cents and \$20.

8.2 Employees

Of the 60 employees interviewed, 58% were civil servants or parastatal employees, 42% employees of shops or other small businesses. Most of the respondents (72%) were men who had lived in Murehwa for around 4 years (median - mean of 6 years). In relation to the rural households and even the business owners, the reported income of this group was high: a median of \$341 and mean of \$482 per month. The means of reported monthly expenditures were \$10.93 on rent, \$3.93 on electricty and \$1.57

on water, with median water usage of around 1 000 litres. Overall, 80% reported access to flush toilets and 55% to house taps. Very few households had paid connection charges for either water or electricity.

Figures such as the 80% for access to flush toilets can give a somewhat misleading impression. Accommodation is an acute problem at Murehwa, particularly for the parastatal and non-government employees. While Government and council employees generally had access to some form of housing provided by government and district council respectively, other employees did not. The Grain Marketing Board, for example, one of the largest parastatals at Murehwa, had 127 of its employees living in small tin houses, many of them sharing with other employees rather than having their families living with them. Most employees of retail outlets were housed in crowded illegal outbuildings on the business stand. One room housed as many as three employees, with tremendous pressure on utilities such as toilets and bathrooms.

Where government or council houses have an electricty connection, they are generally of the load limited type which is only suitable for lighting. Among non-government employees, only 10% have access to electricity, with the majority depending on paraffin and candles for cooking and lighting respectively. Monthly elelctricity bills vary according to use, with charges ranging from $3 to $54. Payments are made either to the local council or directly to ZESA. Telephone services are rarely connected in individual homes, eg only 11% of the government employees interviewed had telephones.

8.3 Business Owners

Of the 28 business owners interviewed, 90% were engaged in commerce (retailing or wholesaling, most being general dealers) and 10% in manufacturing, albeit on a very small scale (carpentry). Most of the respondents (75%) were men who had lived in Murehwa for a longer period (mean of 10 years) than they had been in business (6 years). In giving reasons for locating business in Murehwa, 40% said that it was their home area, the rest pointed to favourable market conditions with the rapid growth of Murehwa in recent years. Most of the businesses were very small, with only four of them employing five or more employees. Within a large range from $150 to over $10 000 per month, median turnover was about $1 500, with reported monthly median drawings of $267 (mean higher at $440 per month).

Most business premises were rented, the median rental being $160 per month. About half had electricity, while 70% had piped water, but only about 30% had had to pay connection fees. In some cases a flat charge was being paid for water, in others a volumetric charge, with the median of those reporting on the amount paid being $13.50 per month. With a similar proviso that only half responded, the average (mean and median) usage was about 1 200 litres per month. Only 68% reported that the flow of water is always sufficient for their needs.

As regards their residential accommodation, overcrowding in small and often dilapidated buildings was observed to be characteristic, with many small business owners living in illegal structures at the back of their shops. Most shared toilet and bathing facilities, with one third having access to flush toilets and half to indoor piped water. Only 20 % reported on payment for water, giving a median of $15 per month, with median quantity from a larger sample of 1 700 litres. About one third would like to use water for income generating projects, principally gardening, but the common problem there was small plot size. As regards electricity, 29% have electricty for cooking and lighting, with a further 14% have load limited supplies suitable for lighting only. Only 10% had had to pay water or electricity connection charges. Almost all the households were dissatisfied with their accommodation, on grounds of size, standard of construction, lack of sanitation, electricity or piped water.

8.4 Willingness to Pay for a Piped Supply into the House

It is difficult to guage people's WTP in a situation where there is no definite policy on water provision and use. While almost all residents use free water from standpipes to some extent, only some of those who have access to in-house piped water actually pay on a monthly basis for this. Amongst employees, 55% reported having access, but only 45% of these to be paying; the corresponding figures for the business owners group were 50% with access, with 55% of these paying. It is thus not just those government and council employees who have water provided as part of their conditions of service, but also other residents, including some business owners, who *de facto* do not pay for piped water.

In the bargaining game for employees, with the connection charge fixed, the median monthly WTP was found to be $3.50, while with monthly payment fixed, the WTP median connection fee was found to be $32 (range $0 to $400). In the business owner bargaining game, with the connection charge fixed, the median monthly WTP was found to be $8.50, while with monthly payment fixed, the WTP median connection fee was found to be $67. For business owners not living on the premises, being asked about WTP for business use only of piped water, the corresponding figures were $11.50 and $110. Other than giving orders of magnitude, these average figures are not very illuminating, as they cannot be directly compared to those given for the median of what is presently being paid. Presenting the results graphically (Figure 7), it can readily be seen that [redacted] In the first instance, cost recovery could be markedly improved by applying a more consistent policy with respect to payment for piped in-house water and ensuring that tariffs are collected from all users on an equitable basis.

8.5 Methodology

Despite the relative complexity of the two-part bargaining game, respondents reacted positively to it and gave answers which were "reasonable". Whether they were unbiased is another matter. The fact that the answers are clustered around more-or-less the charges that are presently in force could reflect more of a variant of "compliance bias" than a statement that those values are appropriate. There may also have been "strategic bias" in that the levels of income are relatively high in relation to the WTP responses; the strong desire expressed for in-house piped water has also to be taken into account.

The important observation made in the previous section about the lack of a clear and consistently applied policy on water charges in Murehwa also has an important bearing on whether the results were biased. In Phase II of the study, it would be interesting to investigate whether conditions for implementing the bargaining game successfully have improved and to do some follow-ups with respondents from Phase I. More importantly, perhaps, would be to examine whether the initiatives being taken by the Urban Development Corporation are bearing fruit in terms of higher growth rates and expanding employment opportunities. These comments refer to the wider framework of growth point policy, which is discussed in some detail below in Chapter 11.

Figure 1 : Bargaining Game - PWS

APWS-16
1 - 4

BARGAINING GAME

" As you know, it costs money to maintain an improved water supply (borehole or protected well). Imagine that you had to pay an annual charge to cover the maintenance costs of the improved water supply you use. If you paid, you could continue to use the supply. If you did not pay, you would not be allowed to use the supply."

- Discuss with respondents to make sure they understand clearly

INTERVIEWER - starting with the 25c annual charge, follow through the bargaining game diagram below, changing the value at each step until you get to a **

- make the dotted lines solid according to the sequence of replies and circle the final value

QUESTION:

If the annual charge was (25c) per family, would you choose to pay and use the borehole (or protected well) or not pay and only use unimproved sources?

ANSWERS:

Pay annual charge and use well	"Yes"	Y }	Trace out the answers and
Use unimproved sources	"No"	N }	ask subsequent questions

Not known If this reply is given:

Explain why respondent doesn't know:

5

1 Respondent refuses to take game seriously
2 Respondent is not sure
3 Other (specify) ....

```
          Y                      Y                        Y
25c - - - - - - - $3 - - - - - - - - - - - - - - $10 - - - - - - - - - - ** $10
 :                :                               :
 :                : N                             : N
 :                :                               :
 : N              :         Y                     :        Y          Y
 :                $1 _ _ _ _ _ _ _ $2             $5 _ _ _ _ $7 _ _ _ _ ** $7
 :                :               : :             :          :
 :                : N        N    :  : Y          : N        : N
 :                :              :    :           :          :
 :                :              :     :          :          :
**                **            **     **         **         **
ZERO              25c           $1     $2         $3         $5
```

CHECK - with respondent that the value deduced at ** is the maximum amount household is willing to pay

- record maximum amount household is willing to pay:

$ c

6 - 9

Figure 2

BARGAINING GAME - BUSINESSMENS' RESIDENTIAL USE

INTERVIEWER - confirm by checking with the respondent which "water category" they are in:

Type A - not connected, but would consider being connected

Type B - is connected and paid connection charge of $ .... c ....
(enter ZERO or actual amount, INCLUDING security deposit)
AND
- pays flat amount for any quantity of water of $ ...... c ......pm

Type C - is connected and paid connection charge of $ .... c ....
(enter ZERO or actual amount, INCLUDING security deposit)
AND
- pays amount that depends on the quantity of water used, average being about $ .... c .... pm

Respondent is Type .... and pays monthly $ .... c ....

Check to confirm how much water is used per month, if known: .... lts

BARGAINING GAME 1

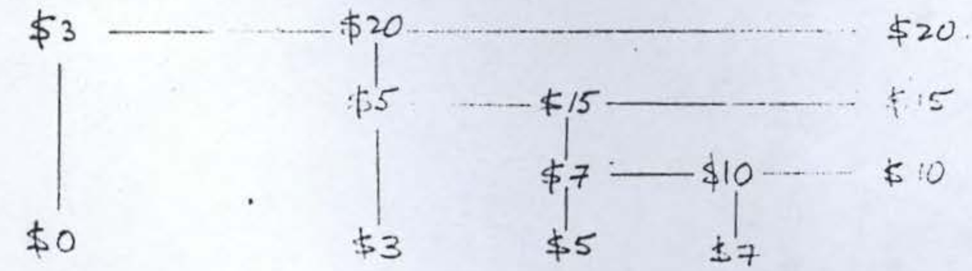
CONNECTION FEE FIXED AT ACTUAL AMOUNT [ZERO FOR POTENTIAL CUSTOMERS]

QUESTION TO "A" RESPONDENTS:
"Suppose there was no connection charge and you only had to pay for piped water on a monthly basis.
If you had to pay [$$ from diagram starting at $3] per month for enough water for your household needs, would you agree to a piped connection?"

QUESTION TO "B" RESPONDENTS:
"If your monthly bill went up to [$$ next value on diagram], would you continue to use the water, or ask for the piped water to be removed and resort to using other sources?"

QUESTION TO "C" RESPONDENTS:
"If your monthly bill went up to [$$ next value on diagram], would you continue to use your present quantity, or reduce it dramatically (by more than half) or perhaps ask for the piped water to be removed and resort to using other sources?

Example:



CHECK that the amount found is the MAXIMUM that the respondent is willing to pay
Maximum amount: $ ....

BARGAINING GAME 2
MONTHLY CHARGE FIXED, CONNECTION CHARGE AS A VARIABLE

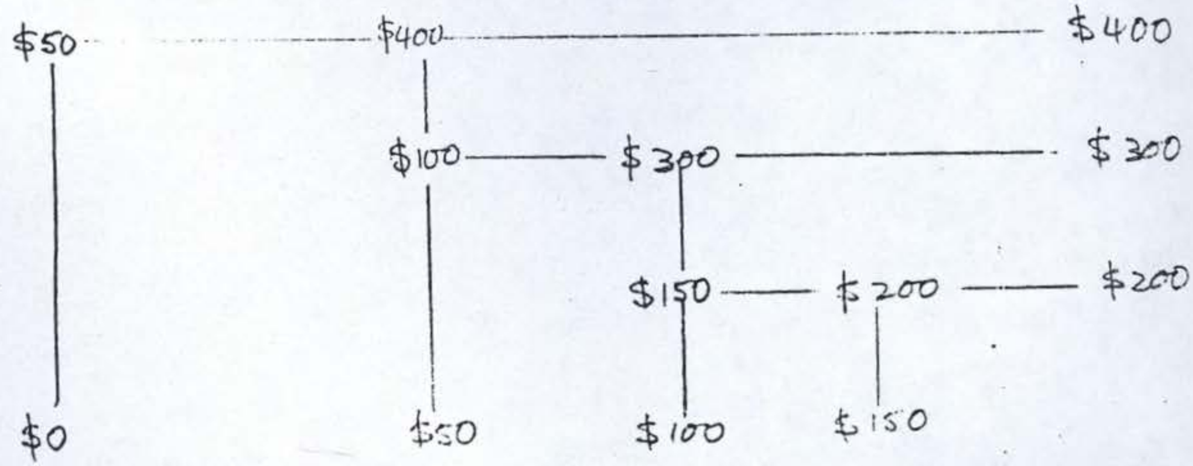
From Bargaining Game 1, respondent is willing to pay $ .... per month.

The next lowest value out of 3, 5, 7, 10, 15, 20 is $ ....

Ask respondent to imagine that monthly charge is now fixed at that amount.

QUESTION:

If you had/would have had to pay a connection charge, including a security deposit of [$$ from diagram starting at $50], as well as the monthly charge of $ ...., would you still want/have wanted to be connected?"



CHECK that amount found is MAXIMUM respondent would be willing to pay as a connection charge (including security deposit) if the monthly charge is set at the level specified

Maximum amount: $ ....

IF BUSINESSMAN DOES NOT LIVE ON PREMISES, do second Bargaining Game for business use on separate sheet

ANY OTHER COMMENTS

....

....

....

....

....

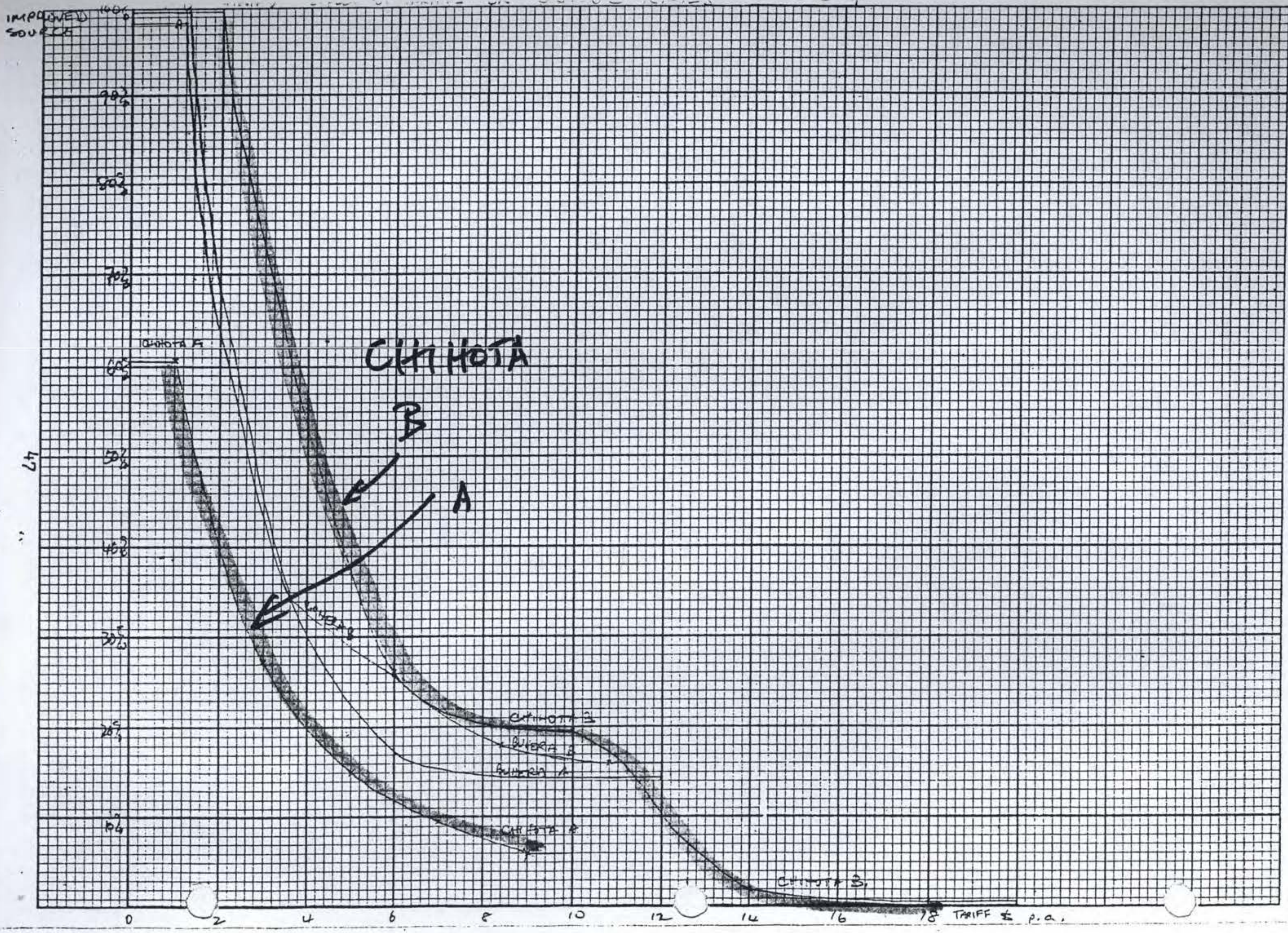
....

Figure 3 : Income Range Card

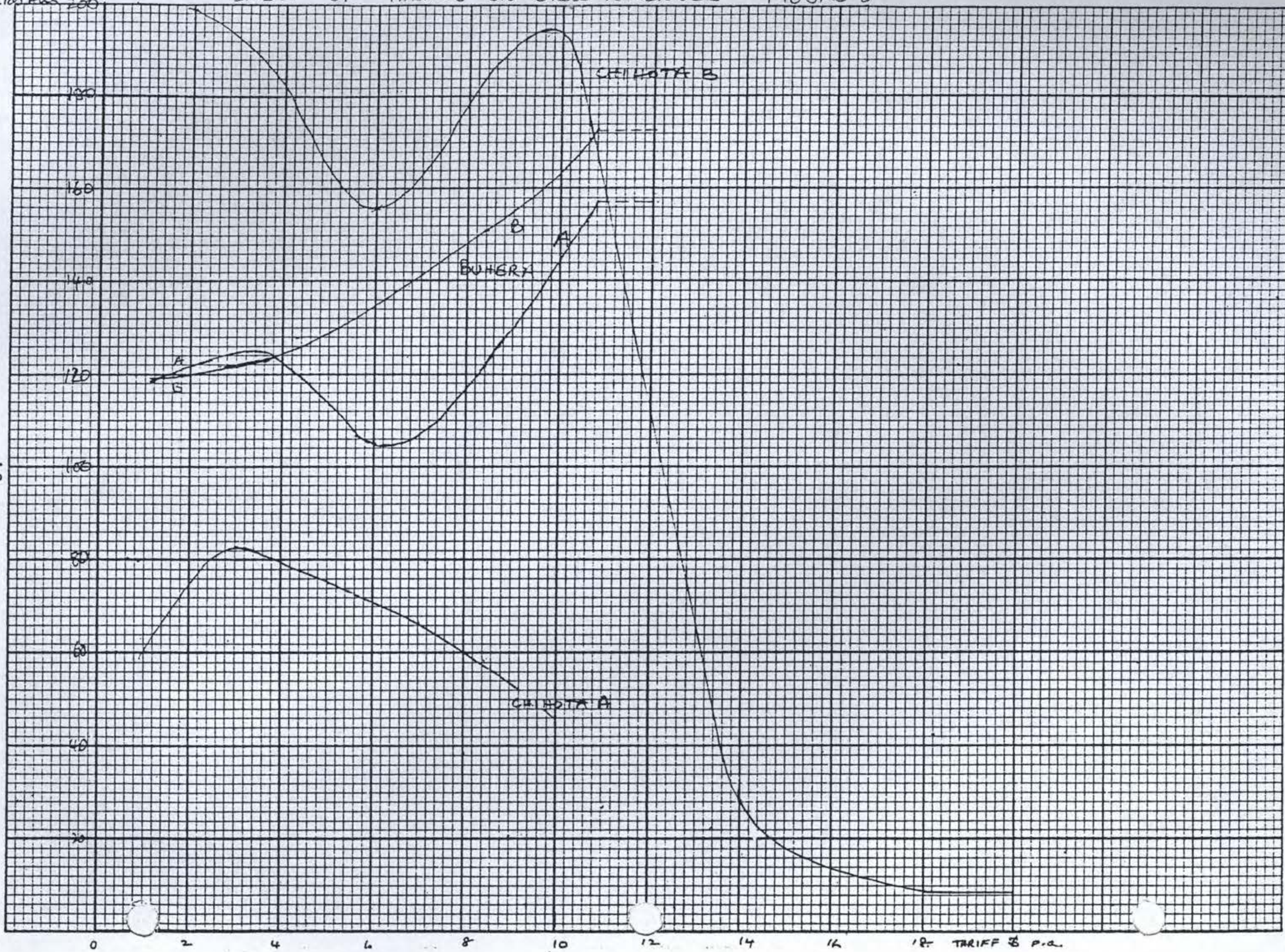
WORLD BANK WTP STUDY - ZIMBABWE

INCOME RANGE CARD

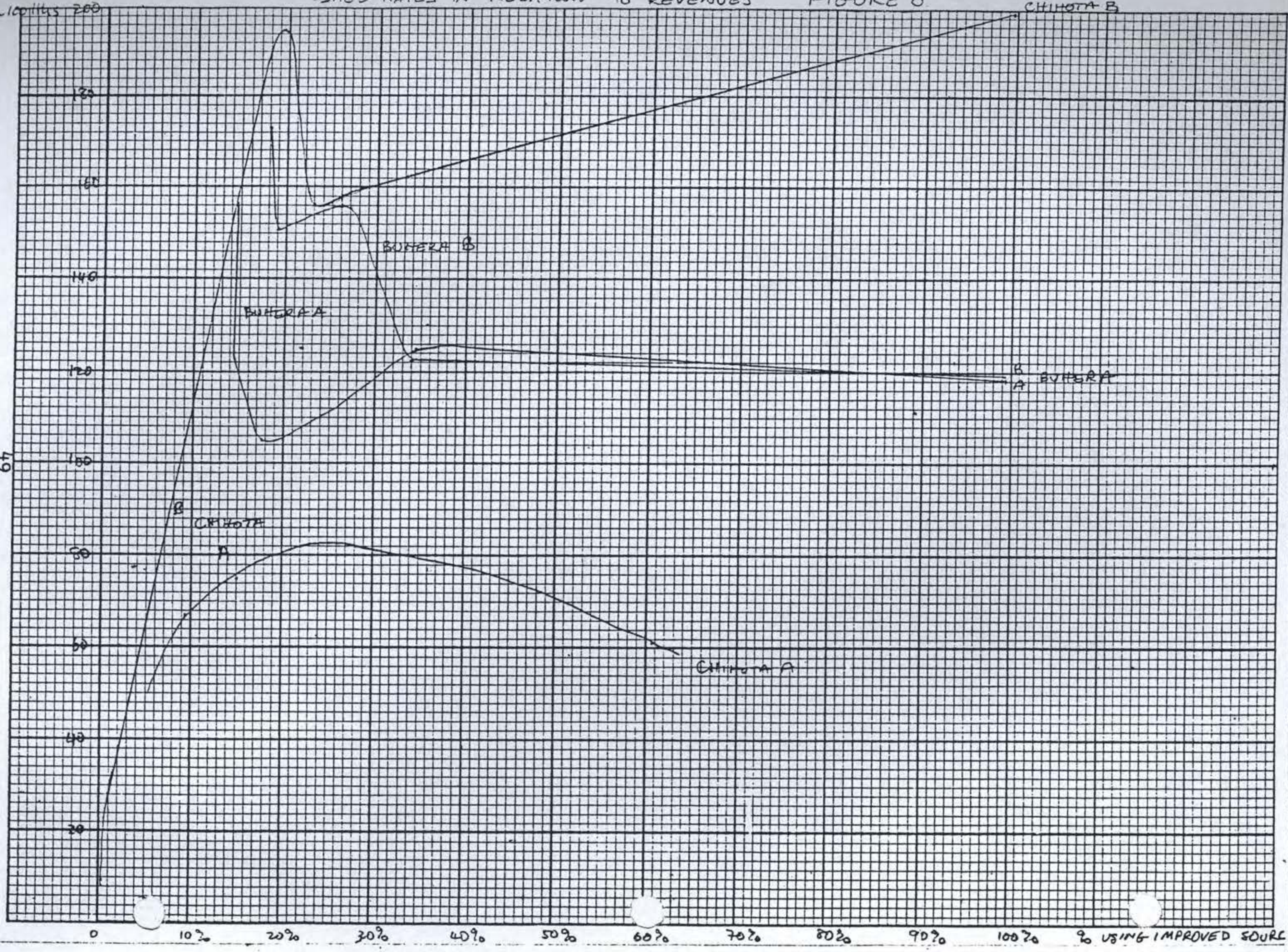
Per month	Code	Per year
Less than $25	01	Less than $300
$25 - $50	02	$300 - $600
$50 - $75	03	$600 - $900
$75 - $100	04	$900 - $1200
$100 - $150	05	$1200 - $1800
$150 - $250	06	$1800 - $3000
$250 - $500	07	$3000 - $6000
$500 - $750	08	$6000 - $9000
More than $750	09	More than $9000


IMPROVED SOURCE
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0
2
4
6
8
10
12
14
16
18
TARIFF £ p.a.
CHHOTA
B
A
CHHOTA A
CHHOTA B
BUHERA B
BUHERA A

EFFECT OF TARIFFS ON GROSS REVENUES FIGURE 5

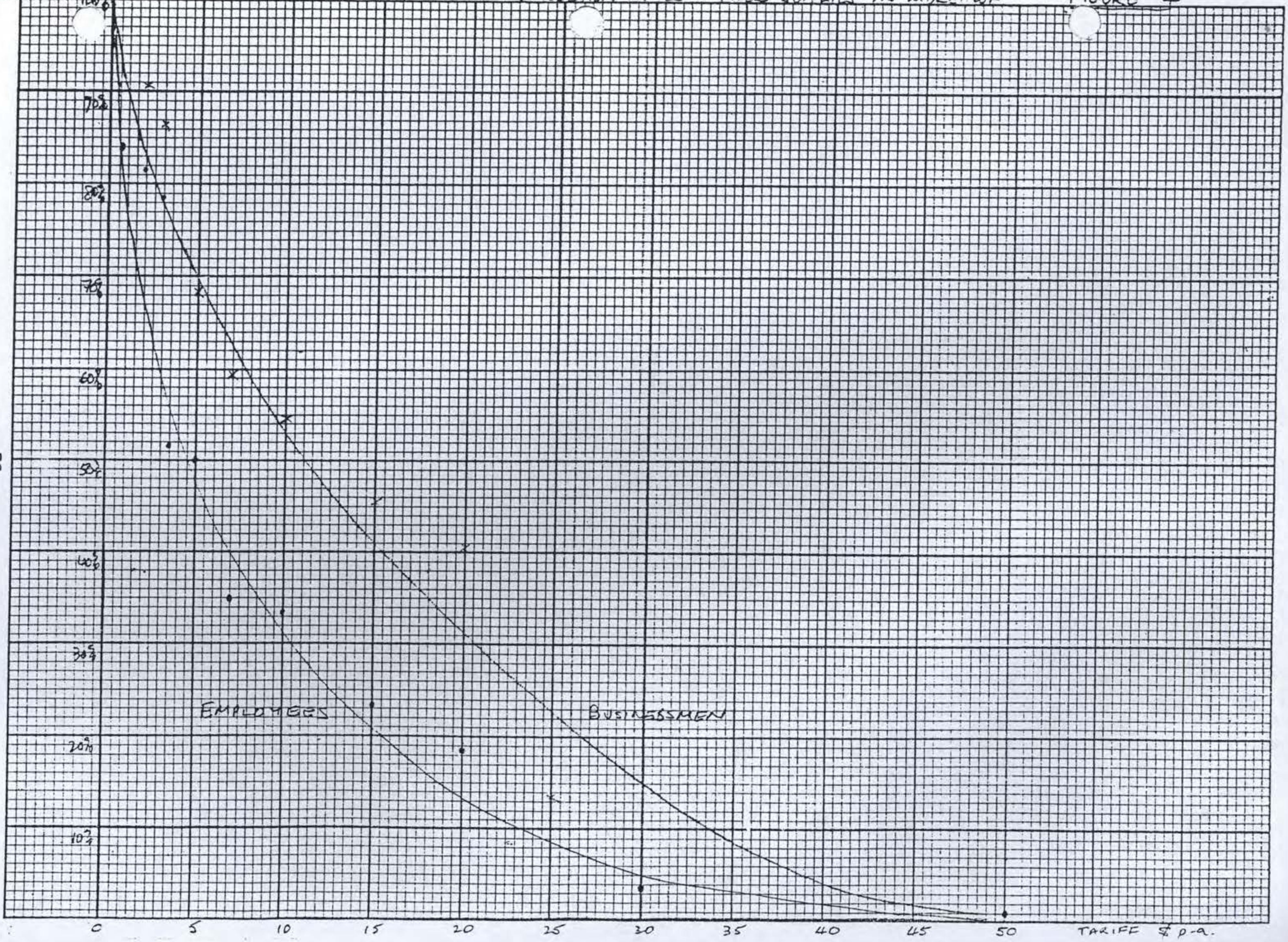


...RATES IN RELATION TO REVENUES FIGURE 0



EFFECT OF TARIFFS ON CONNECTION RATES - PIPED SUPPLIES IN MIRENWE

FIGURE 7



PART II : POLICY IMPLICATIONS

CHAPTER 9 : THE WATER AND SANITATION SECTOR IN ZIMBABWE

9.1 Background

The inadequacy in the provision of services such as clean water in the rural areas of Zimbabwe is a historical legacy from the pre-independence era. Indeed, although land is usually cited as the prime issue in the liberation struggle, a more comprehensive view would include the entire structure of discrimination in access to resources and provision of services as factors.

Except in so far as it came to be recognised at the end that something had to be done to "win the hearts and minds of the people", throughout the UDI period resources were concentrated on the areas where the whites were living. Using the new terminology, this implies a privileged legacy for the "low density" areas (LDAs) within the urban areas and the large scale commercial farming areas (LSCFA) falling under Rural Councils in the rural areas. The LDAs and LSCFAs are economically productive and have a substantial tax base which can be tapped to provide the funds for the provision of services. At the local level, these areas have administrative structures which permit a high degree of autonomy.

The "high density" urban areas and the communal lands stand in marked contrast to this. Neglected in the past, these areas are economically dependent and have an insufficient revenue base to generate the funds needed to provide an adequate level of services. Local administrative structures, particularly the District Councils, are totally dependent on central government for funds and have very little autonomy in decision-making. Unfortunately, the overwhelming majority of the people are to be found in these categories, with approximately 22% of the population in the urban HDAs, and 74% living in the rural areas either as peasant farmers in the communal areas or farmworkers in the LSCF sector. Even within the communal lands, there are enormous disparities, with those farthest from the centre being in extremely marginal areas climatically and ecologically.

Despite the efforts of Government to redress the imbalances of the past, huge disparities between the level of services enjoyed in the different areas remain. [redacted] but the unseen consequence of this is a lack of resources to provide even the basics in the rural areas. Even in the sectors on which Government has focussed its equity orientation, such as health, progress in reducing disparities is extremely slow. It is only relatively recently that priority has started to be given in rural development to the marginal communal lands on the periphery; the water sector, for example, is now urging donors and NGOs to focus attention on such areas.

9.2 Progress in Rural Water and Sanitation since Independence

Government has since Independence placed considerable emphasis on improving water and sanitation in the communal lands. Assistance has been forthcoming from a large number of donors and non-government development organisations (NGOs), with projects being executed throughout the country simultaneously. A comprehensive planning exercise, the National Master Plan for Rural Water Supply and Sanitation, was carried out with Norwegian funding during 1984-85. From a 1984 base where only 33% of communal area dwellers were estimated to have had perrenial access to an improved water source and 15% to adequate rural sanitation, the plan seeks to ensure complete coverage over the period 1985-2005. While the plan report runs to 18 volumes and 10 annexes, its scope is limited to potable household water and sanitation in the communal and resettlement areas. The LSCF, urban and peri-urban areas are omitted, and non-domestic water uses are not analysed in great detail.

[redacted] The number of new PWS being installed is thus not a particularly useful indicator of success. The new integrated approach which is outlined in the next section is intended *inter alia* to address this problem and lead to greater sustainability of the water programme, but the implication in the short run is likely to be a drop in the annual number of new PWSs.

There is no ambiguity about the success of the rural sanitation programme and Zimabwe has earned a well deserved reputation in this regard within the context of the International Drinking and Water Supply Decade (IDWSSD). As regards technology, the major achievement was the development by the Blair Research Laboratory of the Ministry of Health of the ventilated improved latrine; this has become accepted throughout Africa as the obvious choice for rural on-site sanitation. In terms of programme implementation, [redacted] with total numbers constructed since Independence exceeding 100 000 by the end of 1987.

9.3 Planning and Institution Building

The success of the sanitation programme can be explained in part by the fact that responsibility lies with just one Government ministry, Health. Responsibility in the rural water sector is necessarily more diffuse, and one of the key recommendations of the NWMP is on the institutional structure for implementation of the plan. Although the plan itself is yet to be formally adopted by Government, the institutional strutture recommended has been established and is operational at the national level and in some "pilot" districts. Activities in the sector are co-ordinated by the National Action Committee for Water and Sanitation (NAC), which is chaired by the lead ministry in the sector (Local Government, Urban and Rural Development), with vice chair from the Ministry of Energy, Water Resources and Development, and membership from the Ministries of Health; Community and Cooperative Development and Womens Affairs; Finance Economic Planning and Development; and from Agritex, the agricultural extension agency falling under the Ministry of Lands, Agriculture and Rural Development. The District Development Fund (DDF), is the operational arm of the Ministry of Local Government in the water sector, as DDF is responsible for construction of wells and boreholes and the establishement of a nation-wide "three tier" operation and maintenance system for all primary water supplies.

Building on the recommendations of NWMP, the NAC has elaborated the concept of integrated, inter-ministerial projects for rural water and sanitation projects and linked this strongly to the Government iniatives to decentralise decision making and responsibility through the structures established in response to the Prime Minister's decree of 1984. These are development committees at village (VIDCO), ward (WADCO), district (DDC) and provincial (PDC) levels. The idea is that the basic planning unit for the integrated projects should be a district, and once a district has been nominated by a province, coverage will be provided to a uniform standard (50 persons per shallow well equivalent, plus 20% overcapacity and 50% coverage of households with BVIPs).

To minimise the role of central Government structures while still making use of the technical skills available, NAC interacts directly mainly with the PDCs, which have the reponsibility for nominating target districts and coordinating at provincial level. The nominated districts have the responsibility to prepare project documents using standard guidelines issued by the NAC and explained, elaborated upon and adated in a series of workshops. Once finance has been secured, the line ministries at the provincial and district level have to execute their respective responsibilities, keeping in close touch with the other agencies involved through regular committee meeetings, as well as informal contacts. It is hoped thereby to achieve the putting across to the village communities of a strong "integrated" message in respect of the links between water, sanitation and health education.

The "three tier" maintenance structure proposed by NWMP is based on the same decentralisation principles. At the first tier, each water point is supposed to have a Village Water Committee (VWC), elected from users of the pump, which has basic responsibilities such as making sure that the pump is not misused; one of its members is the "pump caretaker" who has to tighten bolts and grease bearings. The second tier is the "pumpminder", who is to be trained and equipped to deal with more serious maintenance problems and who will be responsible for up to 50 pumps in 3 wards. At present, pumpminders are DDF employees. The third tier is the DDF District Mobile Team, which has the responsibilty for attending to major breakdowns and rehabilitating old pumps so as to reduce the liklihood of breakdown. This model will not be universally applicable, particularly in respect of the pumpminders (eg three wards in a mountainous area on a bicycle is not a feasible proposition), but is a useful reference point. To date, the three tier system substantially established in more than half of the districts and is reportedly operating satisfactorily in most of these, even though the role of the pumpminder in some districts remains rather undefined.

9.4 Current Problems and Issues

The integrated concept is very new and it would be premature to judge whether it will be nationally applicable, how quickly it will gather momentum and what is to be done about the inequities which if anything will be exacerbated in the short run. In respect of water, though not perhaps sanitation, it is certainly a great leap forward as compared with the previous situation of uncoordinated action by a wide spectrum of agencies, with many instances scant involvement either with the local communities or with district level government officials and thus a very poor chance of sustainability once the donor or NGO withdraws. ~~The most impressive aspect of the NAC approach is the firm commitment to decentralisation as an operational principle.~~ This cannot be expected to operate without major problems, due to the legacy sketched in Section 9.1, but the process of working through such difficulties is likely to have substantial longer term benefits, not just for the water and sanitation programme, but for the achievement of the much larger objective of having local communities take charge of their lives and determine they own path of development. This theme is pursued further in the final chapter, where a cautionary note is also sounded about assuming that all will be well once decentralisation has got as far as the districts.

More directly at the sectoral level, some of the major issues currently being debated relate to how to make the agreed institutional structure work in practice, how to make best use of existing expertise inside and outside Government, eg in NGOs, how to train the necessary cadres at all levels, how to make effective the proposed operation and maintenance system, and how to ensure that the necessary finance is in place for both the capital investment programme and the operation and maintenance of the infrastructure installed. The major theme running through these issues is that of sustainability of the programme, this being closely associated with a sub-theme of community involvement.

One way in which cost recovery from users of improved water supplies is justified is a fusion of these themes, in that it is argued that having communities pay not only makes it possible to extend services further and faster than if resources were limited to what is provided from central Government, but will ensure that people will demand what they want, with investments thus being properly used and maintained. This line of argument is central to the World Bank thinking that underpins the current study and is thus examined in detail in the next chapter.

10.1 International Experience

In their paper, *Water for Rural Communities: Helping People Help Themselves*, authors John Briscoe and David deFerranti give interesting examples of successes and failures in the rural water sector internationally and strongly develop the case for community involvement, in part through the levying of charges for water. The first point to note here from their paper is that many improvement projects in a wide range of situations in different underdeveloped countries have proved to be neither sustainable nor replicable. The principal reason identified is that conventional top-down approaches, with central governments and external agencies taking dominant roles, have been found to be inappropriate. "To mention two examples from many, in a south east Asian project, the government dug wells, installed hand pumps and committed itself to maintaining them only to find that the people continued to use their traditional surface water sources. In an east African project, improvements were built without adequate planning to support the recurrent costs with the result that even though the people welcomed the new facilities and wanted to use them, the systems fell into disrepair and disuse" (p5).

The problem is not, as was once thought, that the available technologies are too complex to be used by rural people, although the characteristics of particular technologies remain critical to the success of projects. Rather it is that communities were not consulted to identify what was wanted, were not involved in the planning and execution of the projects, including the choice of technology, and felt no sense of responsibility for subsequent maintenance.

The argument so far would be acceptable under any political perspective which endorsed decentralisation, but the next step is more controversial, that is, that universal rural water supply coverage using the existing approach would require a level of resources which "far outstrips any realistic projection of what will be available from government budgets and external funding sources" (p6). It is thus avowed that "an integral and essential part of an effective strategy is to mobilise the communities' own resources both financial and non-financial..... a goal of every improvement effort should be to bring closer the day when the community can cover all of the costs of its water service from its own resources" (pp 1-2).

This "seemingly hard-headed and commercial approach" which is expected of the World Bank, is defended with an argument which could be interpreted politically either as left or right. "Treating the people as the objects (not the subjects) of development inevitably leads to unsustainable subsidies which reach primarily those of greater influence and least need, and to malfunctioning and restricted services which leave the lot of the poor unchanged. Promises of free services to all too often result, in practice, in some service for a few and little or none for most" (p2).

As a corollary, it is suggested that "the limited funds from Government sources and donor aid can be conserved and used wherever they are needed most, whether to assist the poorest communities or to facilitate faster economic growth" (p2). In operational terms, the conclusion is that the first essential step in designing a rural water supply project is to ascertain what the community wants and is prepared to pay for. Hence the need for WTP studies.

10.2 The Case for and against Requiring Communities to Pay

The case given in the Bank document for requiring rural communities to pay for water rests on four interrelated arguments. It is instructive in the context of PWS to examine each in turn, from a Zimbabwean perspective:

(1) *Governments and donors cannot find sufficient resources for universal coverage of the rural areas.*

In order to achieve universal coverage by the year 2005, the NWMP envisages the following investments being carried out in Zimbabwe:

Type	Number	Cost pu	Tot Cost	Pop	Cost pc
PWS	58 000	$4 000	$220 m	8,6 m	$25
Piped	136	$830 000	$113 m	0,3 m	$342

Leaving until the next chapter the piped schemes, which clearly, on the grounds of cost alone require much greater user contributions to be justified, it is evident that in 1985 prices the total investment required to serve the bulk of the hitherto neglected rural populace is about $220 million, although support costs would probably double that figure to around $440 million.

That is a large sum, but comparisons with a few post-Independence expenditures in the urban sector provides food for thought. Around 1985, the Harare Sheraton and Conference Centre was completed at a reported cost of $180 million and it is now proposed that Harare will be graced with a new Parliament Building, new government office complex and new municipal complex, each costing in 1985 prices, well over $100 million. Just those 4 buildings exceed the total PWS cost of the NWMP. It hardly needs to be pointed out that the buildings involve not just an enormous capital outlay, but on-going injections of cash with highly intangible returns. Other examples could be given - Air Zimbabwe's Boeing 767s already ordered for the loss-making overseas services will cost $130 million, while the full long-haul re-equipment is estimated in the Five Year Plan to cost $250 million; to that will be added in due course the cost of a new international airport.

By contrast, benefits from improved rural water, while also largely intangible and difficult to measure are universally acknowledged to be substantial - improved health, reduction in time spent in collecting water which can be devoted to more productive or more pleasurable activities, these leading to higher productivity and incomes amongst the poorest segment of the population.

Economic fundamentals can easily be obscured; at base the uncomfortable fact of the matter is that choices are being made between Sheraton Hotels and Boeing Aircraft for the few and bush pumps for the many. In Zimbabwe's case at least, it is not true that the resources are not there; it is a question of political will, the way class positions are being consolidated after the initial euphoria of Independence.

Before moving on to see whether the Bank document's other 3 arguments might be sustainable in Zimbabwe's case, it should be noted that it is also not unreasonable to claim that the bulk of the maintenance costs of the rural programme could be funded by the Government, although in saying that allowance is being made for community contribution at the first tier (the Village Water Committee).

Both the second and third tiers will fall under DDF, which has a budget for 1988/89 of about $1,5 million for the maintenance of handpumps in the districts. Practioners in the field regard this as giving only a portion of the total amount required, which is probably more like $3,2 million (the 15 000 Bush Pumps at about $200 pa account for most of this, transport being the single biggest cost item). Projecting to 2005, the total budget required might grow (in 1988 prices) to about $9,3 million, just over $1 per capita.

Compare this with an implicit subsidy of $3,6 million to Harare users of water in 1985, this amounting to $5.49 per capita (*Tax Commission*, Table 17.18, p 335). Even the poorest households of Harare are better able to pay for services than the rural communities of a place like Buhera. The resources are there; again it is a matter of political choice, whether it is the rural or urban dwellers who receive the largest measure of support. This situation, particularly the urban-rural imbalance, is typical of developing countries and in fact forms the basis for the next argument from the Bank document for user contributions.

(2) *Equity: "when users contribute little or nothing, a part of the population, often a large part, typically remains unserved or underserved because whoever is responsible for the service has insufficient resources to extend and improve systems".*

As the urban-rural imbalance makes clear, this is certainly true in Zimbabwe. But is the problem intrinsic to a situation where users are not charged for services, or is it simply a reflection of the seeming impossibility of the least privileged groups in society to overcome their position of weakness?

Perhaps this is a rather academic question to ask given the mixed track record since Independence. Rural people, especially women, have been called upon to make massive contributions to rural projects of all sorts, culminating in the mis-named Food for Work Programme. This cheap labour input has been dubbed "community participation", even though it has involved little dialogue, local definition of priorities, transfer of knowledge and skills or experience in people making for themselves the decisions that critically affect their lives. In the light of this experience, the rural communities are well aware that without their contribution, the level of service provision will remain inadequate. As was argued in Chapter 7 of Part I, that should not stop them from continuing to push government and donors to provide whatever they can be persuaded to provide, even though what finally emerges is not always what the community wants or needs.

(3) *When not funded by users, financing has to come from tax revenues. "These taxes adversely affect efficiency. They direct resources from productive uses, distort incentives, and involve higher collection costs" (p18).*

This assertion is at the centre of the concerns of the libertarians. Like so much economic dogma, it is true only within the extraordinarily narrow confines of the assumptions of neoclassical economic textbooks, which do not dare to get their fingers soiled with the reality of the real world, particularly with its intractable income and wealth disparities.

Lack of access to clean water surely surely "diverts resources from productive uses and distorts incentives" a good deal more than income taxes. As for collection costs, it is debatable but unlikely that the costs of collecting water charges, if based on quantities used, the ideal situation from an economic theory viewpoint, would be less than collection costs for taxes which are collected to cover a variety of expenditure categories.

(4) *"When users contribute little or nothing, projects are designed and executed without adequate community involvement, resulting typically in capital assets being under-utilised and poorly maintained, thus giving rise to a waste of resources which could have been better used elsewhere."*

The experience of Zimbabwe on this point supports the plethora of evidence cited in the Bank document from other countries. However, as is clear from our Chihota and Buhera research, community involvement is not easily achieved, not least because "the community" is by no means a homogenous entity, but a collection of groups with rather different priorities, interests and resources at their disposal.

Apart from the general problem of mobilising village communities, real involvement would require that the community be able to make a real choice between a reasonable range of alternatives. In practice, there is not really any choice offered, while the level of involvement in the investment stage has come to be standardised in relation to the technologies endorsed at the national level on thoroughly defensible grounds of making possible the training of fieldworkers and the provision of adequate supplies of spare parts for maintenance.

As regards the lack of choice, Government and donors have agreed that the cheapest option should be adopted wherever feasible, ie shallow wells where hydrogeological conditions permit, then deep wells, then boreholes. There is a clear justification for this at the national level, namely to spread available resources as far as possible across the whole country. [redacted] (see Chapter 6 on preference in Chihota for Bush or even diesel pumps and boreholes over the bucket pumps on shallow wells supplied through the SCF project).

The technological options for PWS which are presently endorsed by the NAC are basically a borehole or deep well fitted with a modified bush pump or a shallow well fitted with a bucket pump; Chapter 6 in Part I gives details of the established stylised community involvement packages which have come to accompany these options.

Points to support the case for continuing with the present system of subsidising rural water supplies have emerged in the course of the above discussion, as well as from the results of the filedwork in Chihota and Buhera reported in Part I. The justification for not implementing cost recovery for PWS can be said to have several inter-related dimensions:

(1) *Political debt*

The promises made during the liberation struggle to the rural people who made the overthrow of the previous regime possible, need to be fulfilled.

(2) *Equity*

Government is committed to equity and yet gives larger subsidies to the relatively well off urban areas. [redacted]

(3) *Humanitarian considerations & health cost-benefits*

The import of the questions in the "bargaining game" part of the field research was that charges could be levied to a point where households would be driven back to using traditional unprotected sources for drinking water. In so doing, the expected health and time saving benefits associated with water projects would in fact be lost. Given the size of the contribution being envisaged from a household and the ability of the nation to allocate the necessary resources if there is the political will to do so, this situation would be totally indefensible on humanitarian grounds.

But in addition to this, it would also be short-sighted on hard-headed economic grounds too. According to recent research, one day's hospitalisation for the treatment of common ailments in Zimbabwe costs the state between $11 at a district hospital and $94 at Parirenyatwa in Harare. Even $11 is eleven times the charge envisaged in NWMP for cost recovery from PWS. Without having the data to analyse this further, the disparity is so large as to make it obvious that expenditure on provision of PWS makes eminent sense, even without cost recovery of users, from the national viewpoint.

10.3 Alternative Mechanisms

If cost recovery from users of PWS is to be implemented, in view of the extremely small amounts that households appear from Part I to be willing to pay, the question arises as to how Government can economically collect these amounts. Government's response would seem to be clear on this; the intention is to raise a Development Levy to be paid by all heads of households in communal areas, this being a single charge to provide revenue for the new Rural-District Councils to fulfil a variety of functions, including the provision of services such as clean water. The intention is that the amount will be set by the Council and approved by the Minister of Local Government, with central Government topping up funds collected locally to an amount inversely related to per capita resource endowment. Without such a provision, councils best able to collect revenue might receive a larger allocation than disadvantaged areas by, for example, collecting very little and then claiming a compensatory grant from equity-minded central government.

Practical and cost-effective though this may be, the effect is to break the link which is critical to the argument for having user charges, namely the link between paying for a service and ensuring that one's resources are providing an adequate return. Again, the theoretical construct of the Bank's "involvement" model is reduced to a rather mundane reality by practical considerations in the Zimbabwean context. Some what ironically, however, this argument can be turned on its head, in that a payment that is not directly linked to the use of an improved source precisely because it is not closely associated with such usage, will not result in the user refusing to pay and discontinuing usage. The adverse health effects from such action would not therefore be encountered. As was discussed in the previous section, households reverting to using unprotected sources would be likely to prove extremely costly for both the individual and the state.

10.4 The Entitlement Approach and New Directions for Policy

The arguments presented above for continuing to subsidise the provision of clean water to rural communities in essence revolve around questions of basic needs, or even basic human rights. There are many in Zimbabwe, including key members of the NAC in their individual capacities, who would endorse such a view, but it is not reason in itself. Where cost recovery from users can be implemented in such a way as to improve national equity and enhance sustainability without compromising access to clean water, it would be a policy to endorse. To accept water provision as a human right would be to accept the right of people to choose to live anywhere in the country and have water provided no matter how difficult and expensive that might be in marginal areas. In a Zimbabwean context, where planning is an accepted concept, provision of water as a human right could legitimately be tied to overall spacial and physical planning of development.

Right of access to clean water in relation to household resource endowments can usefully be conceptualised as a question of entitlement. In his seminal book *Poverty and Famines: An Essay on Entitlement and Deprivation*, Amartya Sen shows the conventional food deficit account of famines to be theoretically unsound, empirically inept and dangerously misleading for policy. His "entitlement" approach highlights that it is more often the lack of access of certain groups to food than an absolute shortage of food itself which explains instances of famine, and more generally of poverty. This approach has been fruitfully applied to problems of food security, and could well prove useful in analysing access to other kinds of resource.

In rural Zimbabwe, water is the key resource needed for survival. Although the country is extremely vulnerable to drought, particularly the large proportion of the communal lands which occupy the marginal natural regions, there is no overall lack of surface or ground water. The problem is precisely one of entitlement. To paraphrase: "the entitlement approach to lack of an adequate water supply concentrates on the ability of people to command water through the legal means available in the society, including the use of production possibilities, trade opportunities, entitlements *vis-a-vis* the state, and other methods of acquiring clean water" (Sen, p 45).

One of the major points highlighted in Part I was the fact that the communities seemed to have no feeling of ownership of the pumps installed as part of donor or government promoted projects. This tends to be interpreted very negatively by policy-makers, whose response is to find ways to make the communities feel that they own the pumps. Such an response does scant justice, however, to the complexities of traditional and cultural practices, which are underpinned in Zimbabwe by the legal requirement that all land remain communally and not privately owned in the Communal Areas. Sen's theory is richer than the conventional economic model, which implicitly assumes private ownership, and could perhaps provide a fruitful starting point for future policy development.

Without exploring this approach further at this juncture, the point that is to be made is that conceiving of the provision of clean water as an entitlement could lead to new directions and options being established which would be more consistent with the needs and aspirations of the rural communities that the water programme is supposedly serving. One of the dangers of the very heavy influence of donors in the sector is that a westernised model, rooted in standard neo-classical economic theory, is likely to dominate to the extent of excluding other options which may be better suited to the situation of rural Zimbabwe. As Government insists through the decentralisation process in more and more responsibility being assumed by Zimbabweans further and further from Harare, the search for unconventional ways of achieving the ultimate objectives should be encouraged.

An alternative and more direct way around the complexities and difficulties of dealing with communal waterpoints is to upgrade traditional household wells. Ministry of Health, extrapolating from the success of the rural sanitation programme, an important aspect of which is the fact that the BVIPs are owned by households and not communities, has been investigating if household water source provision would be feasible. It terms of costs, the only option in this regard would be the upgrading of existing family owned wells (protection and bucket with windlass for lifting). The water quality will not be as good as a fully protected source, but recent tests have shown that quality can be quite acceptable from a health point of view, being very much better than water from a typical unimproved family well. Other advantages of this proposal are that the relatively minor nature of modifications to traditional technologies, together with family ownership, may well result in substantive user contributions to investment costs and full responsibility for maintenance being accepted by households. The resources required from the outside may be as little as $30 per household, compared with three times that amount plus about $2 pa maintenance for a borehole. Although this idea would be applicable only in certain parts of the country, it is to be pursued as a potential complement to the current strategy.

Another consideration arising both from the above discussion and from the fieldwork is that ~~there should be more attention paid in sectoral policies to productive uses of water.~~ It is quite defensible that the primary emphasis should have been on potable water to improve rural health standards, but social service provision cannot be sustained if it is not underpinned by rising incomes somewhere. Fortunately with water, there is the potential to try to do both simultaneously, ie to provide water which can be used both for income generating activities and for household use; in other areas, it would be a waste to use protected water for eg gardening, but it may be possible at relatively little cost to include productive water as a separate component of a project. Where the income generating activities are viable, it would then make eminent sense to recover costs, including capital costs, from beneficiaries. How to structure and design such multi-faceted projects would depend on a detailed analysis of the particular range of possibilities that exist and the entitlements of community members.

→ Just what the communities will not allow.

Yet it is these which translate into WTP.

CHAPTER 11 : COST RECOVERY FOR SERVICES TO GROWTH POINTS

11.1 Growth Point Policy

Since Independence, Government has been firmly committed to developing urban centres within the communal areas as "growth points". However, exactly which centres were to be considered "growth points", was not unambiguously spelt out at the start and different definitions remain. One is that "growth points are the fifty five or so centres selected by the Department of Physical Planning and into which the Ministry of Local Government through the Central Rates Fund has provided infrastructure to the tune of $27 million in the past eight years" [Mabvudza(1988), p 1]. That definition gives a list which is almost, but not quite, coincident with that relating to certain tax incentives established by the Ministry of Finance.

Of more direct relevance to the concept of "growth" are the so-called "resource-based" growth points. These are a subset of the 55 (one per district) growth points, where the Department of Physical Planning, on the basis of a detailed investigation of resources available and potential for devlopment, envisages significant growth occurring. There are about 12 of these growth points in the country, the list usually comprising Chijolo, Maphisa, Ngwesi, Gutu-Mpandawana, Chisumbanje, Birchenough Bridge, Hauna, Gokwe, Sanyati, Muzarabani, Mutoko and Murehwa (Renco and Rutenga are sometimes added, but these are not located in communal areas). It is interesting that Murehwa was not originally on this list, but after it had grown far more rapidly in the early 1980s than many of the then designated growth points, it became imperative that Murehwa be given full growth point status.

What factors determine growth and whether the infrastructure investment in growth points is justified is the subject of a growing academic literature [see, for example, Wekwete (1987)]. Rather than record what is in the literature, to give an impression of how growth factors are perceived by the people in the growth points themselves, in the next section the views of the three groups interviewed in the course of the study in and around Murehwa are summarised.

11.2 Factors Determining Growth - Results of Murehwa Fieldwork

Views of rural households surrounding Murehwa

Persons interviewed from villages surrounding Murehwa growth point had a clear idea of what they want provided at the centre. The main preoccupation of the peasants was that of securing employment opportunities for their children, many of whom have completed secondary education but are unemployed. Because of the high unemployment within the rural community, services said to be required included those which would equip their children with vital skills, for example skills training colleges. About 90% of the interviewees expressed the view that industrial development should be promoted at Murehwa to ease unemployment. Where possible, it should be linked to agricultural activities, eg the manufacture of agricultural implements.

Views of employees in Murehwa

The concensus among the civil servants interviewed was that the policy of growth points is a success as far as Murehwa is concerned. They believed that it has helped to curb migration to urban centres by creating local employment, eg the opening of the GMB depot, which absorbed a considerable number of local people. Others indicated the benefits accruing to farmers who now travel reduced distances to market their produce. A lack of "proper" accommodation at growth points was the main negative factor identified as slowing development.

Non-government employees and other residents were also in full support of the policy of growth points. Services were being brought closer to the people and much construction work was going on. All these developments were deemed by this group to be indicative of the success of the growth point policy.

When asked to identify services considered most important to be provided at a growth point, employees gave the following ranking:

> water, electricity, shops, recreational facilities, designated residential areas, employment opportunities and banking services.

In a second phase, respondents were shown the "Services Card" and were asked to rank all the services listed there. Water provision was still given priority, closely followed by electricity, health, agriculture, banking, good roads and residential areas. When residents' first three preferences were quantified and ranked, the services in order of priority were as follows:

- water	1
- electricity	2
- health	3
- designated residential areas	4
- good roads	5
- schools	6
- shops	7

Views of business owners in Murehwa

Business owners understand that a growth point is a place set aside within the communal areas that should serve as a focal point for development of manufacturing and service industries. To that extent, there exists concensus that the local people benefit when services are brought closer to them and that employment opportunities are created to help curb the rural-urban drift. However, many of the business owners cited problems that would have to be solved if the growth point policy is to succeed:

(i) Land Ownership

The principal problem identified as hindering the rapid expansion and development of growth points is that of land ownership. Without freehold title, there is no security of tenure. Investors cannot invest their money in large industrial structures if such buildings/plants cannot be used as collateral when seeking loans from banks. Business owners indicated that the issue of land ownership has to be tackled urgently in order to give them security of tenure. Freehold title could be given exclusviely to those at growth points within specified parameters without affecting traditional ownership in the rest of the communal areas.

The resolution of the problem of freehold titles would help in part solve the accommodation problem. People would find it worthwhile to invest in housing.

(ii) Incentives

Business owners claimed that it is necessary to provide a package of incentives that would attract investors to growth points. These would need to be publicised to prospective investors. The present tax relief incentives should be extended for a longer time horizon. Loans should also be made easily available for those who choose to invest at growth points.

(iii) Balance between commercial and industrial development

Business owners expressed the view that in the development of a growth point there must be a balance between commercial/industrial activities and the provision of leisure activities. There is need to diversify and avoid unnecessary duplication. Big organisations should not move into rural areas because they have developed efficient economies of scale and would drive the small emergent business owners out of business.

Business in growth points that provide goods and services are dependent upon the financial well being of the local population. Since most growth points are established in rural or semi-rural areas, it is essential that industrial development take place to ensure that service and goods providing businesses can be sustained in times of drought, ie, developing a population that is not solely dependent upon the sale of agricultural produce as a source of income.

(iv) Transport

The need for more efficient and cheaper transport to serve growth points was stressed by the respondents. Transport costs are high and they have no option but to pass on these costs to the consumers. Business owners would like to see rail being extended to growth points and goods haulage being subsidised.

(v) Labour Laws

Various weaknesses were identified within the current labour laws which might be disincentives to employment creation. The business owners cited the issue of the right to fire an incompetent employee as an obstacle to their hiring more personnel. It was claimed that the ability to lay off employees when there is an economic downturn would also result in a higher level of employment overall.

Notwithstanding the problems outlined, the reasons given for locating at growth points had largely to do with the advantages of capturing part of a growing market. Those who arrive first can benfit from the incentives offered and prosper because there is not much competition, profit margins are good and turnover is growing. This line of reasoning is possibly not consistent with the other reason given, which is more social-minded in character, namely that services are brought closer to the people thus saving them expensive trips to major urban centres.

As regards the ranking of services for growth points, from the open-ended question business owners ranked piped water and electricity on a par as first priority, followed by shops, recreational facilities, residential areas, employment opportunities and banking facilities. In the ranking of all services on the "Services Card", business owners still ranked electricity and water as first priorities, followed by residential areas, health facilities, employment, hotels and roads. In comparing with the residents' list, the business owners include hotels and banks, and the residents schools, otherwise the priority services are the same (employment opportunities, water, electricity, health, shops, residential areas, recreational facilities and roads).

11.3 Policy Implications

Government's commitment to promoting growth points is clear. In several cases, money has been liberally spent on creating infrastructure and providing services. It is only in the light of experience of very little "growth" resulting, that policies are coming to be more critically assessed and new institutions, such as the Urban Development Corporation, set up to concentrate on making the growth point policy succeed.

The discussion from the previous chapter about projects often being mis-designed due to failure to consult potential users about what they were wanting and needing and were prepared to pay for, is highly germane to Zimbabwe's growth points. The unused bus terminal and market in Juru is a good example of wasted resources, arising because the facility was located away from the shops where storekeepers pay busdrivers to halt their vehicles. The empty houses at Mpisa provide another; at $85 per month, they are considered too expensive to rent.

The example of the introduction of radio telephone technology into PTC's rural installations is a particularly interesting one. Before Independence, rural telephone installations were by and large confined to the large-scale commercial farmers where cost recovery was both feasible and desirable. After Independence, PTC responded to the Government's rural orientation with donor funded projects which retained not just the cost-recovery directive but the specifics of calculating costs according to established practice. This implied, for example, an installation fee based on distance from the exchange, a rational approach when distance implied greater lengths of cable, booster units etc but hardly defensible with a new technology like radio based phones where the distance from the exchange is immaterial.

With consequent connection charges of $250 to $2000 coupled with monthly charges of $10 to $150 per month (higher figures for single substations), it is found that very few connections have actually been made. Donor evaluation teams visit pristine exchanges which have very few subscribers, while a large unsatisfied demand for telecoms in rural areas continues to exist. Even if PTC has put its charges onto a more rational basis, the problem remains that full recovery of the costs of providing services to the growth points would neutralise the fundamental reason for providing the services in the first place - namely to attract investment to create jobs and encourage settlement and growth at the chosen centre.

There is a chicken-and-egg problem here. As the business owners of Murehwa made clear, without an adequate package of infrastructure and services and possibly also institutional changes like individual land tenure, sustained growth will not be achieved. Without such growth, however, the cost of providing the services cannot be recovered, leading to precisely the situation the World Bank document describes of localised subsidies in identified "growth points" while the mass of the population in the rural areas proper will continue to suffer a lack of any kind of service. Unfortunately too with very low demand levels persisting for the foreseeable future in the growth points, the long-run least-cost form of supply (ie, in the case of electricity, connection to the national grid) is often not economic, necessitating investment in stand alone technologies, (eg, diesel generators), which bring their own maintenance and recurrent cost problems.

The diverse Government agencies reponsible for creating the environment for growth in the rural areas must be made to recognise the significance of their individual interventions and work together to produce a coherent package of infrastructure and services to attract new economic activities and encourage expansion of existing ones. Initiative and entrepreneurship is to be fostered at all levels so as to build up a productive economic base as soon as possible. In respect of infrastructure, subsidies in the growth points may well be required initially, particularly for installation costs, but by following the principle of investing in what entrepreneurs want and can reasonably be expected to pay for, significant cost recovery may be possible without destroying the incentives for growth.

CHAPTER 12 : BROADER ISSUES

12.1 Decentralisation

The role of the water sector in giving support and momentum to the Government's policy of decentralisation was welcomed and endorsed in Chapters 9 and 10. Previously, in Chapter 7 of Part I, willingness to pay for improved PWS was tied to decentralisation being effectively carried out, as it is within such a context that cost recovery for services such as water could more readily be justified than has been the case under the previous centralised and fundamentally undemocratic structures which were inherited from the past.

What exactly is meant by decentralisation? Clearly, decentralisation is not simply a technocratic matter but a political one, and it is important to note that divergent political opinions may have similar policy implications. This allows, for example, ideologically incompatible governments and donor agencies to cooperate on specific projects, apparently talking the same language, but actually operating within quite different paradigms.

As there are so many different parties which are involved in formulating and executing rural development policies (central and local government, multilateral and bilateral aid agencies, consultants, NGOs and do-gooders, to say nothing of the communities themselves), it is useful to identify a range of political positions on decentralisation. Creating labels for convenience, the following can be identified:

Left idealist view

This would put people and communities at the centre of development, emphasizing the critical importance of ordinary people being involved in making the decisions that intimately affect their everyday lives, whether or not this would be compatible in the short run with economic efficiency. In this view, autonomy and the direct experience of democracy are to be valued in their own right, particularly perhaps in a country such as Zimbabwe where the experience of democracy is so scant. Institutionally, this view would endorse full devolution of power to local government.

Democratic centralist view

Equity considerations make it infeasible to devolve powers to very unequal local authorities. Intervention by central government is therefore critical, and local government structures are there merely to carry out decisions made at the centre where control is vested. This institutional form corresponds to what Mutizwa has dubbed "deconcentration" [Mutizwa(1987)].

Bourgeoise Paternalistic

In practice, the institutional structures deriving from this ideological position would be broadly similar to those deriving from democratic centralism. Differences are more likely to lie in the total resources allocated by central government for local development and in the legitimacy or otherwise of the regime as far as the rural people themselves are concerned.

Right libertarian

Coming full circle, the complete devolution as opposed to deconcentration of power to local authorities is advocated not only by the idealistic left but by the libertarian right. Libertarians are generally anti-government, but particularly anti central governments which have a planning orientation. Autonomy and local initiative are seen as an antidote, particularly where these allow the individual full expression. The "rational" or economically motivated individual is at the centre of the libertarian philosophy, in sharp contrast to the left idealist position where the individual is placed irreducibly within a social setting, and the community is given prominence in analysis and policy-making.

Whether the approach of the Zimbabwe government to decentralisation is motivated primarily by a "left idealist" view is open to debate. To probe into the government's intentions, it is necessary to ask whether decentralisation is considered a good in itself or whether it is a policy which is believed to offer cost savings. The idealist view justifies decentralisation on the basis that there is intrinsic value in spreading development as widely as possible, and this may well be important in Zimbabwe due to the historical legacy already described. At the same time, however, with the major urban centres growing to proportions where congestion costs are becoming a factor to be taken into consideration in planning, it may be thought to be more economical to halt further concentration of population through a regional development policy.

This may sound surprising as it would conventionally be assumed that there are economies of scale in the provision of urban services, but when a point is reached where a billion dollars are to be invested in an urban commuter rail system, promotion of smaller centres comes to look increasingly attractive. This argument could be criticised on the basis that there are far cheaper and more appropriate solutions to the Harare-Chitungwiza transport crisis than the proposed rail link, but that point is clearly not accepted amongst a significant number of policy-makers. An additional rationale for supporting decentralisation on the basis of reduced costs overall is that lower and therefore cheaper standards of service may be easier to get away with politically in the smaller centres. It is likely that there were elements of both intentions in the formulation of Government's growth point policy.

Because of the country's historical legacy, the policy of decentralisation is bound to prove difficult to implement and major problems will be encountered. At that point, will there be the resolve to continue or will a return to centralisation take place? The interface between those involved in sectoral issues and central government will be critical here. Even though the water sector has now committed itself to a decentalised strategy, donor and other pressures for "results", measured in terms of water delivery, may lead to impatience with the democratic learning experience at the local level.

At the present time, the single most important national policy change for which the water sector needs to continue to push is for central Government to allow financial autonomy at the district level. Once this has been achieved, it should not be naively assumed that the districts will work together for the achievement of the overall objectives, as the political struggles between different levels and groups in the districts themselves have also to be resolved. Nonetheless, without the districts having control of financial resources, participation in decision making can never be achieved. As argued previously, the collection of user charges for the provision of services will become a logical and integral part of policy once the districts having revenue raising and spending powers.

12.2 Need for Long Term Planning

What will Zimbabwe look like at the turn of the century? Where will the population of 12 million be living? If it could be assumed that the next 12 years will be a period of sustained industrialisation, requiring rapid urbanisation in the existing primary and secondary urban centres, it would then be logical on equity and efficiency of investment grounds to allocate the bulk of infrastructure investment to the urban areas. Unprotected or minimally upgraded water facilities in the rural areas could be defended on grounds that further improvements would be needed only temporarily, not justifying the corresponding investment costs.

Unfortunately there has been little debate in Zimbabwe about our longer-term future. The furthest ahead we have dared to look is to 1990, when the Five Year Plan quite unrealistically, even in its own terms, envisages that urbanisation will have risen from 26% in 1985 to 40% in 1990. Any sober appraisal of economic prospects and economic realities brings home the fact that the bulk of the population will still have to be resident in the rural areas, dependent primarily on agriculture for a living. To emphasize agriculture and rural development in order to involve this majority of the population as directly as possible in development is not necessarily to foreclose the potential for industrialisation.

Under such a strategy, industry would have to be reoriented to serve the consumption and production needs of the majority, implying concentrating on producing simpler, less import intensive goods. This would also be consistent with a growth points emphasis on decentralised production and consumption to reduce transport costs and create local employment opportunities. Preparation in terms of finding markets, exploring technological alternatives and training of a future generation of industrialists could at the same time take place, making possible a more sophisticated phase industrialisation at a later point [see, for example, Robinson (1987)].

In the rural areas proper, key elements in ensuring the success of this strategy would be significant land redistribution and effective community mobilisation for all facets of development, this probably being more difficult and challenging than anything else on the agenda. To raise standards of living, the focus must be on improving productivity, generating income and creating employment. The provision of services such as water and electricity where possible should seek to increase incomes as well as contributing directly to an improved standard of living.

In such circumstances, the virtuous circle can be closed through part of the increased income going to pay the cost of providing the services.

Income distribution, economic growth prospects and demographic factors in Zimbabwe are such that if the urban LDA segment succeeds in preserving its per capita position, average living standards for the rest of the population in the HDAs and the rural areas are bound to fall by the year 2000. Something will have to give: if it is not to be a *volte face* on prestige projects, acceptance of more flexible standards for housing and services in the urban areas which would free up resources for growth point investment, is bound to come. The sooner we as a nation face up to our longer term future and start planning realistically for it, the better able we will be to rise to the challenge of health, water, housing and education for all by the year 2000.

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THE EFFICACY OF IMPROVED SUPPLY SYSTEMS IN MEETING RURAL WATER DEMAND FOR DOMESTIC NEEDS

Evidence from Northern Kerala

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EXECUTIVE SUMMARY

With the pressure of growing population and various environmental factors resulting in scarcity and poor quality of water from traditional sources, the responsibility of providing safe and clean water to dispersed rural communities has been taken over by the governments. Many donor agencies have come forward to lend their support to this task.

The low level of efficiency in the operation and maintenance of the improved systems which are capital, technology and management intensive has meant unsustainable subsidies and the condition of those most in need of this service, remaining relatively unchanged. At a time when developing country governments and donor agencies are facing a severe resource constraint one argument which is gaining ground in the policy debate is the need for beneficiary contribution towards operation and maintenance of the system.

While vast amounts of financial and human resources have been devoted to solving technical problems, very little attention has been paid to the behaviour of current and potential users of the improved systems which in the end is what determines whether they will be used and maintained. The sole reliance on certain rules of thumb without much attention to the social determinants of water use patterns and willingness to support the system through managerial, physical and financial contributions by the users has resulted in the systems being designed to provide an abysmally low level of service across all environmental and social situations.

This study has assessed the impact of socio-economic characteristics of rural households, the environmental conditions which determine the role of traditional sources in supplying water and the quality of the piped water service itself, upon the sustainability of the improved system.

Our evidence reveals that the improved service in its present form is performing only a supplementary role in meeting the rural water demand. Most households use atleast two sources of water and wells emerge as a parallel source to piped water. The improved system accounts for less than half the water consumed by the households with yard taps, and only between one-quarter to one-third of the demand for water among non-connectors is satisfied through the public taps.

While the improved service in its present state might not have provided an alternative to the traditional sources, it has certainly helped in minimising the hardships faced by rural households, much more so in the scarcity areas. However, given the supply constraint faced in the provision of the improved service, a vast majority of households in the communities served by the improved service still fall short of the consumption norm of 40 litres per capita per day. The hardships are more severe during the summer season. Perversely, the system seems to be working less inefficiently during the monsoon when it is least in demand and most inefficiently during the summer when it is acutely needed.

Since most households cannot rely on a single source to meet any of their particular needs (drinking, cooking, cleaning and bathing, etc.), they tend to switch and shift from one source to the other according to the dictates of their environmental conditions.

The evidence in favour of an overwhelming desire for a convenient service among our sample households indicates a vast scope for the improved service, particularly house connections, both in the existing and in the sanctioned sites. Public taps, too, provide much needed relief in the scarcity and poor quality areas.

By emphasising solely public taps (standposts) and shying away from making a provision for yard taps, the service has been starved of much-needed finance for augmenting supplies and improving its reliability through proper operation and maintenance. Our evidence reveals that while wells are considered to be highly competitive with yard taps, the latter are regarded as a normal good and people tend to switch to them as income and educational levels rise. Tariff is an important determinant of whether people would hook up to the improved system, but it becomes statistically insignificant in that part of our analysis where connection costs are controlled. Thus it is the initial connection cost which would seem to be the main impediment to taking house connections. Our analysis also reveals a relatively lower demand for public taps than for yard taps.

While meeting connection costs through loans/subsidies or its incorporation into the tariff structure should enable a large number of households to take house connections, access to potable water for the very poor households will necessarily have to be through public taps and quality of service at these taps needs to be enhanced through augmentation of supplies and trouble-free operation and maintenance. An important source for meeting the cost of this upgradation would be through the cross-subsidy from charges for house connections.

Reliability of service has a substantial positive effect on decision to hook up to the improved system and it strongly offsets the negative effect of tariff. In its present state, however, the service remains highly unsatisfactory as it supplies very limited quantities of water and that, too, very erratically. In the absence of any improvement in the quality of service, willingness to pay remains firmly entrenched around the current charges.

It is the inflexible consumption and investment norms, lack of communication with and participation of the local people and ignoring of the resource mobilisation potential through the provision of house connections, which have laid a trap of inadequacy and inefficiency around the improved system. It is clear that people want house connections for which they have been paying and are willing to pay. Their willingness to pay is further enhanced with rise in incomes, educational levels and reliability of the service. There is also a clear indication that there is a reasonably high level of understanding and preparedness on the part of local communities to improve the operation and maintenance of the system. The removal of restrictions on domestic connections, the meeting of connection costs through credit facilities, subsidies or their incorporation into the tariff structure and putting people especially women in the driver's seat, would thus seem to be lessons for augmentation, operation and maintenance of the improved system. Since the source choice probabilities are affected by environmental differences in water conditions, a disaggregated approach would be required in the determination of scale, technology and financial choices in place of any rules of thumb.

CHAPTER I

INTRODUCTION

1.1 General Background

Nearly half the population living in developing countries continues to remain without access to safe drinking water and most of this population lives in the rural areas. It is estimated that the amount spent on rural water supply in different parts of the developing world in the recent years has been of the order of U. S. $ 1500 million per year, of which 80 per cent is by the national governments themselves (1). Universal coverage for safe drinking water by the turn of the century would necessitate a three to five-fold increase over the current level of investment in this sector.

The low level of efficiency in the operation of the schemes for improved water supply in the rural areas makes the task even more difficult. It is believed that at least a quarter of such schemes are in a state of disrepair and that, in some countries, the construction of new facilities is not even keeping pace with the rate of failure. The earlier diagnosis which ascribed this malaise to the technology, believed to be too difficult for the villagers to maintain, has now been replaced by what is seen as a top down approach in the construction and management of these schemes, and the dubiousness of the prevailing notion that water must be supplied to rural households necessarily free of cost. Further, the mushrooming of repair and maintenance services and the availability of a large number of self-trained mechanics for pump-sets (run on electricity or diesel) for irrigation in many parts of rural India, is seen as an eloquent testimony to the quick and appropriate response by local groups, and belies any apprehension about back-up support by local populations in the introduction of modern technological devices. The same is true with respect to technical back-up at the local level in the repair and maintenance of radio and television sets, motor cycles, and welding and casting of spare parts of various agricultural implements. It is, therefore, not the "complex technology" but the top down approach in the planning and implementation of drinking water supply schemes which might be responsible for rendering them dysfunctional. In Thailand, the

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(1) Briscoe and deFerranti (1988)

government installed community handpumps and standposts, and committed itself to maintaining them only to find that a sizable proportion of the population continued to use their traditional surface water sources. In Tanzania, water supply schemes were launched without adequate planning for the support of operation and maintenance costs, with the result that even though the people welcomed the new facility and wanted to use it, the schemes fell into disrepair. For the local population to evince an interest in the repair and maintenance of schemes rather than turn away from them when they fall into a state of disrepair, they must be accorded the role of primary decision makers in the planning and implementation of these schemes, and be made to contribute towards their costs.

The provision of protected water free of charge has, in the main, led to unsustainable subsidies, ultimately resulting in the condition of those most in need of the service, remaining unchanged. The realisation that it is imperative to intensify, considerably, efforts to supply safe drinking water in rural areas, has come about at the time when most developing countries are going through a serious resource constraint. The issue of cost recovery from users, therefore, becomes crucial. The fact is, however, that even if water tariffs are calculated to reflect actual costs, let alone future investment needs, in general they exceed the means of those who must have water necessarily at low cost. The scope for cross subsidisation, too, may not be so vast as to recover the full costs of water supply schemes, both because of the growing low-income population and due to various compulsions to constantly subsidise the privileged residential and industrial areas in the cities. Sound financial management, therefore, would require that efforts at cost recovery are combined with cost containment, with technology playing a crucial role (1).

1.2 The Indian Context

The supply of potable water in India is essentially the responsibility of the state governments which are perennially short of funds for development activities. Until 1979 (the end of the Fifth Five Year Plan), the share of water supply and sanitation in the plan outlay ranged between 1.2 to 2.7 per cent. With the declaration of the 1980s as the International Drinking Water Supply and Sanitation Decade and the consequent

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(1) Briscoe and deFerranti (1988) and W.H.O. (1987)

special focus upon the problems in this field, the share of this sector in the plan outlay increased to 4 per cent in the Sixth Five Year Plan (1980-85) and to another 6 per cent in the Seventh Five Year Plan (1). The efforts of the state governments were now supplemented by the government at the Centre in the form of the Accelerated Rural Water Supply Programme (2). Apart from the resources committed by the Central government, the capital cost of water supply projects are also met through loans from financial institutions within the country, and through multinational and bilateral external assistance from the World Bank, and the institutional developmental agencies of The Netherlands, Denmark, the Federal Republic of Germany and the European Economic Community. By now a little over two dozen water supply projects in the country have been financed through external assistance, which has met between 41 and 96 per cent of the capital costs of these projects.

Unlike some other developing countries which adopted the strategy of first covering the areas which can be reached easily and less expensively, the strategy in India has been to concentrate first on the problem areas. In all, 2.31 lakh villages were identified as problem villages to be covered by the end of this decade. These were defined as the villages which did not have assured sources of water within a distance of 1.6 kms, or within a depth of 15 metres (or hilly areas where water sources were available at an elevation difference of more than 120 metres from the habitation), or where the available water suffered from either chemical (fluoride, iron, brackishness and other toxic elements) or biological (guineaworm, cholera, typhoid) contamination. Recently, the norm with respect to distance has been revised to 0.5 kms and a basic service defined as a handpump / standpost serving a population of 150, at a distance of 250 metres horizontally and 15 metres vertically from the habitation. A concurrent evaluation undertaken recently by the Department of Rural Development in different states revealed that in about 81 per cent of cases, the nature of the source was ground water. Only 19 per cent of water sources were based on surface water such as rivers, canals, reservoirs or springs. Handpumps on bore / tubewells and standposts for piped water were among the two main sources of potable water in the villages, accounting for 92 per cent of the available sources. About 88 per cent of water sources were based on the pumping system and only 12 per cent on the gravity principle (3).

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(1) G.O.I. (1981 and 1985)

(2) For details, see G.O.I. (1986)

(3) G.O.I. (1989)

The water schemes are managed either by government departments such as the Public Health and Engineering Department (PHED) or local level bodies such as the Zilla Parishads (district level local bodies) or Panchayats (village level local bodies). In those rural areas where comprehensive regional supply systems which span large areas and which are relatively more technology and capital intensive exist, the management is in most cases by the PHED, believed to be better equipped to handle these systems financially as well as technically. Even otherwise, the task of operating and maintaining the water supply schemes is left mainly to government agencies, as only 23 per cent of these schemes are operated by the panchayats.

The water supply schemes are designed to provide 40 litres of water per capita per day under normal physical and socio-economic conditions and 70 litres per capita per day in desert and hilly areas. It is reported that the proportion of the population with access to such "protected" water has, over the last few years, increased from 31 to 47 per cent. This is, perhaps, an over-estimate. A survey of handpumps in the states of Orissa, Rajasthan, Madhya Pradesh and Tamil Nadu revealed that only about one half of the villages serviced through handpumps were actually able to avail of this service. It is believed that 30 per cent of the handpumps installed in the countryside are out of action at any given time (1). The situation with regard to standposts for piped water is only slightly better. In about 46 per cent of the cases, treatment of water was required, but was not done. Only 61 per cent of the schemes were providing water for all domestic needs, 29 per cent only for drinking and cooking and 10 per cent only for drinking. Nearly two-third of the families meant to be serviced by the drinking water supply schemes had to resort to the alternative (traditional) sources for meeting their domestic needs, because of the inadequate supply from the "improved" service. In Kerala the percentage was as high as 82. In many cases tubewells were installed without any proper scientific survey, which often resulted in situations where the source was either inadequate to meet the required demand or the water was of poor quality. In many other cases, the withdrawal of ground water was greater than the recharge available. There was no provision in the plans to take care of preventive maintenance and the shortage of power and mechanical failures further compromised the effectiveness of the system. The water losses in distribution systems are reported to be of the order

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(1) The drop from the earlier 75 per cent to 30 per cent can be attributed to better quality handpumps and better maintenance. The UNICEF-led innovation - India Mark II handpumps - have been instrumental in bringing about this change. See, O.R.G. (1986).

order of 20 to 30 per cent of the total flow. According to the Government of India's own admission, the lack of attention to pre- as well as post- installation phases was compromising the usefulness of the water supply systems in the rural areas by 50 to 70 per cent (1).

The above-mentioned situation is a result of insufficient attention to technical, institutional and financial aspects in the wake of crash programmes to improve water supply at break-neck speed. In 1986 the Government of India set up a National Technology Mission on Drinking water, for looking into the technical and institutional aspects with a view to improve the performance in this sector. It is expected to suggest measures to improve the performance and cost effectiveness of ongoing programmes for the supply of drinking water in rural areas, in order to make available adequate quantities of water of acceptable quality on a sustained basis. The idea is to arrive at low cost solutions with the help of science and technology and to evolve replicable and sustainable models of drinking water supply programmes in the rural areas. In its institutional dimension, its brief is to evolve practices for sustained management of water supply schemes with participation from voluntary organisations and various other groups from within the local population, particularly women, and to set up computerised information management systems on water sources, availability of materials and skills and designs of the supply systems. The Mission began its work by focusing first on the spillover "problem villages" identified during the Sixth Five Year Plan and other such villages identified for water supply schemes in the Seventh Five Year Plan. It was assigned 50 pilot projects at the district level, covering at least one district in each state. The attempts made by the Mission towards these tasks over the last couple of years include:

a) source finding through satellite imageries, geo-hydrological investigations, geophysical investigations, and source development;
b) improvement of traditional methods in building structures (wells, tanks, ponds, etc.), in water conservation and in enhancing potability;
c) purification of water by evolving cost effective solutions for desalination, iron removal, defluoridation, by slow sand filteration, pot chlorination, etc., and by chemical treatment for eradication of guinea worm;
d) improvement of materials and designs for handpumps, electrical pumps and pipes;
e) development of maintenance norms, designing of maintenance manuals and training of staff and panchayat functionnaries to improve maintenance methods;

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(1) See, e.g., G.O.I. (1984)

f) creating a computerised data bank for a management information system. It has enlisted co-operation from various voluntary organisations and research and development institutions in its work.

Commissioning "improved" services without realistic measures for supporting the maintenance operations has inevitably led to the depletion of assets created with large investments in the water sector during the last decade. Since a sizable number of systems are not operational and many others are providing unsatisfactory service, the useful life of the systems is being reduced by 50 to 75 per cent and has necessitated premature replacement of many of the system components. By the end of the Seventh Five Year Plan, Rs. 700 crores worth of assets would have been created in the rural water supply sector. According to the Working Group on Rural Water Supply in its approach paper on this sector for the Eighth Five Year Plan Rs. 350 crores would be needed just for the operation and maintenance of these systems which, it suggests, must be met by contributions from the users. It states,

> " the entire cost of O & M should be met by contributions from the users, taking care to have cross-subsidisation for scheduled castes / scheduled tribes and weaker sections. The O & M responsibility with the public funds should only be for a limited period of three years and thereafter it should be the responsibility of the users,through the system of village panchayats, NGOs or separate self-sustaining organisations. Even in the first three years, there should be close linkage of local PHED officials with village panchayats and funds for maintenance should be spent by their close involvement. PHED should report on O & M to panchayats" (1).

The measures recommended toward this end are water tariffs, special levy and introduction of state lotteries for drinking water supply schemes. In situations where the improved water schemes are able to provide water upto 70 litres per capita per day,house connections are recommended which, in the opinion of an earlier Working Group, serve as an important avenue of cross-subsidy in this sector. To quote again,

> " In case of piped water supply, house connections must be encouraged wherever adequate supply is available and a maximum of Rs. 10 per month should be levied. Additional charges may be levied for extra taps installed in the same house. In case of the households which do not have house connections, Rs. 2 per month may be charged" (2).

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(1) G.O.I. (1989)
(2) G.O.I. (1989)

The latter refers to the use of standposts which, in general parlance, are called public taps.

1.3. Theme of Cost Recovery with Special Focus on the Willingness to Pay Principle

The theme of cost recovery, at least O & M costs, seems thus to be gaining strength in the Indian policy for the water sector. Although measures such as state lotteries, indirect taxation by levy on other items (production of milk and agricultural items) and services (transportation) are mentioned, the emphasis on making the user pay for the service is unmistakable. Apart from it leading to the better maintenance of the systems by inculcating a sense of ownership and responsibility among the users, it is also expected to result in water conservation and economy in the use of water. It might also ensure user participation and public accountability of the systems, as those who pay would develop stakes in demanding a better service by seeking to participate in the system design, implementation and maintenance. The tariffs and taxes, therefore, have an important role to play in the water sector.

There are, however, two major difficulties in following the system of tariffs and taxes in this sector, one rooted in tradition and political compulsion and the other in the nature of the commodity. Provision for drinking water has acquired an almost sacred character in the Indian tradition. It is considered a minor sin if nothing is done for those going hungry, but it is a great moral failing if nothing is done for those going thirsty. One's dharma (moral responsibility) enjoins one to set aside everything one is doing and rush to the aid of the thirsty. To quote from the Indian poet-saint Rahim,

" Rahiman pani rakhiye
bin pani sab soon
pani bina na ubhre
moti manas choon."

Translated freely it would read,

" O Rahim, give of water freely to those that need it."
(This could also be interpreted to mean "Conserve your water!").

" For without water, as without self respect, all is lost. Just as pearls develop not their lustre outside of water, nor the wheat grow golden unless fed by it so, too, for man is thirst the usurper of his self esteem."

Accordingly, the augumenting of water resources for drinking and meeting domestic needs through the digging of wells and the cleaning, deepening and repairing of ponds, has traditionally been the most common form of charity by individuals and institutions. Governments also undertook this activity in seasons of drought or as famine relief measures in order to generate employment. In the Rajasthan countryside, the greatest assurance that heirs can give to a departing soul that his/her reputation will grow in glory even after death, is to announce at the deathbed that water will be provided to the needy for a certain number of coming summers. In a context such as this, and given the scramble for announcing populist measures (including the writing-off of loans given for agricultural production) among various political groups, the levying of charges for water is not likely to be a favoured item on the agenda of the political leaderships responsible for taking such decisions.

This is not to deny the need to levy tariffs or taxes for improved water supply schemes and to surmount the weight of tradition or political expediency. These schemes are capital, technology and management intensive. Most lessons in what is sustainable and what is not would lie in the task of carrying out these capital, technology and management intensive schemes and in generating resources for checking the depletion of the assets already generated and for future investments to provide universal coverage for access to potable water.

Water as a public commodity should be available to all. In cases where full coverage is far from attained, the supply of water to any given consumer, targeted or otherwise, implies that the service will not be extended to others who have an equal right to it. The concept of equity is essentially related to actual qualitative improvements, easier access, and the extension of significant advantages to as many people as possible. The income-augmenting (via generation of new jobs and skills due to growth in this sector) and time-saving characteristics of the improved supplies, and the realisation that better health ultimately leads to better employment and incomes, also add to the argument for introducing the monetary element into the consumption of water from drinking water supply schemes.

The crucial problem in levying water tariffs arises from the other problem, i.e., the multiplicity of sources in the supply of this commodity. Whether the proposed tariffs will generate required resources or not will depend on the acceptability of the tariff to the users of this service. The principle of cost recovery and the considerations of restricting consumption might suggest tariff rates which could divert the consumers to other sources of water. In the rural areas, people have recourse to other sources (wells, ponds, streams, and rivers) which will render any tariffs based on standardised water demand theory, which treats water as a homogeneous good, ineffective. If the primary objective behind the water supply schemes in the rural areas is to make people use protected water, the principle of willingness to pay has a much greater relevance in generating resources than the concept of affordability, cost recovery or resource conservation. It is this approach which has informed our study.

1.4 Objectives

The study is aimed at :

a) asertaining the role of the improved system under different environmental conditions in meeting domestic needs for water by developing an empirical base on source choice, source characteristics, consumption levels and source contribution;

b) understanding how rural households in different socio-economic and environmental settings respond to different levels of improved service at different prices;

c) assessing the consequences of this information for key policy variables such as the level of service, option of yard taps and stand posts, resource mobilisation through beneficiary contributions and beneficiary perticipation in operation and maintenance of the system.

1.5 Structure

The structure of the study is set out by summarising the chapter seriatim.

In chapter two we have specified the different environmental settings obtaining in northern Kerala in terms of the availability of water through the traditional sources. This is followed by a description of the field procedures followed in this study such as site reconnaissance and site selection, investigator training, sample selection and questionnaire development. It also contains a profile of the sites covered in our investigations.

Chapter three provides an overview along with our qualitative observations, of the institutional framework for the improved water supply service, the performance of the improved system in terms of meeting the rural water demand, problems in system design and implementation and grasroot problems of tariff collection, and public accountability and public involvement in operation and maintainance of the system.

In chapter four we have presented the empirical evidence on water sources and use patterns among the sample households under different environmental conditions. It analyses water source characteristics and combinations, water consumption and end-use patterns and people's response to the improved water system in terms of its reliability, affordability and willingness to pay.

Chapter five is devoted to the analysis of willingness to pay through the help of contingent valuation method using logit and probit models developed by environmental and resource economists to deal with the provision of public goods.

Chapter six contains a summary of our main findings and conclusions of our study.

The report also contains two appendices. While Appendix I profiles the sample households in terms of their socio-economic characteristics, Appendix II contains the statistical procedures for welfare analysis.

CHAPTER II

COVERAGE AND METHODOLOGY

The evidence for our study pertains to three socio - economic and environmental settings in northern Kerala. Why Kerala, one might ask, when there are so many well-known problem - afflicted regions facing absolute scarcity, biological and chemical contamination and the fast depletion of static ground water reserves due to over-exploitation for irrigation resulting in receding of the underground water table. Kerala has traditionally been regarded as a water abundant region where people's cultural practices in relation to construction of water systems and water use have evolved within a context of assured water resources. Curiously, Kerala represents what might be described as a changing ecological environment, from a traditionally water abundant region to a water problem zone. For example, the district of Palghat in northern Kerala, which was earlier known as the 'granary of Kerala', today ranks among the worst water scarce districts in the country. Good quality water from traditional sources, mainly dug wells, is fast turning into brackish water due to saline intrusion on a sizable scale. Among the positive features which attracted us to Kerala are its distinguished record of state intervention in the provision of public services (notably in the sphere of education and health care), an ambitious setting out of pipelines for water supply in certain parts of rural northern Kerala, attempts at administrative innovations in the Kerala Water Authority, the involvement of multinational and bilateral external assistance in the water sector, a history of protest movements aimed at widening the base of social and political discourse , and the consequent high potential for receptivity to modern services arising out of such a socio-political and cultural background.

2.1 Typology of Socio-Economic and Environmental Settings

The study has covered three socio-economic and environmental settings in northern Kerala:

Area I - with access to adequate and good quality traditional sources of water.

Area II - where water scarcity has become a constant feature over the years.

Area III - with abundant quantities of water through the traditional sources but which water is of poor quality due to saline intrusion.

In each of these environments we included two sites for our investigation:

Site A - one where the improved water supply has been in existence for a few years (existing site)

Site B - which is a socio-economic and environmental setting similar to site A, but for which an improved service has already been sanctioned and likely to be commissioned within six months or so (sanctioned site).

This has entailed our investigation spreading over six sites, i.e., two in each of the three socio-economic and environmental settings.

2.2 Site Reconnaissance and Site Selection

The process of site selection for this study in northern Kerala demolished some of our earlier notions of the Indian countryside and the hope of coming across neatly categorised socio-economic and environmental settings. Not only was there none of that sleepy and forlorn look of scattered hamlets, the size of the villages in Kerala was almost akin to that of emerging small towns with populations ranging from twenty to thirty thousand, and each village having its own 'town' (an exaggerated version of a high street), sometimes even two. It was difficult to distinguish the end of one village from the beginning of another. Within the village itself the houses were densely located, the wards within the villages were not distinguishable by any physical features but were more in the nature of administrative divisions of the panchayat, and even the physical features, particularly with respect to quality of traditional sources of water varied within the same village. In quite a few cases where an improved water supply system was sanctioned, it was targeted to only certain wards or pockets within wards in the village. While the rest of the village remained uncovered, the supply system branched off to serve another ward or a pocket of a ward in an adjoining village. The same village which fell within the category of villages with improved water supply schemes could also figure in the other category of villages where improved water supply had merely been sanctioned. While this facilitated the task of matching an existing site with a sanctioned site within the same socio-economic setting, the task of finding a village site which was purely good quality, scarce or saline in its water resources, became that much more difficult. The selection of sites for this study, therefore, entailed a prolonged process of visits and re-visits to a good number of villages, and discussions and reviews with the field teams of the Kerala Water Authority (KWA) and the Socio-Economic Research Unit sponsored by the Danish International Development Agency (DANIDA) at the KWA. This process began in November 1987 and the relevant field procedures and field investigations were completed by May 1988.

In the first round of site visits, we concentrated on Calicut district for selecting existing and sanctioned sites for two of our socio-economic and environmental settings, i.e., the one where traditional sources were adequate and of good quality and the other where they had turned saline. Visits were made to Badagara division of the district where water quality in the concerned sites was physically verified, some details about the existing systems were gleaned from the divisional engineers and a few households with yard taps were contacted. It must be noted here that in the context of a willingness to pay study, the provision for yard taps (house connections) assumes a crucial significance and the existence of a sizable number (between 50 to 100) connectors was an important consideration in our selection of existing sites. Palghat district was visited for selecting an existing and sanctioned scheme for the third type of socio-economic and environmental setting, i.e., where the scarcity of water from traditional sources was becoming increasingly acute. The second round of preliminary visits for site selection was to Edappal and Malappuram divisions in the Malappuram district to look for a larger number of candidates for site selection, particularly for the good and saline environmental settings. Subsequently, a series of discussions were held with the officials at the northern Kerala headquarters of the KWA at Calicut and the regional offices at Badagara, Edappal, Malappuram and Palghat to prepare a list of candidate villages to choose our sites from. This list extended to eighteen candidates (three for each site or six for each area) with details about conditions prior to / after commissioning of the improved supply and the conditions currently prevailing for the sanctioned schemes, the coverage, access through yard taps, proportion being served or proposed to be served through standposts and yard taps, the time since the existing improved supply system had been in operation and the progress of work on the schemes falling in the category of sanctioned ones. We visited each of these eighteen sites to ascertain for ourselves the particulars about socio-economic and environmental conditions, the quality of traditional sources of water, the functioning of the existing schemes and the progress of work on the sanctioned schemes. With this began the process of elimination, either because the socio-economic environment was that of an urban periphery, or because the improved water system was too inadequate to permit access to an appreciable number of households, as the provision for yard taps did not exceed two to three dozen households. The process of site selection within this list finally ended with our choice of Ezhuvathuruthy panchayat in Edappal division where we found the existing improved water supply system for both adequate-good and abundant-saline areas; Nannamukku village in the same division for a sanctioned scheme in an adequate-good area; and, Vallikunnu village in Malappuram division for a sanctioned scheme under conditions of salinity. All of them form part of Malappuram district in northern Kerala. Elapully panchayat in Palghat district was chosen for the existing as well as sanctioned improved water supply systems under conditions of water scarcity.

To recapitulate, the area-wise and site-wise distribution of the sites is given as follows:

	(Existing scheme)	(sanctioned scheme)
Area I (adequate-good quality area)	Ezhuvathuruthy adequate-good Ezhuvathuruthy panchayat Edappal division Malappuram district	Nannamukku Nannamukku panchayat Edappal division Palghat district
Area II (scarcity area)	Elapully A Elapully panchayat Palghat division Palghat district	Elapully B Elapully panchayat Palghat division Palghat district
Area III (saline area)	Ezhuvathurthy abundant-saline Ezhuvathurthy panchayat Edappal division Malappuram district	Vallikkunnu Vallikkunnu panchayat Malappuram division Malappuram district

2.3 Area and Site Profile

2.3.1 Ezhuvathuruthy adequate/good and Ezhuvathuruthy saline (existing scheme)

> " The only time the authorities show up is to read the meter, collect the charges and give the receipt. It is no use complaining about the erratic water supply. This service is useless; it is not even worth disconnecting. I manage alright because I also have two wells."
>
> Irate middle class connector

" The rich tap water illegally by tampering with the pipe lines and diverting the little available water into their homes and fields without even paying for it. When we protest to the authorities, we are told, 'why don't you do the same' ! But we are poor. We have neither the required equipment nor tools to do it nor do we have house connections or fields to divert the water to. We need water at the public taps."

Poor labourer, whose only source is the standpost

Ezhuvathuruthy, a single village panchayat in Ponnani taluka of Malappuram district, is just a few kilometres to the north of Edappal town on the Trichur highway (and a divisional headquarters of the KWA, located roughly equidistant between Ezhuvathuruthy to the north and Nannamukku to the south. Nannamukku is our sanctioned site with adequate and good quality water from the traditional sources). Although not a coastal village, the backwaters make deep intrusions into the land area. To a visitor, the first impression is one of water everywhere. Water logged paddy fields stretch into the distance. On either side of the road leading from the panchayat office towards the Biyyam, where the backwaters flow into fresh water canals affecting the area with the most acute problem of salinity, run long water troughs full with turbid looking water, some with a layer of floating matter on the surface. Children from a neighbouring cluster of thatch huts belonging to labouring, lower castes frolic in one of the troughs. In another a woman carefully finishes washing her hair and fills two pots of water to carry home. In some other parts of the village moist, neat lanes wind past spacious houses some of them 'Gulf' mansions, private wells are aplenty and standposts are in evidence almost everywhere. The Bharathapuzha river, the longest of all the Kerala rivers, flows through the Ponnani taluka before reaching the sea, and makes for an abundance of lakes and troughs (kulams) in this region.

Behind the universal presence of water is a complex ecology. Ezhuvathuruthy is a blend of good quality and saline water sources and while in the majority of the wards one or the other feature predominates, pockets of good quality sources in a largely saline area and the reverse is a common feature of the village. Although the village wards are only administrative units (and the boundaries were, in fact, undergoing major redefinition on the eve of the panchayat elections which coincided with our survey), it was possible to identify wards 1, 2, 5, 6, 8 and 9 as having predominantly adequate and good quality water and wards 3, 4, 7 and 10 as areas where water from these sources had turned saline.

The choice of Ezhuvathuruthy panchayat for good and saline environmental conditions in terms of the quality of traditional sources of water needs to be explained. We had originally considered this panchayat only for the reportedly saline character of its traditional sources. On repeated trips to the panchayat, however, the complexity of the place and its value as a site typical of the situation in northern Kerala grew on us. Within the same panchayat and along the same distribution pipeline, we observed saline and non-saline areas existing cheek by jowl. The demarcation of the sites into good or saline, in the context of this panchayat, proceeded apace with physical verification of the quality of traditional water sources.

The population of the village is 24,414 comprising 4,931 households, with Hindus constituting roughly 65 per cent of the population. For the rest, Muslims account for 30 per cent and Christians 5 per cent. Apart from one locality with a large concentration of rich 'Gulf' families (in ward 9), all the wards of the village have pockets of scheduled castes and over 60 per cent of the population ekes out a living through wage labour. Of those owning land, a little over half have holdings of less than 0.5 acres (no crops are grown on these holdings but fruit trees such as coconut, cashewnut, jackfruit and banana are an important component) and another almost 43 per cent are small farmers with holdings of between 0.5 and 3 acres. Only 14 families in the village have holdings of over 5 acres. Paddy and orchard cultivation (coconut / arecanut) has been the traditional pattern of agriculture, although in recent years paddy has been rapidly yielding to coconut. A large number of people are coir workers under a putting out system. Other sources of employment are a few bakeries, rice flour mills, oil mills and automobile workshops in the village. Fishing in the backwaters is another minor activity. Wages for farm labour are Rs. 35 for men and between Rs. 12 to 20 for women, in construction labour it is Rs. 40 and 20, respectively, while for transport labour, employees in commercial establishments and artisans like carpenters the wages are between Rs. 25 to Rs. 40.

The sources of irrigation for the orchards (and fields) are the troughs, wells and tanks that abound. In some cases lift irrigation using river water is also resorted to. There are 75 diesel pump sets and 200 electric pump sets of 1.5 HP, and 9 diesel pumpsets and 35 electric pump sets of 3 HP.

Wells, and to a lesser extent taps, are the most important source of water for drinking and cooking, while trough water may be resorted to for other domestic needs by households who do not have their own wells. Neighbours willingly share their well water with others who need it. The quality of pipe water is acceptable but the service is too erratic to be relied upon, with water coming sometimes only twice a week or, if everyday, just for an hour or two and even that sometimes only at night. It is in summer that pipe water comes as something of a relief, as the water level in some of the wells drops and well owners prefer not to have to use their motorised wells and draw up reddish water. The majority of well owners have the traditional arrangement of pulley, rope and bucket, and where they are also connectors the pipe complements their use of their wells in this season.

It is those with saline wells who feel most let down by their pipe connection. Wells of neighbours with good quality water are generally regarded as a more dependable source for meeting domestic requirements, while for chores like washing utensils or cleaning the house, the saline well water is resorted to. Since the houses are fairly clustered, distances to neighbouring wells or troughs are not a problem.

For the poor, with no wells of their own and living in saline pockets thick with thatched huts and bare of trees and garden plants, the improved system has brought for the first time the possibility of a better life. Earlier they were solely dependent on saline wells, often at least a kilometre away, for most domestic needs. Now, too, water for drinking and cooking must on most days be fetched from distant public wells. These wells start drying up as early as January and for roughly four months of the year clear water has to be painstakingly lifted (it can take upto half an hour to fill a ten litre pot) and left to stand and the mud to settle before it can be used for drinking and cooking. The fetching of water in this fashion takes easily upto an hour in the morning for the women who must cook for the household before they leave for agricultural labour by 8 a.m.. They return home by 5 p.m. and set off again to fetch water for the bulk of the housework, as cleaning and washing is done at night and water heated for men's baths. By the time the women sit down to their evening meal, it is often midnight.

The public taps which are ubiquitous in this village, suffer from the same problem of unpredictable and weak supply described earlier and, when the water does flow, not more than two pots can be filled per household. Queues are long - we saw snaking lines of pots stretching away from public taps - and clashes fierce. In the monsoon, water collects around the public taps obstructing the approach and while sometimes in this season supply might even be adequate, it is not unfamiliar for Ezhuvathuruthy residents to have the absurd experience of turning the handles of stubbornly dry public taps in vain, even as earth and sky seem to have become a single sheet of water. Poor households generally set out available kitchen vessels to catch rain water which is then used for drinking and cooking. Another problem is that the public taps have been sited without regard to the uneven terrain (and this, indeed, is the plague of several domestic connections as well) and the flow in the pipes, when it does come, rushes towards the low level taps leaving those at a slightly higher elevation dry. Connectors facing this problem are familiar with the phenomenon of air moving their meters and of paying monthly bills without ever having got adequate water.

Grave, too, is the problem of pipe water supply becoming available only in late night hours, and denying effective access to women who are understandably indignant about having to leave their homes and wait at public taps at dead of night. Rich owners of orchards use the opportunity to attach tiny pumps (costing roughly Rs. 1000 in the local market) to the pipes just before they reach the public taps, and divert the water to their orchards on the homestead and to overhead tanks.

The improved water supply system in Ezhuvathuruthy panchayat consists of two schemes, one commissioned in 1979 and the other, only very recently. Both schemes are set up and maintained by the KWA and the panchayat helps in collecting the water charges from those having metered yard taps for which it charges 7 per cent of the total value of such collections. The Bharathapuzha river serves as the source for improved water at this site. Although a treatment plant was envisaged, it had to be given up in favour of an infiltration gallery alone, due to cost considerations. Disinfection is now done using bleaching powder. The old scheme comprises 760 metres of pipelines and the new scheme 4095 metres of pipe length. There is a storage tank with a capacity of 2.4 lakh litres. The system is operated on hydro-electric power and motors. The power is supplied by the Kerala Electicity Board at the rate of Rs. 0. 15 per Kwh. A sum of Rs. 9483 was paid towards the electricity bill for operating the old scheme between January and December 1987. The charges for the new scheme had not been worked out at the time of the survey. Also, there were no figures available on other expenses such as salaries, chemicals and sundry expenditures involved in operating the system. The system is designed keeping in mind the water supply norm of 40 litres per capita per day (lpcd). There were about 300 standposts at a distance of about every 30 metres as against the general norm of one standpost for every 250 metres. The number of yard taps ran into a little over 150.

On an average a connector is placed between 15 to 20 metres from the distribution line and his connection costs work out to around Rs.1000. Of this Rs. 220 is accounted for by the water meter and Rs. 45 by the brass tap. The rest is divided between the cost of the G.I. pipe @ Rs. 13 per metre, labour charges for trenching, cutting and threading, etc., @ Rs. 7 per metre and a charge of 25 per cent of these costs to be paid to the KWA for its supervision of the works in the laying of the pipeline for the domestic connection. The tariff fixed for the yard taps was Rs. 1.0 for the first 1000 litres of consumption and Rs. 0.50 for every additional 1000 litres consumed. This water supply system also serves four other villages in the vicinity. The system works at only half its capacity, which was ascribed to frequent breakdowns in the power supply. In the summer months it seldom works beyond 4 or 5 hours in a day. In the winter this rises to about 5 to 6 hours and in the monsoon to about 8 hours a day. The problem is further compounded by mechanical failures due to voltage fluctuations. In 1987 alone the pumps failed 15 times costing around Rs. 30,000 in repairs. The irregularity and shortage in the availability of potable water has seriously undermined the credibility of the system with the local people.

2.3.2 Nannamukku - adequate and good quality water area - (sanctioned scheme)

> " Seeing is believing. We would welcome pipe water, but will pay only if it is fit to drink and the service is good ."
>
> Middle caste woman

Nannamukku in the Ponnani taluka of Malappuram district, reflects its description in the survey as an area of adequate and good quality water sources. Although just twelve miles away from Edappal town on the Trichur highway, and on the border of the bustling town of Changaramkulam, as well as being the home of the famed temple of the godess Mookathala, the village has retained a distinctly rural character and presents the familiar appearance of green fields and dense coconut palm groves associated with tourist brochures of Kerala. Bounded by Edappal in the north, Perrumpadappa panchayat in the south, Valliancode panchayat in the west and Alancode panchayat in the east and north-east, it is not a coastal village, but water is an important feature of the landscape. Wells dominate, there are large tanks (kulams), canals and a rivulet, and the backwaters from a loop around the western boundary of the village separating it from Valliancode panchayat. But water sources are by and large good, and even the Chelakkadavu area at the edge of the back waters, towards which the pipeline extends, shows no salinity in the wells.

Occupying an area of 19.36 sq kms., Nannamukku is a single village panchayat. Most of the area is under cultivation (4572 acres out of 4790), and 72 per cent of the population report owning land, although the bulk are owners of small holdings of below one acre. Paddy and orchard cultivation, the latter mainly coconut, arecanut and banana, occupy almost equal proportions of the cultivated land. Half the cultivated area is under irrigation. Eight large ponds / tanks (kulams), two canals and one rivulet (aruvi) - the Narainipuzha - serve as sources. There are also 200 electric pumpsets and 212 diesel pumpsets in operation, used mainly to irrigate the coconut and arecanut orchards. Trade and commerce and labour (both agricultural and non-agricultural) are other sources of livelihood, the latter an important one. Wages for construction labour are Rs. 40 and Rs. 20 for men and women, respectively, and for farm labour Rs. 35 and Rs. 20, respectively, and wages for men in transport labour and commercial establishments are Rs. 26 and Rs. 28, respectively. Carpenters command Rs. 40 a day.

The population of 24,330 (5047 households), is a fair blend of Hindus and Muslims. The village has a strong ' Gulf ' presence, with large modern mansions complete with imported garden furniture highlighting the better-off families and several poorer households reporting male members in labouring jobs in the Gulf region.

For drinking and other domestic uses, well water is the main source in this village. Although private wells are numerous and the water tastes good, it is worthwhile to note that in recent years some wells have been drying up for about two months in a year, in the summer. Wells are generally at a depth of 36 to 40 feet and costly to dig and construct and it is only those who can afford it that can repair their dry wells every summer by digging deeper to release water. Below a certain depth, moreover, the water quality has been found to be poorer. Alternatively, households facing a shrinking of their own water sources in the summer, resort to neighbours' wells that are better endowed.

There are disparities in access to well water in Nannamukku village. Predictably, private wells are few and far between in the areas where scheduled castes cluster (although these castes account for a bare 2 per cent of the population) and virtually all of them dry up even in the month of January. For these populations, therefore, there is an acute shortage of drinking water for almost six months of the year. During this period, they have to walk one to two kilometres to fetch water and it is the women who bear most of this burden.

The two most important sources for those without their own wells or access to neighbours' wells, are two bore-wells. The Mookathala High School bore-well which has a handpump is one. But the water quality is bad,with an unpleasant odour and colour. The other source is a bore-well near the hospital in the Changarankulam 'town centre' from where water is piped to 50 odd standposts. Even this water leaves a lot to be desired in terms of quality, being high in iron, unpleasant and turning a nasty yellow on the surface due to oxidisation when left to stand.

The bore-well scheme was the first experiment by the KWA to provide potable water, particularly for households without their own sources, in this village. Twenty-two bore-wells were drilled but twenty had to be abandoned due to the ground water being highly acidic with traces of iron. The two functioning bore-wells , meant primarily to cater to the requirements of the school and hospital, respectively, meet the water requirements of an additional 3000 people, and in the drought of 1987 when a great many wells went dry, many more people were forced to resort to it. Declared as " unfit for human consumption " by a rich 'Gulf' returnee of the village, this water remains the main source for the less well endowed, even in normal years and for almost half the year. This system has no storage facility.

The people of Nannamukku's experience of pipe water is, therefore, a somewhat dismal one. The newly sanctioned scheme, called the Edappal and Adjoining Panchayats Scheme hopes to redress these misgivings.

The sanctioned water supply system in this site is built under the programme of bilateral assistance through DANIDA. This scheme has been designed for Edappal and four adjoining panchayats of which Nannamukku is one. This system was likely to commence within eight months of the survey. At the time of survey, one and a half kilometres of main line with sub-lines, about eight kilometres in all (7,887 metres) had been laid, covering wards 1, 2, 3, 8 and 10. The system has been designed to provide 55 litres of potable water per capita per day. Stand posts are being provided at the vertical distance of 250 metres and each standpost is meant to serve around 300 persons within the vicinity of 30 metres. The location of standposts is being decided upon in consultation with the Socio-Economic Unit sponsored by DANIDA at the KWA. It is expected that about 40 per cent of the households placed within the distance of 30 metres of the distribution of the pipe line are likely to opt for yard taps.

The Bharathapuzha river which runs across Edappal and adjoining panchayats serves as the water source for this scheme. A well has been bored in the river bed and fitted with electric pumpsets and provision has been made for an infiltration gallery. A storage tank with a capacity of between four to five lakh litres has been constructed.

2.3.3 Vallikkunnu - abundant and saline - (sanctioned scheme)

" We earn our livelihood from the sea, but are we forever fated to quench our thirst with salty water? "

Poor fisherman

Vallikkunnu, our saline site with a sanctioned scheme, is a coastal village in Tirur taluka of Malappuram district. Nestling in the lush, green, undulating Malappuram countryside Vallikkunnu, now easily accessible from Feroke and Calicut through the Kottakkadavu bridge across the Kadalundy river, is famous for its nurseries of both flowers and fruit trees . The village has a long coastline along the east, in the west it is bounded by the Kadalundy river, in the south are wards 8,9,10 and 11 of Ariyaloor village in the same panchayat, while in the north the Kadalundy river curves to flow into the sea, causing what is probably the most acute problem of salinity of drinking water sources in the three islands located at this confluence, but also making for general salinity along the river's lower reaches. There is also a problem of flooding during the monsoon months as the Kadalundy river, which originates in the forests of the Silent Valley and flows 81 miles through the talukas of Perinthalamanna, Ernad and Tirur until it meets the sea at Vallikunnu, flows in its lower reaches through a comparatively shallow terrain, and during the monsoon breaks out in floods submerging parts of this area.

Like much of northern Kerala, however, Vallikkunnu has a fairly complex ecology. The Vallikkunnu panchayat consists of two villages - Vallikkunnu and Ariyaloor - and acute salinity is an overwhelming feature of only some parts of Vallikkunnu, particularly the plains where the backwaters intrude. There are small pockets of salinity in other parts, surrounded by areas of good quality water sources. The hilly tracts, which comprise roughly half the village, are lacking in salinity (in Ariyaloor village at present, there is no problem of acute salinity. What little salinity exists is on account of chlorides and, as ground water reserves get depleted, this problem could be expected to intensify). The orchards and nurseries of Vallikkunnu are concentrated in the non-saline areas - large gardens, with big prosperous houses set in their midst, growing coconut, arecanut, banana and paddy, with the odd cashew tree. Those engaged in farming form a small proportion of the population and most of their holdings are between one to two acres. There are about 20 'Gulf' families in the village and the vast majority of the population eke out a living as fishermen, coolies and wage labourers. The total population of Vallikkunnu village is 17,151 comprising 3,474 households spread over seven wards (wards 1 to 6 and 12, with wards 7 to 11 falling within the Ariyaloor village boundary). With its almost equal proportion of Hindus and Muslims, it is largely akin to Calicut district in its north, of which it was historically a part until it was merged into the newly constituted Malappuram district in 1969.

In its relationship with the Kerala Water Authority, Vallikkunnu falls within the jurisdiction of Parappanangadi sub-division of Malappuram division. Two small schemes already exist. One was set up in 1975 for a very small part of the village, mainly servicing the three islands, covering an extremely small number of households. The source here is a small open dug well with a 15 HP engine and a storage tank with a capacity of 33,000 litres. It is a weakly functioning scheme. In 1983 under the Drought Relief Scheme, a very small pipeline was laid across a small part of the village running from the Kadalundy-Tirur main road, across the railway line into a little of ward 4. This scheme, providing only public taps, never really took off and has since been the cause of considerable cynicism about government water policies among the poor in this area who most need the public taps and for whom the project was purportedly conceived. There are also nine filter point wells in the village, but almost 50 per cent are in a state of disrepair.

The newly sanctioned scheme covers wards 1, 2, 8, 9, 10 and 11. The most saline wards are 1 and 2 and fall within Vallikkunnu village of Vallikkunnu panchayat. Physical verification was carried out within 30 metres of the pipeline to exclude a few odd clusters of wells with good quality water. The two wards have about 10 kilometres of pipeline running through them and public taps have been sited. Some of these taps include the ones set up earlier under the Drought Relief Scheme.

The two wards consist of 473 and 430 households, respectively, and fishing and farming are the main occupations. There is a striking concentration of Muslims here, as compared with the rest of the village, 90 per cent and 75 per cent, respectively, in wards 1 and 2. Ezhava Hindus account for roughly 5 per cent and 15 per cent of the ward populations, respectively, and both wards have a 5 per cent scheduled caste population. In contrast to the rest of the village these two wards, which run down from the northern tip of the village in a narrow strip with the sea on one side and the railway line on the other, present a fairly congested appearance particularly along the western side of the Tippu Sultan Road where the fishermen live. The houses are fragile, thatch huts on the windswept beach, mostly single room hovels with mud / sand floors and no electricity or bathroom/ toilet facilities. On the other side of the road are permanent dwellings but even these lack the spacious homesteads thick with trees that can be found in the interior.

The survey area covers the localities of the Tippu Sultan Road, Firoze Nagar, Kadalundy Nagaram and Anangadi. The public water sources available to the people of these two wards are five functioning handpumps and one public well and, of course, the Kadalundy river. The public well is used by approximately 200 families. It has a fairly neglected appearance and greenish looking water and has not seen cleaning for some time. The water is saline and it is only in the monsoon that the rain water helps to dilute its salinity and make it somewhat usable. In the monsoon alone, too, is the river water resorted to and families living close enough carry several pots home to meet all domestic needs. A mosque in ward 2, served by a well with good quality water and some private wells with good water, all on the eastern side of the road, are the other sources of drinking water and used by a large number of households. There is a tradition of neighbours keeping an 'open well', so to say, to all who need them, and there is one oft-used well whose owners have decided against erecting a compound wall - an integral feature of Kerala homesteads - on account of the steady stream of takers for their well water. Generally, adult men walk the distances - upto a kilometre one way - to fetch water and where families have a number of children, the latter bear the major burden of fetching water for the family, as culturally-determined inhibitions deter women from undertaking the walk down the main road twice a day. Those families which can afford it or are short of family help, hire hand carts to carry full water pots for Rs. 2 per trip, and upto two trips might have to be made twice a day.

The water from neighbours' wells, the mosque well and the handpumps are used primarily for drinking and cooking by those who have their own but saline wells. And in this area, where water is available at very shallow depths, a high proportion of households have their own wells, according to panchayat records 300 and 250 households in the two wards, respectively. The saline well water is used for washing utensils and cleaning the house, sometimes as a first wash for clothes with the final rinse done with good water from an outside source. Invariably, all water is carried home and chores attended to around the house. It is only under conditions of extreme hardship that the saline well water is used for drinking and cooking. And this hardship must come often to the wretchedly poor families along the beach where the washing away of the odd huts by rough monsoon seas is an annual feature.

The degree of salinity in the saline wells in wards 1 and 2 ia variable across the hours of the day and across seasons. The most familiar pattern is that of salinity in the wells rising with the tide and rendering the water unusable and, during low tide, clear water seeping in to dilute the salinity at which time it can be used for cleaning utensils and, sometimes, the house. Similarly, salinity is uniformly high in the summer and slightly less so in the winter, while during the monsoon the wells are least saline. Similarly, neighbours' wells have to be resorted to in rotation, as very few wells here are perennially good. A good quality well may after two days or so of heavy use be rendered saline, necessitating moving on to another good well. The problem is most acute for the poor pockets on the beach whose ring wells yield uniformly saline water and can be moderately used only in the monsoons. Away from the seafront, even saline wells have water that is more usable.

The new water supply system which was nearly complete at the time of the survey, is a large one covering three panchayats - Tirurangadi, Parappanangadi and Vallikkunnu - and is one of the most modern and prestigious of the KWA schemes in Northern Kerala sanctioned under the Accelerated Rural Water Supply Scheme (ARWSS) of the Central government in 1979. Its source is the Kadalundy river. A well has been sunk on the banks of the river, 6 metres in diameter and 15 metres in depth. There is a raw water pumping main and a complete treatment plant, and the clear water is pumped to the Parappanangadi tank (capacity 3.6 lakh litres), for the Parappanangadi zone, which covers Parappanangadi panchayat and Vallikkunnu panchayat. The high level area (much of the land in Malappuram district is of an undulating nature) is fed from the Kodakkad reservoir by boosting from the Parappanangadi tank. The system has two 15 HP clear water pumpsets and one standby. For raw water, again, there are two 20 HP pumpsets and one standby.

Although under the rules for ARWSS sponsored schemes, domestic connections are not to be encouraged until all problem areas are first provided with a basic service, viz, public taps, the KWA feels confident that since only 50 per cent of the area will be covered, it will be in a position to grant connections, and the Assistant Engineer opined that 200 applications may be forthcoming. The size of the population designed to be beneficiaries in Vallikunnu is 12,000, of which at least 40 per cent have a problem of salinity.

2.3.4 Elapully - scarce and good to indifferent quality water - (existing scheme and sanctioned scheme)

> " Yes, there are ghosts in Elapully. We are the ghosts, the women who roam through the night in search of water and wait at the water pits for a few drops of water to seep through the parched earth. "
>
> old scheduled caste woman

Far flung plains, brown fields covered with clods their little sticks of dried stalk being chewed tenaciously by cattle, hot barren hills distant yet protective, seeming to gather the village to their bosom as they turn purple in the gathering twilight, dispersed houses, a warm heavy stillness broken only by a sudden wind rustling loudly through the palmyra leaves - Elapully village in Palghat district, our area of water scarcity, is very much more rural and quite a different experience altogether from our other sites in Northern Kerala.

It is a large village, 49.07 sq. kms. in area. The population is 31,986 comprising roughly 7,997 households. Paddy is the most important traditional crop, sugarcane, groundnut and maize being the other significant ones. Orchard cultivation - coconut and jackfruit, principally - is also practised. For the last three years, however, this village has experienced failure of the monsoons and all except the best-endowed cultivators (who have good tubewells) have been forced to leave their fields untilled. Only 10 households have holdings of 10 acres and above and another 148 could be called medium farmers owning between 5 and 10 acres of land. Over 60 per cent of those owning land are marginal farmers (below 2.5 acres) and another 30 per cent own between 2.5 and 5 acres. The majority of the population consists of agricultural labourers, many of whom have been forced to turn to other forms of employment due to the continuing drought. Wage rates have generally been lower in this region than in our other sites, Rs. 15 for men and between Rs. 8 and Rs. 10 for women in agricultural and construction activity. Factory wage rates are marginally higher at Rs. 25 for men and Rs. 20 for women. The only source of factory employment within the village, however, is a sugar factory employing about 2000 casual workers. Besides this, there is only the odd brick kiln, a few oil and flour mills, bakeries and teashops. Large numbers of men and women - all except the very old - go long distances everyday to neighbouring villages and towns scouring for jobs, or eke out a living on a bare five to six days employment in a month on those paddy fields which are still green or, among the women, earn a pittance sometimes in kind, doing occasional chores in the homes of the better off.

The proportions of Hindus, Muslims and Christians in the village broadly reflect the general Palghat pattern. Hindus predominate at 85 per cent, with Muslims forming the next largest group. Numerically largest among the Hindus are the Ezhavas as in other parts of Northern Kerala, Nairs are present in sizable numbers, and scheduled castes dominate among the agricultural and non-agricultural labourers. The largest group among the scheduled castes are Cherumans, others being Kanakkars, Parayans and Pulayans. The region also has a large number of traditional artisan castes - carpenters, stone masons, copper smiths. black smiths, etc,. - several of whom have undergone proletarianisation. The population is by and large bilingual, (as different from the rest of Northern Kerala) speaking both Malayalam and Tamil, the district having been a part of the erstwhile Madras Presidency.

The connectors and sample non-connectors in Elapully are concentrated in those parts of wards 5, 9 and 10 covered by the existing improved water supply system. Besides the private and public taps, the main sources of water in this site are private wells, a very small number of private and public troughs and a few public wells.

A number of the private wells are dry but for those connectors with well-endowed wells the private taps are an important complement, particularly in the summer when the water levels drop. Motors are not used from as early as March. Some connectors even use their wells as tanks for storing pipe water, which is then pumped up to overhead tanks. For connectors without their own well, the tap is a source only for drinking and cooking (stored in containers of every size and shape), as the water flow is weak and short lived, about one hour a day going upto a maximum of two hours a day. In wards 5 and 9 problems of elevation further compound the unreliability of the piped water supply. For other domestic needs, women in these families walk some distance to the nearest trough for bathing and washing clothes,and a little water is brought home, too. One particular private trough in Kuppiode in ward 5 is used by roughly 2000 people, indicating the tremendous pressure upon limited water sources. Some households permit access to their private wells, but place regulations upon the amount of water drawn (upto two pots, roughly 25 litres per household) and the timing of access (after sunset when the lamps before the household deities are lit is considered an inauspicious time, among higher caste Hindus, for giving away valuable commodities). Despite these restrictions, upto 40 families may be found using a single private well.

For non-connectors in wards 5 and 9, who belong to scheduled castes - as both these are mixed localities - and who have relatively limited access to neighbours' wells, the public taps and public wells are the main sources of drinking water. Several public taps are out of commission. Those that have water work for barely one and a half to two hours a day. Queues of pots, kitchen vessels, even tiny talcum powder tins stand patiently, representing their owners. When the water begins to flow there is a great rush and tensions run high. Again, social controls operate, as only one pot per household is permitted at a time and a woman must take her place in the queue a second time for more. On an average, a woman can accomplish two pots during the course of the flow, often she might be able to carry only one full pot home, but even under the best of circumstances the number rarely exceeds four, since the average pressure upon a public tap is 40 families. One public well in Elapully Petta in ward 9, its broad black rock bottom starkly showing through, and a little circumference of water the size of an average 10 litre plastic bucket in one corner, is typical of the kind of public wells that people have to resort to. The rockless part of its bottom is dug deeper every summer through voluntary collections and labour, but makes for little improvement. It takes roughly an hour and a half to fill four water pots, as water has to be drawn up using a tiny bucket rather like a large glass used for drinking (nothing larger will immerse in the shallow water), then strained through a cloth and left to settle. For all other domestic needs, the only public source in the locality is a trough nearby, a small shallow pan where men, women and older children have to vie with buffaloes for the use of the knee-deep turbid greenish looking water. Small children suffer in these circumstances, getting bathed only once in two weeks or so.

The economic and social disparities which are evident even within wards are even more apparent when one visits ward 10, Elapully Gramam, the exclusive Brahmin quarter which still retains its gracious, old world charm. The settlement pattern is different here, a spotless broad street with houses on either side, most of them traditionally crafted, large walled-in backyards with groves of coconut and jackfruit. In this small cluster of 25 families, 20 have their own good wells, there are 6 house connections and 2 public taps. The taps run for a regular four hours a day. The public taps are also used by the servants of the quarter living in unserved neighbouring localities, but the wells are exclusive. There are two public wells on the street but like most public wells in the village these, too, are in a state of disuse. Like several of the non-connectors in the village for whom a pipe connection is affordable here, too, the non-connectors have made requests for connections but have been advised by the KWA to wait until the sanctioned scheme goes into operation. Even in this part of the village, water in the wells has began to shrink from about March. Elderly residents say that the water situation was not so grave 15 years ago. They attribute the steadily worsening water environment to the mushrooming of a large number of tubewells in the region.

The sanctioned scheme is even more eagerly awaited by the poor in the as yet unserved wards 2, 3, 4 and 7 for whom the problem of water is grimmest. There are none of the familiar swaying palms or garden plants around these houses - although they look neat and well kept - and they are devoid of any but the most rudimentary of cooking vessels, everything of any value having been sold away in the last three years of the drought. In the distant, exclusively scheduled caste locality of Venthapalayam in ward 2 at the foot of the burning, desolate hills, upto 70 families have to use a single public well, almost fully dry, where the shallow pool of water at one end is quickly exhausted and fresh water takes interminably long to seep through. The drawing of water from this well goes on round the clock for this reason and the water, lifted using children's tiffin boxes small enough to be teased into the pool, serves only for drinking. Even water for cooking has to be trudged for to distant public taps or to a severely regulated tubewell in a sugarcane field about a kilometre away. Baths are not possible outside the monsoon months, and the spectre of unemployment and thirst dominate the people's consciousness. This and another poor locality, Chozhiambakkam in ward 4, are too distant even for the tankers which the panchayat has been arranging for in recent summers. The tankers confine themselves to the main road and give water on production of the ration card, limited to five pots per household. In Chozhiambakkam, the only source of any kind of water are two troughs. Both look virtually dry, except that one has some greenish looking water at one end which is used by the 85 families or so here, for all domestic needs other than drinking and cooking. On drawing closer to the other trough which is used for coaxing out water for drinking and cooking, one can discern a strange pattern on the surface. There are a number of holes rather like giant snake pits all over the brown, dry surface of the trough. In the monsoon these pits fill up and the water is used for drinking and cooking. They start drying up steadily from the higher reaches until only the ones at the water level remain. The acute problem starts in this locality, as in the rest of Elapully, as early as October and by March or so, only about two pits remain. A canal leading from the Vayalar dam, which is one of the sources of irrigation in the village, flows through the bleak wastelands where these troughs stand and when the water flows in the canal some water seeps into them. Water is scooped into containers using ladles, and there is a steady stream of women round the clock to collect the few drops that seep through at a time. Social criticism is levelled sharply against any one sullying this water, but despite this, the water has a viscous whitish hue.

The existing scheme in Elapully which dates back to 1971 was designed mainly with the intention of relieving the people of hardships in finding water even for drinking. Based on a norm of 15 litres of water per capita per day for drinking and cooking, a dug well was improved upon and fitted with a 6 HP electric pump set. It supplied water through a small length of pipe line covering three to four wards in the village by providing stand posts and a few domestic connections. A storage tank of 22500 litres capacity was constructed. Keeping in mind the national norm of 40 litres of water per capita per day for meeting domestic requirements and with a view to bring a larger number of households under its coverage, this scheme was strengthened in 1983 by adding a tube well. A pump house was constructed and an electric pump set of 10 HP was installed to draw water from the source. Both these sources taken together, supply potable water through a distribution pipe running into 5452 metres. It serves mainly wards 5, 9 and 10 through 150 standposts and about 100 yard taps.

The sanctioned scheme with its main focus on the remaining parts of this panchayat is much larger in scale. Its source is the Chittoorpuzha river, where a large sized well has been sunk, and fitted with a pump house, infiltration gallery and collection and inspection wells. The distribution pipes are 36,775 metres in length and cover predominantly wards 2, 3, 4 and 7. Standposts have been provided as per the norms mentioned earlier. The system also allows for some domestic connections. There are, in fact, a great number of persons in this village whose applications have been kept pending with the KWA for the last few years, in anticipation of the new scheme.

Both these schemes - existing and sanctioned - are by the KWA which is also responsible for their maintenance. The role of the panchayat is limited only to collecting the amounts billed for house connections, for which it keeps 7 per cent of this amount towards collection costs.

2.4 Sample Selection

The focus of our study being on demand for water from the "improved" service, only those households with access to the distribution pipeline formed the universe for the study. Keeping in view the prevailing norm for standposts meant to cover households within a distance of 30 metres and the existing pattern among those opting for yard taps (where the maximum affordable connection cost ranged between Rs. 1000 and Rs. 1200) only those households located within 30 metres of the distribution pipeline were deemed to meet the access criterion. The households with access to improved water supply under the existing schemes were divided into two groups: those with yard taps, whom we termed 'connectors', and the others without yard taps, the 'non-connectors'. Those households within reasonable access, as defined above, to "improved" water supply under the sanctioned schemes, formed a single group of 'probable connectors'. The distribution of these groups in the relevant sites in the different environmental areas are presented in the following table.

Table 2.1

Group-wise Distribution of Households under Existing Schemes

Area / site description	Number of households			
	In the universe	With yard taps (connectors)	Non-connectors	Non-connector sample households
Ezhuvathuruthy (adequate/good-quality)	885	66 (7.5)	819	100
Elapully (scarce / good to indifferent quality	809	86 (10.6)	768	100
Ezhuvathuruthy (abundant / saline in quality	866	98 (11.3)	723	100

Figures in parenthesis indicate the percentage of connecting households in universe.

Table 2.2

Group-wise Distribution of Households Under Sanctioned Schemes.

Area / site description	Number of households	
	In the universe	Number of sample households
Nannamukku (adequate / good quality)	1497	200
Elapully (scarce/ good to indifferent quality	876	200
Vallikkunnu (abundant / saline quality	1313	200

It would be observed that only between 7 to 11 per cent of the households have opted for yard taps. Since the number (in absolute as well as relative terms) of connectors was extremely small, and since the main theme of our study is to ascertain willingness to pay, we decided to cover the entire number in our field investigation. Among the non-connectors, we included every seventh household based on randomness. The same procedure was followed for the sample households from among the universe for the sanctioned schemes. Since sampling was not strictly random, in Table 2.3 we show the weights used in estimation.

Table 2.3

Sample Weights.

Area / Site description	Sample weights for		
	Connectors	Non-connct -ors	Probable connectors
Adequate / good quality water area	0.0028	1.65	1
Scarce / good to indifferent quality water area	0.2293	1.66	1
Abundant / saline quality water area	0.2283	1.76	1

2.5 Questionnaire Development, Design and Investigator Training

The field investigation was carried out with the help of pre-designed questionnaires which were administered by a team of field investigators. In all, three types of questionnaires were prepared: one - Household Schedule A1 - for those with a yard tap (connectors), a second - Household Schedule A2 - for the sample non-connectors, and a third one - Household Schedule B -

for the households situated within access of the distribution pipe line under the sanctioned scheme whom in the interests of brevity and in the absence of a better description we have termed probable connectors. The household questionnaires in all the three cases are structured to collect detailed information on (a) demographic, social and economic characteristics of the households; (b) "revealed behaviour" of the households, i.e., characteristics of the principal and the "next best" sources used - the level of service, distance, reliability, cost, quality of water, etc.; and, (c) "contingent valuation", i.e., source choice decision in the presence of an alternative, specified by the level of service, distance, quality of water, etc., and source choice decision as a sub-set of price.

"Bidding games" have been evolved to address policy issues of specific interest in the context of Kerala. They revolve around the three basic issues of connection costs, tariffs and quality of the service.

For those who are currently connected (Household Schedule A1),two bidding games are played. In the first game the monthly charges are increased steeply from the current average level and the respondents are asked whether, at each specified level,they would continue to connect, or disconnect and use other sources. The second game administered to them is identical, except that they are asked for their responses if water were made available for a longer duration than is available currently.

For those who have access to the improved service but have chosen not to connect, (Household Schedule A2) three bidding games were developed. The first game assesses their response to a graduated set of connection costs without changes in the existing level of tariff. In the second game, the connection cost is reduced drastically, but the level of tariff is increased significantly. And in the third game, the connection cost is fixed low and the monthly tariff raised but the element of quality of service is introduced.

For those households yet to have access to the improved service (Household Schedule B), the first bidding game assesses the response to a range of connection costs and the second game assesses the response to a financing scheme which reduces the initial costs and raises the monthly charges.

In addition to the above, the contingent valuation technique was used to ask connectors, on the one hand for what purposes they would use their pipe water were it to become available to them at a higher level of service and, on the other, what traditional sources they would resort to if the pipe water became prohibitive.

In the case of non-connectors, reasons for not taking a connection despite access were ascertained and in the case of the probable connectors the basic level of awareness of what a pipe water system is, was determined.

Two other tools of investigation were used. One was a village schedule designed to capture the relevant socio-economic and water related details for the village. The other were focused interviews conducted with informal women's groups, men's groups, mixed groups, and local opinion makers in each of the several pockets of the sites where the survey was done. The principal objective of these group interviews was to capture those aspects of social/economic life and water sources and water use which would ordinarily not get reflected in household interviews. The group discussions focused on people's perceptions about traditional and improved sources of water supply; their views on the planning, execution, operation and maintenance of the improved service, their opinions on connection costs and tariffs; and, the links between water sources, water use, health, sanitation and environmental factors.

Six investigators, two women and four men, all young graduates and natives of northern Kerala were selected. Themselves rooted in villages, they had a basic sensitivity to the issues being investigated. The training of the investigators proceeded apace with questionnaire development. By the time the questionnaire was finalised for pre-testing, the investigators were familiar with the whys and wherefores of every question included. The language of the questionnaire remained English throughout, but went through an informal process of translation into Malayalam and back into English as the training proceeded. Training took place over a period of three weeks and the methods included group discussions, mock interviews, field trips and demonstrations. A field supervisor received training along with the rest of the team.

Pre-testing was conducted for each type of questionnaire in different sites by each investigator, with principal investigators present at the time and place of household interviews. Apart from serving as a final check on the absorption of training by the investigators, it compelled us to change the sequence of many of our questions (this is revealed by the sequencing pattern in our questionnaires), introduce counter-checks and reformulate questionnaire administration protocols. Familiarity with physical verification of water quality and condition of wells, assessing well deoth through measuring rope length, conversion of water quantities from pot quantities into litres through familiarity with water pot sizes and shapes in different sites, measuring distances to water sources in paces and its conversion into metres, recognising housing construction materials - these were some of the elements that went into investigator training in the field during the training and pre-testing period.

The household survey began in January. We started our work in Edappal sub-division for both existing and sanctioned schemes in the area with adequate and good quality water from traditional sources - Ezhuvathuruthy village and Nannamukku village - and for the existing scheme under conditions of abundant but saline water - Ezhuvathuruthy village. From there we had planned to move to Malappuram sub-division to a sanctioned site under conditions of salinity - Vallikkunnu village - but abandoned this course in the wake of news about the outbreak of cholera in Palghat. We moved instead to Palghat sub-division to the existing and sanctioned scheme sites under conditions of good to indifferent water quality but acute scarcity - Elapully village - in order to complete the investigation before the cholera could acquire epidemic proportions and affect our field work in any adverse way.

A noteworthy feature of our field work was that our entire team of field investigators and supervisor, the two principal investigators joining them frequently for extended periods, stayed together in houses rented by us in the respective survey sites. This had many advantages. Those who were interviewing and those who were being interviewed had easy access to each other, informal interactions were much more frequent and intense, and it afforded a certain degree of participant observation. The investigators had greater interaction with each other and with the supervisor. A lot was learnt from each other in terms of modifying individual styles for administering the questionnaires, establishing rapport with the local communities and in evolving mechanisms to check and counter-check the questionnaires. The focused interviews were conducted by the principal investigators themselves.

CHAPTER III

AN IMPROVED WATER SUPPLY SYSTEM AND ITS BENEFICIARIES: SOME QUALITATIVE OBSERVATIONS

The main concern in this chapter is to gain insights into the functioning of the improved water supply system in Northern Kerala, by undertaking a review of the institutional and administrative innovations at the Kerala Water Authority (KWA) and by ascertaining views at the grassroot level from the users of this service on its efficacy in meeting their requirements for potable water. While our analysis of the former is based on various reports and discussions with the KWA and its functionaries at various levels at the Northern Kerala headquarters and at the divisional and sub-divisional levels and with the personnel of the Socio-Economic Unit of the DANIDA located at the KWA, our evidence on the latter aspect is derived from focused interviews with various groups in the population. Group discussions were held in the existing as well as sanctioned sites in most of the wards falling within the service area of the improved supply system upon conclusion of the survey in each site. Anyone with a willingness to participate was invited and discussions were held with all-women groups, men's groups, and mixed groups. The strength of these groups ranged from 15 to 25 persons. While the majority of those attending these meetings were in the age group of 40 to 50 years, those representing younger and older age groups were also present. In some cases we held separate discussions for the well-to-do (salaried persons, orchard owners and businessmen) and the disadvantaged groups such as scheduled castes and wage labourers. The participation by women was much greater among the latter. The discussions were focused around the conditions before and after the improved supply, the continuing role of traditional sources, the assessment of and/or expectations from the improved supply with respect to quantity and quality, planning, and implementation of the improved service, the relative roles of standposts and domestic connections, the question of maintaining and operating the system, the ways in which the required funds could be raised for this purpose, the role of the improved service in promoting people's health particularly those of women and children, and last but most important, their willingness to participate in the planning, execution, operation and maintenance of the 'improved' supply system.

3.1 Institutional Framework

Provision for water services in Kerala is the near-exclusive responsibility of the Kerala Water Authority which was created first through a Government Ordinance in 1984 and subsequently supported through a legislative act in 1986. It functions as an autonomous authority and apart from improving and regulating water supply, it is also responsible for waste water collection and disposal. The scope of our discussion here is confined only to the former. Earlier these functions were performed by the Public Health and Engineering Department (PHED). The changeover to the Authority / Board / Corporation form from the departmental form, it was argued, would streamline the planning, execution and management of the water supply and sanitation system. It was also hoped that the new organisational form would be better equipped to raise financial resources from instititional sources of finance - both internal and external - and to adopt a better financial management system. The moves for this organisational change coincided with the various negotiations which the Government of Kerala was conducting with the Government of The Netherlands and with the World Bank. The UNICEF has also been financing drinking water schemes in the state. It is quite likely, therefore, that the immediate motivation or stimulus for the change in the organisational form might have come from the desire to facilitate these negotiations. Nevertheless, the attempts to streamline the planning, execution and management aspects, too, followed almost immediately. Management and financial consultancy services were hired to suggest improvements in the organisational plan including the delegation of powers and defining of job responsibilities, staffing pattern, project planning, materials management and the financial accounting system.

The consultants reviewed different forms of organisational structure for the KWA and finally recommended a structure based upon three operational regions, supported by a Planning and Services Division based at the headquarters at Trivandrum. This framework was provided to allow for the decentralisation of the functional aspects of the KWA, headed by Chief Engineers in the three regions and in the Planning and Services Division, who would report directly to the Managing Director. The opportunity to scrutinise this plan came when the World Bank set up its appraisal mission prior to making definite commitments for financing investments in the water sector in Kerala. The appraisal mission was of the opinion that the post of Financial Advisor and Chief Accounts Officer (F.A. and C.A.O), too, should be on par with that of Chief Engineer as he/she ought to be expected to provide leadership in the financial management of the KWA. The appraisal mission also felt the need for introducing further decentralisation in functional aspects as a cost reduction measure and for reducing the undue load on the Managing Director as he had far too many functions under his direct control. The Government of Kerala had ruled that all sanctioned posts needed this prior approval. The KWA, backed by the consultants' report, could now approach the government with the demand that it be vested with the powers to sanction and fill any post which carried a pay scale below Rs. 2500 per month, i.e., a position equivalent to that of Deputy Chief Engineeer. The appraisal mission pointed out that instead of expressing this demand in monetary terms, the KWA could better express clearly the level at which these positions were meant, and thereby avoid any distortion due to price rises and salary revisions in the future.

The need for maintaining close links with the various departments of the government, with the local bodies and with the members of the public, has been recognised in the organisational structure of the KWA. The Secretaries of the Departments of Health, Finance, Development and Local Administration are members of its Board of Governors. Two representatives from local bodies and a member belonging to a scheduled caste or scheduled tribe are also appointed by the Government of Kerala to the KWA Board of Governors.

The KWA has its own fund called the 'Kerala Water Authority Fund' which is deemed to be a local fund and to which are credited all monies received otherwise than by way of loans or on behalf of the Authority. It also has another fund called the 'Kerala Water Authority's Loan Fund' which is deemed to be a local fund and to which are credited all monies received by or on behalf of the Authority by way of loans. In addition, it has the powers to constitute such other funds as may be necessary for the effective performance of these functions. Again, the KWA is the sole agency authorised to borrow money for water supply and sewerage works. The Government of Kerala by and large guarantees the repayment of loans and payment of interest on all loans made by or transferred to the KWA. 'The government may from time to time, after due appopriations by the law of the State Legislature make grants, subventions, capital contributions and advance loans to the KWA.'

The KWA is entitled to fix - by notification in the Gazette - the cost of water to be supplied by it according to volume and also the minimum cost to be charged in respect of each connection. It may provide water meters to consumers and charge a rent on it. It can demand a sum of money as security from any consumer, provided it pays interest at the official rate. It is also entitled to charge fees for connection, disconnection and reconnection of water supply or for testing or supervision of any other services rendered or work executed or supervised. Any sum due to the KWA - on account of any tax, fees, cost of water, meter rent, penalty, damage or surcharge -is recoverable as arrears of land revenue.

3.2 Grassroots Issues

3.2.1 Tariff collection

The improved water service is mainly through standposts and only a small proportion of households have been provided with yard taps (house connections). Most of the schemes are very small in size, using ground water or surface water as their source for raw water. The tasks of tapping the source, acquiring land for storage tanks and pumping stations, laying the distribution lines and maintenance of the system, are solely with the KWA. The responsibility for the recovery of operation and maintenance costs and for the granting of house connections, generally rests with local level institutions - the panchayats -, at least in the old schemes. These costs include the salaries of operating staff, repairs of pipelines, repairs of pumpsets, electricity charges, chemicals for disinfection, and other sundries. Every quarter, the Executive Engineer sends a bill for the same to the panchayat. The panchayats have the necessary authority to levy a water tax, which most of them do, on the basis of a certain proportion of the rateable value of the individual dwellings. Alternatively, the panchayats can meet these costs from their grants or other revenues.

When the panchayats fail to pay up the operation and maintenance costs, an adjustment grant from the government has to be invoked by the KWA to make good the lapse. Due to consistent defaulting by the panchayats, the KWA has taken to collecting water charges from private consumers in village panchayats coming under the new schemes undertaken by it, in addition to its responsibility for the actual maintenance of the systems themselves. But the KWA lacks the proper staff for such collection. Where formerly there were three or four schemes in a taluka overseen by three assistant engineers in a sub-division, there are now 50 to 60 such schemes and as many operators. Attending to the technical maintenance of the schemes is in itself a major job, without what the KWA sees as the onerous task of reading meters and collecting tariffs. Nor have operators been found to be sufficiently responsive to complaints from users in general about the level of service, from private connectors in particular about faulty meters, e.g., or from users of public taps regarding the condition of the taps.

The expansion of the role of the government through the newly constituted water authority, to meet the objective of making drinking water available throughout the state through modern supply systems, has raised two crucial issues - of making these systems financially viable and self-sustaining and of enhancing the acceptability of the systems to the users by involving the latter in the operation and maintenance of the systems. The question of financial viability assumes even more serious proportions when we consider that the more recent schemes are larger and more expensive and, in the case of Life Insurance Corporation (LIC) loan-based schemes, e.g., it is the local bodies who are supposed to repay the loans.

The two obvious mechanisms to achieve the above that have suggested themselves to policy makers is, one, to raise the tariff for water so that a greater absolute amount becomes available for repairs and maintenance; and the other, to make panchayats unequivocally responsible for collecting tariffs and for bearing the maintenance costs of the systems. At present, there is no uniform tariff structure in Northern Kerala. The tariff varies from 40 paise to Re. 1 for domestic connections, and the fixing of the tariff has hitherto been left to the discretion of the concerned municipality or panchayat. A unification of the tariff for the entire state is under consideration. Authority officials opine that at Re. 1 per 1000 litres in the case of private connections, the KWA might be able to cover at least the minimum repair and maintenance, something which is not happening at present.

Tariffs can be recovered only from private connectors. At present, connectors form a miniscule proportion of village populations, generally 2 per cent, so the connector base will have to be widened if revenues are to be generated. An important factor influencing people's decisions on whether to connect or not can be expected to arise out of their experience of existing systems.

3.2.2 Supply constraints

Generally, in terms of the amount of water available to the households, the situation has undoubtedly improved with the commissioning of the water supply schemes. With the exception of one case, we have not come across an improved water supply facility in a state of disrepair or disuse. There are maintenance problems, but they are of the nature which renders the service only partially ineffective rather than in a total state of disuse. For example, when a public tap has been leaking due to some defect in the tap, the response of the maintenance staff has been one of sealing the tap and thereby cutting off the water supply to that point until pressure from the community mounts, rather than one of repairing or replacing the tap at the earliest. Pipes also get damaged and it takes upto a few months to repair or replace them. The situation whereby most of the distribution line is rendered inoperative within the first few years of installation seems to have been by and large avoided. Complaints about meters being of poor quality and requiring frequent repair or replacement are common but this at least has no impact on the systems' ability to provide water. Pumps have had to be repaired very often - as many as 15 to 20 times a year - and this has on occasion led to disruptions in the service. This also raises operation and maintenance costs, as every repair costs on an average Rs. 2000. Pump failure is mainly on account of volatile fluctuations in the power supply.

The constraints on the amount of and reliability with which water can be made available to the community are mainly on the supply side and not because of the service being in a state of disuse or disrepair. Most often the schemes are very small, either because of the limitations of the source itself or because the amount sanctioned was too small to permit larger schemes. Again, the national norm of 40 litres of water per capita in the design of improved water schemes is considered low in the context of water use practices in Kerala, which implies that even the predetermined number of beneficiaries require more water than what the scheme provides for. Yet another factor making for poor supply performance of the schemes arises out of the nature of the government guidelines for rural water supply schemes and the manner in which they are implemented. According to the guidelines of the Accelerated Rural Water Supply Programme of the Central government and the Minimum Needs Programme (under which the states undertake water supply projects), schemes may only be designed which provide 40 litres per capita per day <u>at the standposts</u>. House connections are not accounted for in the planning and provisioning for the schemes and, indeed, are expressly prohibited. Given the reality that certain sections of the population demand and are given house connections, the level of service may be expected to go down generally (both for connectors and more so for those who are solely dependent on public taps). Again, given the settlement pattern where rich and poor are often to be found in proximity to each other, there cannot be any effective demarcation between one pocket (or locality) and another in most of the villages (only the scheduled caste pockets would appear to be, by and large, homogeneous), and the pressure for house connections on a scheme based on a predetermined number of beneficiaries is likely to step up (this would be particularly true of schemes meant for economically weaker sections, for example). The other constraint - in many ways the most serious one - is the absence of durable supply of electric power. Even when there are no limitations imposed by the source and the system appears to be capable of supplying greater quantities of water, it fails to do so because electric power is available only for a limited number of hours in the day. There is no regularity, either, in the timings of the power supply, and the fluctuations in voltage apart from damaging the pumps reduce the pumping hours even further.

Hardly any improved water supply scheme has been able to provide water for upto eight or ten hours in a day. A few provide water for upto six hours a day. Many are able to keep up a supply of only four hours, while some can work up to a feeble one, two or three hours a day. The inevitable result of this has been long queues at the standposts. In many places there are as many as forty to fifty persons in a queue and it might take anywhere upto an hour to get one's turn. As a result, rationing mechanisms have evolved. In some places, a household is allowed to fill upto two pots, in others the maximum permitted is four. The flow of water from the tap is usually so weak that one might not get a second chance in the queue. Those with yard taps (house connections) do not have such a severe problem of getting sufficient quantities of 'improved' water, but their number is limited; they constitute 10 to 15 per cent of the households serviced by the water supply schemes.

In a situation such as this, the improved water service remains by and large a supplementary rather than primary source for meeting water requirements. In the areas with adequate supplies of good quality water from traditional sources, a sizeable number of households have their own wells. There are also a good number of public wells. Water levels in the wells, however, start dropping from November/December, and by April/May only a few wells are capable of supplying water. The pipe water is useful as a standby arrangement to the owners of dry wells who can turn to the yard tap or the standpost when their wells have dried up. For those who have been using the neighbour's well, the yard tap or standpost allows them to shift away gradually and with dignity, as fewer and fewer wells are available for drawing water in the dry season. At other times, the water from the yard tap or public tap implies a smaller number of trips to the neighbour's well or fewer buckets to be drawn from one's own well. In areas with abundant but poor quality water from the traditional sources, the quantity of water available through the taps has resulted in some saving of the time, distance and effort involved in procuring water from the extremely limited traditional sources supplying good quality water. The relief is much greater during the dry season when these sources shrink even further. In the areas where water has traditionally been scarce, pipe water may not provide full freedom from want or from the need to cover relatively long distances to fetch water, but it does provide some water when and where it is needed most. This is, however, not to gainsay the need for supply to become more reliable. In all, there can be no doubt that pipe water in northern Kerala has led to an improvement in people's lives insofar as it has augmented the supply of water for drinking and other domestic needs.

As regards the quality of pipe water, the situation differs from one scheme to another. Where the pipes are not cleaned and where the water at the source particularly in some borewells has turned acidic, pipe water is considered inferior in quality, and rightly so. In areas where well water is generally of excellent quality, cooking practices evolved over time (local diet, too, being rice based) predispose people to prefer well water, at least for cooking and drinking. Apart from this, people have no preconceived notions which would make them reluctant to use the improved service. There is in fact, in northern Kerala in general, a positive approach towards pipe water, highest in scarce and saline quality water zones, but also reasonably high even in areas of good quality water where rather than acute need it is the perception of pipe water as a symbol of modernity and relief from drudgery that operates. In the good quality water zones, however, the demonstration effect of a badly run service is a deterrent to people opting for house connections, while in all three types of water zones poverty is the overriding factor which rules out the possibility of paying the initial cost of connection.

3.2.3 Problems in system design and implementation

Apart from removing the supply constraints, there are several other features of the service which would need to be taken care of if it is to qualify for the nomenclature "improved" service. In this regard, the planning of distribution lines and standposts deserves utmost attention. In their initial phase the schemes have invariably tended to start the distribution pipe lines from those parts of the village which are most centrally located, which are also the pockets where the relatively better off live. When the distribution pipes are extended to other parts of the village, the system due to its initial weakness, viz., being underdesigned (a point touched upon in section 3.3.2) has already exhausted its operational capacity. This leads to weaker flows, shorter duration of supplies and longer queues at the standposts in the localities which are covered later (scheduled caste localities suffer more than others in this regard). Again, the pipes are laid only along one side of the road, which makes the system inaccessible to those living on the other side, as it is a major problem and an expensive one to cut through the road and take a connection across to the other side (internal roads in

Kerala villages are much broader than what one encounters in the rural areas of many other states). The rationale offered for this practice is that by doing so, the KWA does not have to acquire any land other than what is required for reservoirs, pumping stations and treatment works. The defects in the distribution pipelines and the other factors which make the service ineffective for the majority of the population are a direct outcome of the top down approach which does not appreciate the need for consultations with the local people. Our discussions with groups of people at the sites covered by us suggest that the local populations have been observing the planning and laying of the distribution pipelines with keen interest and have shown a greater anticipation of the problems arising out of differences in altitudes and in the size of pipes, than was probably expected of them. In their view, it is not a major problem to pass the distribution pipes through private lands provided the people are taken into confidence and transmission lines are designed keeping in mind the maximum benefit for the entire community.

The absence of any consultations with the local population is also responsible for the faulty location of standposts. Since standposts are decided upon on the basis of distance, e.g., every 200 metres or so, they are either too close to or too far from the intended beneficiaries. Sometimes there are standposts situated in the centre of a cluster of houses each with its own private well. In some cases a standpost might serve as many as 70 to 80 households, while in others it might be relevant to only five or ten. It is the opinion of the people who would most use the standpost that density of settlement rather than distance should be the criterion for locating standposts. In all our sites, particularly in those areas where wells were few or non-existent which were also the areas where the poor clustered, the need to increase the number of standposts was pointed out to us. Interestingly, the exclusively scheduled caste-targeted schemes we had visited in Calicut district, for example, had sited standposts fairly densely. Yet, in the large comprehensive schemes, scheduled castes / poorer sections suffering the same disabilities as their counterparts elsewhere, have been relatively under-provided for in the planning of these schemes. There are also examples of standposts being located at points which get flooded during the monsoons, thereby making them inaccessible for that period.

The gap between the time a scheme is sanctioned and when it is actually commissioned is often too long, robbing the service of any credibility it might have otherwise enjoyed. A two year gap is very common, and in some cases the gap has been of the order of four to six years. In those sites where the time gap between the laying of the distribution lines and the projected date of commissioning has been unduly long, widespread scepticism prevails regarding what the system's performance will actually be like - a not very happy prognosis for an 'improved' water supply system. People stoutly maintain that they will not believe that pipe water will be supplied to them unless they see it flowing regularly for at least a month. The decline of credibility of drinking water schemes has also been fuelled by political factors. The laying of pipelines as part of election promises even before the dependability and quality of the source has been ascertained, leaving the pipelines to rust away in the interminable vacuum that follows elections, is one example. The gimmick of supplying water through temporarily connecting distribution pipes to some other scheme in the neighbourhood during the electioneering period or on the days that elections are held, is another experience that has made people doubt the intention behind the schemes. People's frustrations have also flared up (particularly in the areas of acute scarcity) when unannounced testing of a yet-to-be commissioned scheme has resulted in water flowing in the pipes round the clock for a day or two and equally abruptly shutting off, virtually forever as far as the people are concerned. These are also the sites where people will in all likelihood not receive more than two to three hours of running water at the most per day when the schemes go into operation. A closer two-way communication between systems and their beneficiaries cannot be sufficiently stressed. (Interestingly, we observed a more neutral attitude moving upto an even positive one - albeit cautiously positive - in those sites where the commissioning of schemes promises to closely follow the laying of pipelines).

3.2.4 Public accountability and public involvement in operation and maintenance

The plank on which community involvement in operation and maintenance of water supply schemes can be fostered, must necessarily be a greater communication between the people and the KWA. This presupposes a much larger canvas of community involvement than is presupposed in the dictum that village panchayats must shoulder the responsibility of meeting the O and M costs.

The example cited a little earlier of the cynicism generated by unannounced testing of pipes was only an extreme illustration of the lack of communication between the planners of water supply schemes and the users. The only people in the village with any contact with the water systems at present are private connectors, i.e., those who pay, whose meters are read and who are billed for their water use. Outside of this, there is no clear locus of responsibility for public supply, no mechanism for lodging complaints about the functioning of public taps - irregularity of flow, leakage, breakdown or misuse by the rich watering their orchards from public taps to save on electricity or diesel. There is not much, either, by way of a regular flow of information about the progress of new schemes in the respective villages. Some of this last has been described earlier under design and implementation.

This locus of responsibility cannot come about as a logical result of panchayats being made responsible for recovering O and M costs. Apart from the sheer size of the villages they are supposed to govern, there is much to be desired by way of a live tradition among panchayats, of acting in the interests of disadvantaged groups. It would appear, therefore, that for the effective functioning of water schemes, it is necessary to have a multi-tiered decentralised system in addition to widening the connector base as connectors can function as an effective pressure group to demand efficient working of schemes.

An area of much potential is the formation of citizens' committees for water or 'water committees' (pani panchayats as they are called in some parts of the country) at the level of pockets with a strong representation of women. Women cut across all caste and religious groups as the single most disadvantaged group in relation to water, with the women in poor and scheduled caste households having to bear the double burden of going to distant sources at all hours of the day and night to carry home heavy pots of water in addition to doing all the housework and going out everyday in search of employment where, too, they are paid lower wages than men. Whether Hindu or Muslim, women fetch water until the last day of pregnancy and resume when the 90 day limit is over, sometimes as early as 40 days where the pressure on them is greater. When they are sick women neighbours help by fetching water or, if well owners as in the good quality and saline water areas, provide free access to their own wells. When men help, even among the scheduled castes where women enjoy a relative autonomy being themselves wage earners, it is only to fetch water for their own use. Where the household has a number of children, they shoulder some of the burden of fetching water. Among all but the most wretchedly poor Muslims of our Vallikkunnu site, men will not under any circumstances be seen in the culturally inferior role of water carriers or do any water related household chores, such as washing their own clothes.

Women have no recourse but to enter into networks with other women, in the joint family or in the neighbourhood, to share the drudgery when they are sick or around childbirth. It is only among the better off without wells or house connections that water carriers are hired - again women - on payment. While women in all communities and income groups feel neglected, the feeling of powerlessness is most acute on the part of the men and women of the scheduled castes in their relatively segregated pockets, who feel alienated from even the local body, the panchayat.

All the sections we talked to, however, responded positively to the suggestion that citizens' committees might be an effective mechanism to ensure accountability of systems and their operators. There is a strong desire for being involved in the siting of public taps, for being kept informed about changes in hours of supply or power breakdowns. for some means of invigilation of water misuse. As one citizen put it, "good service must also insure against the drying up of supplies in a scarcity situation". Women were generally enthusiastic about the idea of women operators and co-ordinators. "Women understand best the problems of other women and a woman operator will ensure that timings of water supply are not prejudicial to women," was an oft-repeated comment. It is interesting that in the sanctioned sites of Nannamukku, Elapully and Vallikkunnu, the enthusiasm was higher than in the existing sites of Ezhuvathuruthy where 'bad' development seems to have engendered anger against the functioning of the system but, correspondingly, a feeling of passivity and hopelessness about the possibility of people's intervention. When asked what they would do with the extra time they would have once the pipe supply was available, middle caste women in the assured water sources site of Nannamukku could visualise, variously, doing kitchen gardening, taking up sewing and doing more housework and the scheduled caste women felt they would be free to do more wage labour and augment their incomes. In the scarcity area of Palghat, poor women universally exclaimed that when the pipe water came they would sleep through the nights and stay in bed until dawn. In the saline area of Vallikkunnu, for the wives of the poor fishermen, pipe water would mean an assured drink of clear water without having to travel long distances for it.

CHAPTER IV

WATER SOURCES AND USE PATTERNS

An important factor influencing a rural household's choice in favour of the improved water system and, its willingness to pay for this service, is the existence of alternative sources. The quality and amount of water available through these sources, the differences in access to them for various sections of the village population and the end-uses to which the water from these sources is put would all be determining factors. Further,the appeal of the improved service when viewed in terms of its health benefits is determined not by its bacteriological quality but by the perceived quality of the water in terms of taste, odour, colour and tradition. The assessment of an improved or new service in the rural water sector in both the pre- as well as post-planning phase must therefore be in relation to its role vis-a-vis the traditional sources. This chapter is devoted to the examination of access to different water sources (including piped water through yard or public taps), the effort involved in fetching water from these sources, seasonal variations in supply of water, reliability of individual sources in meeting household needs, end-use pattern and the perception of water quality and service among the different groups (connectors, non-connectors and probable connectors) in the good quality, scarce and saline water zones.

4.1 Water Source Characteristics and Combinations

The two salient aspects emerging from observations of the three environmental settings in northern Kerala are that rural households continue to exercise the choice for multiple sources of potable water and that the desire to opt for a convenient service is overwhelming. Own well / neighbour's well emerges as a parallel source to the yard tap among the connector households, and to the public tap among the non-connector households in the sites with piped water supply (Table 4.1.1). In sites where the piped water supply is yet to commence, too, the assertion of desire for a convenient service is equally strong. Almost all the sample households in the proposed sites located in the adequate / good quality water area are using either their own well or the neighbour's well. Only in the abundant but saline quality water area do one-fourth of the sample households turn to public wells in search of better quality water. In the water scarce zone, on the other hand, where the situation does not permit the widespread existence of individually owned wells, about half the probable connectors take recourse to public wells; nearly one - fourth of these households have to turn to other traditional sources as well, the chief among which is the trough.

Table 4.1.1

Most Important Water Source

Water source	Percentage Distribution of Sample Households in								
	Adequate/good quality water area			Scarce/good to indifferent quality water area			Abundant/saline quality water area		
	A1	A2	B	A1	A2	B	A1	A2	B
Yard tap	100.0	--	--	100.0	--	--	100.0	--	--
Public tap	1.52*	7.0	--	--	42.0	--	--	61.0	--
Total piped water	100.0	7.0	--	100.0	42.0	--	100.0	61.0	--
Own well	77.3*	77.3	86.5	44.2*	32.0	16.0	65.3*	20.0	37.5
Neighbour's well	18.1*	15.2	13.5	9.3*	13.0	28.5	23.5*	17.0	36.5
Public well	--	--	--	5.8*	13.0	47.0	8.1*	1.0	24.5
Total well	85.4*	82.5	100.0	59.3	58.0	91.5	96.9*	38.0	98.5
Others	--	--	--	--	--	8.5	3.1*	1.0	1.5

* In case of connectors it refers to the most important additional source to their own yard taps.

Note: A1 refers to Connectors
A2 refers to Non-connectors
B refers to Probable connectors

The reliance on multiple sources of water is most pronounced among the connector households in all the three environmental settings, among non-connectors in the saline area and among probable connectors in the scarcity area. The fact that the reliance on a single source (Table 4.1.2) is least among those with a yard tap reveals the supplementary character of the piped water schemes in their current form. It reveals the inadequacy of the service to meet relatively high needs of potable water. A relatively strong reliance on a single source among the connectors in the water scarce area is more a reflection of the overall supply constraint there rather than of the ability of the improved system to meet household requirements for water. While most households in all the categories rely on upto two sources for most part of the year, in the summer season most of them have to stretch themselves upto three sources due to the scarcity of water from their principal and / or most important additional source.

Among those who rely only on a single source for their water requirements, piped water is of significance only in the water scarce area. Here 37 per cent of the connector households have reported yard tap as their only source. In the case of public taps (standposts) this was the case with 35 per cent of the non-connectors. In the other two environmental settings the reliance on a single source was greatest among those having their own wells.

Among the households taking recourse to multiple water sources, the combinations of yard tap with own well followed by yard tap with neighbour's well are most common among the connector households in all the three environmental settings. For the connector households in saline sites the combination of yard tap with neighbour's well becomes even more important than yard tap with own well in the summer. This is because some of the privately owned wells with good quality water must either be drying up in this season or turning saline. Among the non-connectors, public tap with neighbour's well is the most widely followed combination in the adequate / good quality water sites. It reveals the importance of the public tap for non-connectors in this environmental setting as it grants some freedom from dependence on others for water. Public tap with neighbour's well emerges as the most important combination among non-connectors in the area with saline water where it acquires the highest prominence in comparison with the other two environmental areas. As expected, non-connectors in the water scarce sites follow a wider range of combinations where public tap and / or public well provide a much needed relief. In the sites where the piped water system is yet to commence, public well with own well and public well with neighbour's well are the two most widely followed combinations in all three environmental settings.

Table 4.1.2

Access to Water Sources.

Number of water sources used	Percent Sample Households by Number of Water Sources in: Adequate/good quality water area			Scarce/good to indifferent quality water area			Abundant/saline quality water area		
	A1	A2	B	A1	A2	B	A1	A2	B
<u>In all seasons</u>									
Single source	5.0	85.0	60.5	37.2	69.0	40.0	3.1	15.0	54.0
Two sources	87.5	14.0	39.5	62.8	30.0	60.0	96.0	80.0	46.0
Three sources	7.5	1.0	--	--	1.0	--	1.0	5.0	--
<u>Winter</u>									
Single source	5.0	91.0	99.0	37.2	74.0	65.0	4.0	36.0	75.0
Two sources	83.0	8.0	1.0	62.8	25.0	34.0	86.0	61.0	25.0
Three sources	12.0	1.0	--	--	1.0	1.0	10.2	3.0	--
<u>Summer</u>									
Single source	5.0	85.0	60.0	37.2	69.0	40.0	5.0	15.0	54.0
Two sources	83.0	14.0	39.8	61.8	30.0	60.0	71.6	80.0	46.0
Three sources	12.0	1.0	--	1.0	1.0	--	23.4	5.0	--
<u>Monsoon</u>									
Single source	5.0	93.0	100.0	37.2	79.0	60.0	3.1	41.0	73.0
Two sources	87.5	6.0	--	60.8	28.0	39.0	96.0	58.0	26.0
Three sources	7.5	1.0	--	2.0	1.0	1.0	1.0	1.0	1.0

Note : A1 refers to Connectors
A2 refers to Non-connectors
B refers to Probable connectors

Table 4.1.3

Mono Source Reliance

Water source	Percent Sample Households in								
	Adequate/good quality water area			Scarce/good to indifferent quality water area			Abundant/saline quality water area		
	A1	A2	B	A1	A2	B	A1	A2	B
Yard tap	4.5	--	--	37.2	--	--	3.1	--	--
Public tap	--	6.0	--	--	35.0	--	--	12.0	--
Neighbour's tap	--	--	--	--	6.0	--	--	1.0	--
Total piped water	4.5	6.0	--	37.2	41.0	--	3.1	13.0	--
Own well	--	57.0	49.5	--	21.0	2.0	--	3.0	32.5
Neighbour's well	--	21.0	10.5	--	2.0	15.0	--	9.0	18.5
Public well	--	1.0	0.5	--	5.0	23.0	--	--	3.0
Total well water	--	79.0	60.5	--	28.0	40.0	--	12.0	54.0

Note : A1 refers to Connectors
A2 refers to Non-connectors
B refers to Probable connectors

Table 4.1.4

Source Combinations

Water source combinations	Percent Sample Households with Access to Multiple Sources in								
	Adequate/good quality water area			Scarce/good to indifferent quality water area			Abundant/saline quality water area		
	A1	A2	B	A1	A2	B	A1	A2	B
Yard tap + Own well	69.7	--	--	36.0	--	--	52.0	--	--
Yard tap + Neighbour's well	7.6	--	--	22.1	--	--	26.0	--	--
Yard tap + Pub. well	10.2	--	--	4.7	--	--	18.0	--	--
Yard tap + Pub / Nei. well+trogh	7.5	--	--	--	--	--	1.0	--	--
Pub. tap + Own well	--	2.0	--	--	2.0	--	--	15.0	--
Pub. tap + Neighbour's well	--	7.0	--	--	6.0	--	--	33.0	--
Pub. well + Own well	--	--	--	--	12.0	--	--	15.0	12.0
Nei's well + Pub. well	--	5.0	32.0	--	8.0	24.6	--	16.0	12.0
Pub well+ neigh's well + trough	--	--	--	--	--	21.5	--	--	7.0
Pub tap+ Pub/Neig's well + trough	--	1.0	--	--	1.0	--	--	5.0	--

Note : A1 refers to Connectors
A2 refers to Non-connectors
B refers to Probable connectors

On an average a non-connector household has access to a public tap within a distance of 30 to 40 metres requiring four to five trips a day, with an average queueing time of about half an hour to an hour per trip. For those with a yard tap, the connection cost has ranged between Rs. 1300 to Rs. 1700. The highest proportion of households with reticulation among the connectors was observed to be in the adequate / good quality water area reinforcing convenience as the most important consideration for hooking up to the piped water system in this area. Among the connectors in the water scarce area only 20 per cent have reticulation and it is factors such as freedom from queueing at the public tap or dependence on the neighbour's well which would be the main motivation for hooking up to the improved system. As regards the motivation for hooking up to the improved system in the saline sites where about one-third of the connectors have reticulation, convenience as well as freedom from dependence on neighbours and from long queues at the public tap would appear to play an equally important role. Knowledge about the basic features of the improved system and the implications of hooking up to it (i.e., the requirement of paying a monthly charge and the water being available only for a limited number of hours in a day) was widespread among the households where this service was yet to commence.

In all the three areas, the non-connector households covered a shorter distance to the traditional source of water - whether neighbour's well or public well - than to the improved source, the public tap. The average queueing time, too, was considerably less at the traditional sources and as a result the trips to these sources also increased in number. The relationship between distance and the number of trips to the water source is established more clearly in the sites where the improved water system is yet to commence. While there is hardly any significant difference in queueing time at the neighbour's well or public well among the probable connectors in the three sites, the average distance covered in the water scarce area is around 150 metres and only half the number of trips are made by them as compared with their counterparts in the other two sites where traditional sources are at an average distance of between 20 and 80 metres.

Table 4.1.5

Salient Information About Piped Water System

Item	Adequate / good quality water area	Scarce/good to indifferent quality water area	Abundant / saline quality water area
Average connection cost in Rs.	1,727	1,322	1,723
Proportion of connectors having reticulation	45.5	19.8	30.6
Average distance from public taps for a non-connector H.H(metres)	31	41	40
Average number of trips per day to the public tap by a non-connector H.H	5	5	4
Average queueing time(minutes) per day at the public tap by a non-connector H.H	33	24	64
Proportion of probable connecors reflecting knowledge about the main features of a piped water system	98.5	81.0	97.5

Note : H.H. refers to household.

Table 4.1.6

Salient Information About Well Water

Item	Adequate / good quality water area	Scarce/good to indifferent quality water area	Abundant / saline quality water area
For a non-connector using public /neighbour's well :			
a) Average distance (metres)	5	20	28
b) Average no.of trips in a day	10	9	6
c) Average queueing time(min.)	10	20	26
For a probable connector using public/neighbour's well :			
a) Average distance (metres)	18	148	80
b) Average no.of trips in a day	11	5	10
c) Average queueing time(min.)	10	5	7

4.2 Water Consumption and End-Use Pattern

On an average those with yard taps use more water (per household as well as per capita - Table 4.2.1) than others in all the three areas. Among the connectors themselves, those in the adequate / good quality water area use substantially more water than their counterparts in the other two areas, the difference in per capita consumption being 20 to 25 litres a day. The households who have not taken yard taps but have access to the improved service through standposts, too, are better off than the households in the sites without piped water supply.

Our evidence reveals that except in the area with adequate / good quality water from the traditional sources, rural households in northern Kerala face severe shortages in meeting their domestic requirement of water. Only in this area is the average water consumption slightly above the nationally fixed water consumption norm of 40 litres per capita per day for all categories of households. This is also the case with households having yard taps in the other environmental settings. The households with yard taps in the adequate / good quality water zone are in fact observed to be consuming water around the liberalized norm of 70 litres per capita per day. There are, however, marked differences in the consumption pattern of individual households. Except in the adequate / good quality water area, only between 60 to 70 per cent of the connector households are able to get more than 40 litres of water per capita per day. For the non-connectors and the probable connectors this is so only for 30 to 40 per cent of households in the adequate / good quality area and between 5 to 10 per cent in the saline and water scarce areas.

It is the non-connectors and probable connectors in the water scarce and saline areas who face acute shortage of water for meeting their domestic requirements. The only difference is that the former have access to public taps and are, therefore, slightly less worse-off, Their average consumption of water is 36 litres per capita per day in the scarcity area and 38 litres in the saline area, and only between 5 to 10 per cent of them are able to have more than 50 litres per capita per day.

The evidence does not reveal any significant variations in the consumption of water between different seasons within the same category of households. Only among the households in the adequate / good quality area have we observed a difference of between 3 to 5 litres per capita per day. In the other two areas (scarce and saline) the inter-seasonal variations are even slighter. with almost no indication of any variation at all among the non-connectors and probable connectors in the scarcity zone. This is not unexpected when the households find it difficult to meet their water demand even at its lowest ebb. That is also the reason why we were not able to discern any causal relationship between water consumption and factors such as income, family size, presence of higher education in the family, religion or caste etc., for which we had attempted a linear regression. The correlation coefficients did, however, indicate some positive relationship between per capita water consumption and per capita income as well as the presence of a female with high school education in the family among the connector households. There was also some evidence of negative correlation between household size and per capita water consumption suggesting attempts at economy in water use with increase in family size.

Table 4.2.1

Average Per Household and Per Capita Daily Water Consumption of Sample Households

Daily water consumption (litres)	Adequate/good quality water area			Scarce/good to indifferent quality water area			Abundant/saline quality water area		
	A1	A2	B	A1	A2	B	A1	A2	B
1)Per H.H									
Winter	457	335	338	270	197	188	364	218	205
Summer	490	328	314	268	196	186	351	208	201
Monsoon	470	305	340	277	199	184	348	230	220
Average	473	323	331	272	197	186	355	229	209
2) Per capita									
Winter	65	52	49	58	36	34	47	38	34
Summer	70	51	46	58	36	34	45	36	32
Monsoon	67	47	49	60	37	34	45	39	35
Average	67	50	48	59	36	34	46	38	34
3) % distribution of H.H by per capita water consumption									
upto 30 lpcd	-	-	-	-	-	-	-	-	-
31-40 "	22	59	67	34	95	89	41	90	92
41-70 "	26	32	29	14	4	10	42	8	7
71-100 "	29	7	4	32	1	1	14	2	1
over 100"	23	2	-	20	-	-	3	-	-

Note : H.H. refers to household
lpcd refers to litres per capita per day
A1 refers to Connectors
A2 refers to Non-connectors
B refers to Probable connectors

On examining the relative contribution of different sources in meeting water requirements for domestic needs we observed (Table 4.2.2) that the contribution of the improved system is greatest in the water scarce sites. In the sites where rural households have access to adequate and good quality water from traditional sources, the piped water accounts for the smallest proportion of the total requirements and it is claimed mainly by those having a yard tap. As against 61 per cent of water requirement of connectors in the water scarce area coming from the improved system, connectors in the adequate / good quality water area meet only 44 per cent of their water requirements through this service. In the saline area the improved service accounts for 48 per cent of the water requirement of the connector households. While only 2 per cent of the water requirement of the non-connector households in the adequate / and good quality area are met through the standposts, in the water scarce and saline areas the contribution of the improved service is as high as 35 and 24 per cent, respectively. Thus, even in the sites with an improved water supply system, the major contribution in meeting the water needs of rural households except in the case of connectors in the water scarce area, continues to be that of the traditional sources where wells play a crucial role. The other traditional source was the trough which met less than 2 per cent of the total water demand of households in the sites with existing piped water systems. In the proposed sites troughs had a role mainly in the water scarce area where 15 per cent of the water requirements of the probable connectors are met through this source.

In the case of well water, privately owned wells have dominated the scene in the adequate / good quality water area among all categories of households. Wells belonging to neighbours are of significance only among the non-connectors in this area accounting for nearly one-fourth of the total water supplied to them. Public wells play a very minor role in this area accounting for only 3 to 4 per cent of the total water supply. Public wells are of utmost significance in the water scarce area where they meet 20 per cent of the water requirements of the non-connectors and nearly half the water requirements of the probable connectors in this ecological setting.

Table 4.2.2

Source - Wise Percentage Share in Water Consumption

Water source	Adequate/good quality water area			Scarce/good to indifferent quality water area			Abundant/saline quality water area		
	A1	A2	B	A1	A2	B	A1	A2	B
Yard tap	44.5	-	-	60.9	-	-	47.9	-	-
Public tap	-	1.8	-	-	34.6	-	-	24.0	-
Total pipe water	44.5	1.8	-	60.9	34.6	-	47.9	24.0	-
Own well	43.3	74.2	89.0	24.1	26.3	3.2	20.7	29.5	19.3
N's well	6.1	23.9	8.1	12.9	17.7	32.8	4.8	43.7	58.5
Public well	3.7	-	2.8	2.1	20.4	48.9	1.0	1.1	21.9
Total well water	53.1	98.1	99.9	39.1	64.4	84.9	26.5	74.3	99.7
Others (trough)	2.5	0.2	-	-	0.9	15.1	-	1.6	0.3

Note : A1 refers to Connectors
A2 refers to Non-connectors
B refers to Probable connectors

Table 4.2.3

End – Uses of Tap Water
(User Percentage Among the Sample Households)

End – use by Season	Adequate/good quality water		Scarce/good to indifferent quality water		Abundant / saline quality water	
	A1	A2	A1	A2	A1	A2
Drinking and cooking in						
Winter	56.1	8.0	61.6	42.0	71.4	61.0
Summer	56.1	9.0	60.5	42.0	61.0	61.0
Monsoon	66.7	8.0	65.1	42.0	69.4	61.0
Cleaning utensils in						
Winter	7.5	2.0	34.9	31.0	12.2	20.0
Summer	31.8	3.0	30.5	36.0	22.4	8.0
Monsoon	9.1	2.0	31.4	28.0	15.3	23.0
Bathing and washing clothes in						
Winter	4.6	1.0	47.9	17.0	24.4	17.0
Summer	9.1	2.0	46.5	34.0	38.4	18.0
Monsoon	7.6	1.0	46.7	25.0	26.5	24.0
Other uses in						
Winter	4.5	1.0	26.0	28.0	10.2	17.0
Summer	1.5	3.0	24.9	16.0	6.1	9.0
Monsoon	6.1	2.0	31.4	13.0	14.3	8.0

Note : A1 refers to Connectores
A2 refers to Non-connectors
B refers to Probable connectors

Table 4.2.4

End - Uses of Well Water
(User Percentage Among the Sample Households)

End-use by season	Adequate/good quality water area			Scarce/good to indifferent quality water area			Abundant/saline quality water area		
	A1	A2	B	A1	A2	B	A1	A2	B
Drinking & cooking									
Winter	45.5	92.2	96.0	39.5	48.6	74.0	34.7	33.0	72.5
Summer	43.9	86.0	88.5	41.9	47.0	70.5	43.9	36.0	72.0
Monsoon	39.4	92.0	96.5	41.9	54.0	79.0	40.8	32.0	92.5
Cleaning utensils									
Winter	93.9	98.0	97.0	65.1	68.0	80.0	87.8	76.0	93.5
Summer	69.2	97.0	85.5	69.9	62.0	80.0	91.4	79.0	92.0
Monsoon	90.9	98.0	96.0	69.8	71.0	79.0	87.8	70.0	92.5
Bathing & washing clothes									
Winter	86.4	97.0	97.0	60.5	59.0	52.0	85.7	62.0	93.0
Summer	81.8	95.0	85.0	61.6	68.0	60.0	81.6	72.0	90.0
Monsoon	84.8	93.0	91.5	63.9	59.0	58.0	84.7	54.0	87.5
Other uses									
Winter	39.4	37.0	44.5	17.0	13.9	26.0	40.8	14.0	9.5
Summer	39.4	34.0	37.5	15.1	14.0	26.0	38.8	14.0	8.0
Monsoon	37.9	35.0	39.0	18.0	16.3	29.0	40.8	16.0	11.0

Note : A1 refers to Connectors
A2 refers to Non-connectors
B refers to Probable connectors

With respect to the different purposes for which households use water it is observed (Tables 4.2.3 and 4.2.4) that even among those with a yard tap 35 to 40 per cent of the households continue to use well water for drinking and cooking. The reliance on piped water for this purpose is higher among the connectors in the saline and water scarce areas than among the connectors in adequate / good quality water area. Among the non-connector households the dependence on piped water for drinking and cooking is greatest in the saline area and least in the adequate / good quality area. For cleaning utensils, the piped water system is most relevant in the water scarce area both among connectors and non-connectors. In fact, piped water occupies an important place for both these categories of households in this area as between 20 to 40 per cent of them depend on this source even for bathing, washing clothes and other uses. The reliance on well water among a large proportion of households in the sites with an existing piped water system even for drinking and cooking should not be interpreted as an evidence of preference for well water over piped water among the rural households. It is mainly a reflection of the supply constraint. Since enough water is not being supplied through the piped water system, the households with access to adequate and good quality water make free use of traditional sources even for drinking and cooking and depend on them almost exclusively for bathing, washing clothes and cleaning utensils. In the poor quality water sites a vast majority of the households while reserving piped water for drinking and cooking turn to the traditional sources for meeting other needs. In water scarce areas they have to distribute their limited supply of piped water over the entire range of household needs with a relatively greater emphasis on drinking and cooking.

4.3 Response to the Improved Water System in Terms of its Reliability, Affordability, and Willingness to Pay

A rural household's view on the quality of the new service would appear to be determined by its access to traditional sources of water. For example, in the area with adequate and good quality water where most of the connector households have their own wells, a very small proportion (15 per cent) have expressed satisfaction with respect to the quality and taste of water from the improved service. In the water scarce area as many as 81 per cent (Table 4.3.1) of the connector households found no fault with the quality and taste of piped water. In the saline area this percentage declined to 67. Similarly, a greater proportion of non-connector households expressed satisfaction with respect to the piped water (through standposts) than did the connector households in all the three areas.

Table 4.3.1

Reliability of Piped Water System

Item	Adequate / good quality water area	Scarce/good to indifferent quality water area	Abundant / saline quality water area
1) % households expressing satifaction with quality and taste among :			
a) Connectors	15	81	67
b) Non-connectors	80	88	91
2) % conncector H.H which regard available quantity of water to be inadequate in			
Winter	18	35	24
Summer	35	58	63
Monsoon	14	23	16
3) % non-connect-or H.H which regard available quantity of water to be inadequate in			
Winter	29	37	35
Summer	57	61	54
Monsoon	19	31	23
4) % H.H considering piped water supply very irregular in :			
Winter	62	61	59
Summer	71	81	94
Monsoon	39	61	45
5) % connector H.H reporting meter breakdowns	3	8	20
6) % Non-conn--ector H.H reporting tensions at standposts	57	60	49

That the quantity of water available from the improved system falls short of the demand also comes out clearly from the responses of our sample households (Table 4.3.1). As expected the severity of shortage is more acute among non-connector households than among connector households, and a greater proportion of connectors as well as non-connectors in the water scarce area are in need of more water from the improved system than are their counterparts in the other two areas. While in the monsoon and winter seasons only between one-fifth to one-fourth of the households face shortage of water, in the summer season when the availability of water from traditional sources starts to shrink a vast majority of households crave for more water through the improved system. Even in the adequate and good quality water area as many as 57 per cent of the non-connector households are in want of more water through the piped system in the summer season. The irregular supply of piped water is yet another problem. The fact that it becomes most irregular in the summer, the period of peak demand for piped water, makes it even worse. Between 71 to 94 per cent of the sample households expressed the opinion that the supply of piped water was most irregular during summer. Apart from the hardships that it causes in meeting household needs of water it also generates tensions at the standposts as reported by 50 to 60 per cent of our sample households.

Among the various reasons that might stand in the way of a rural household hooking up to the improved system, (taking a yard tap), inability to pay the connection cost seems to be most important (Table 4.3.2). A majority of the non-connector sample households have said that they cannot afford the initial connection cost. The inclination to connect without having to pay the initial cost is higher in the scarce and saline areas as compared with the adequate / good water area. Interestingly, none of the sample households regarded the current monthly charges to be too high to go in for a house connection. In the adequate / good quality water area the widespread existence of own wells has taken out the incentive for hooking up to the improved system among 42 per cent of the non-connector households.

On an average a connector household pays betweens Rs. 7 to Rs. 10 per month for the improved water. From a payment schedule followed by connectors in Elapully panchayat we observed that between 60 to 80 per cent pay within the first 20 days of being given a bill. Only between 1 to 2 per cent take more than two months to pay their dues, except in the summer when the proportion of defaulters rises to 5 per cent (Table 4.3.3). Hence the problem in the payment of water charges is clearly not attributable to lack of willingness to pay on the part of consumers. The problem lies at the level of local bodies who fail to transfer the amount collected from the consumers to the

Kerala Water Authority. Table 4.3.4 gives details of arrears recoverable from local bodies in the various divisions of northern Kerala. Between Rs. 30 and Rs. 70 lakhs stand as arrears from the local bodies, which have been accumulating continuously by 50 to 100 per cent between 1984 to 1987.

Table 4.3.2

Impediments to Hooking up to Piped Water System

Item	Adequate / good quality water area	Scarce/good to indifferent quality water area	Abundant / saline quality water area
% Non-connector H.H reporting			
1) high connection costs as reson for not connecting	51	57	81
2) awaiting KWA sanction	1	9	8
3) being put off by :			
a) unreliable suppply	1	3	--
b) high monthly tariff	--	--	--
c) red-tape	--	2	--
4) having their own well	42	14	2
5) public tap is close-by	1	6	3
6) unspecified reasons	4	9	6
7) maximum willingness to pay tariff and connection cost as it emerged from the bidding games (Rs.)	5.9	12.9	6.2

Table 4.3.3

Monthly Charges and Payment Schedule Among Connectors in Elapully Panchayat

Seasons / months	Amount per month (Rs.)	Percent households making payment on billing within				
		10 days	11-20 days	21-30 days	30-60 days	beyond 2 months
Winter season		59.5	16.6	11.1	10.6	2.2
December	7.4					
January	7.0					
February	7.0					
March	7.4					
Summer season		81.5	5.3	0.6	7.9	4.7
April	10.2					
May	8.8					
June	7.7					
Monsoon season		67.2	20.5	0.8	10.2	1.3
July	7.0					
August	7.0					
September	7.9					
October	8.9					
November	7.1					

Table 4.3.4

Arrears of Water Charges Due From Panchayats in Various Divisions of Northern Kerala

Name of Division	Arrears due as on 31-3-84 (Rs.)	Arrears due as on 31-3-87 (Rs.)	Percentage increase
Kasargod	17,18,524	32,26,702	87.76
Cannanore	23,95,807	58,88,016	145.76
S. Battery	13,20,211	23,78,860	80.19
Badagara	15,62,000	35,15,297	125.05
Calicut	36,54,366	50,89,333	39.27
Malappuram	31,44,534	70,20,948	123.27
Palghat	29,63,326	58,32,039	96.81
Shornur	26,95,104	41,04,271	52.29
Edappal	9,35,875	27,72,360	196.23

CHAPTER V

WILLINGNESS TO PAY : CONTINGENT VALUATION

5.1 Introduction

With the notion of water for drinking as a free commodity increasingly coming under eclipse, the principle of cost recovery for improved water service has been gaining ground both in policy debates and academic exercises. These discussions have, however, tended to be dominated either by an attempt to determine a maximum proportion of income that people can afford to pay for such a service and / or an argument for some contribution to be made by them to the labour input at the time of construction of the system. Hardly any attention has been paid to the behaviour of users in relation to their socio-economic characteristics and water use patterns which must in the end govern their decision on how much to pay for the use and maintenance of the service. As a result the systems are designed to provide a minimum level of service at extremely low most often zero cash cost to the user. While the service is directed at providing health benefits, users are looking for mechanisms to overcome chronic or seasonal scarcity of water from traditional sources, for reduced time costs or for a reliable service and better-tasting water.

5.2 Contingent Valuation Approach

Our attempt here is to determine the influence of household characteristics and source attributes on willingness to pay for the improved service. The approach followed by us in this regard is somewhat akin to the "contingent valuation" method. Rather than use information on the actual choice(s) made by the household(s), the demand for service is ascertained by asking questions, for a given level of service and tariff, about water related behaviour. That is, for each specific option (service quality, price, etc.) the respondent is asked whether the improved service would be used. The purpose here is to construct a hypothetical market for which we proceed as follows. Beginning with an average monthly charge (i.e., as starting point bid or price) paid currently by a typical rural household with a yard tap under similar socio-economic conditions and tariff rates, the respondent answers "yes" or "no" to whether the posited price would be paid for taking a house connection (yard tap). An iterative bidding process is continued where, say, an x amount of rupees is successively added to the previous bid until a bid is reached where the respondent is not willing to pay more.

The major problem with such "contingent valuation" surveys is that biases may arise for three related reasons. First, there is a so-called "hypothetical bias", which arises because the individual may not understand or perceive correctly the characteristics of the service being described by the interviewer. Secondly there is a "strategic bias", which arises because the respondent may think that he can influence the provision of services in his favour by not answering the questions truthfully. And third is the problem of the "compliance bias" in which the respondent may give answers which are prompted by his desire to influence the interviewer. However, the methodology for conducting such "contingent valuation" surveys has undergone further development over the last decade by environmental and resource economists concerned with the problem of valuing the provision of public goods. Despite initial misgivings about the usefulness of the method, it now appears that the major potential sources of bias can be dealt with. In the context of this study, knowledge about pipe water was nearly universal. This was further confirmed by the experience of the interviewers, that every time they began describing what a pipe water supply service was they were invariably met with a smile arising out of previous knowledge on the part of the respondents of what was being described, and their having to treat this introductory sentence therefore as only a necessary formality in the interviewing process. Through careful recruitment and training of interviewers and meticulous efforts at establishing rapport with the local population, we have tried to minimize the other two biases.

5.3 Bidding Games

An assessment of willingness to pay for a pipe water supply system within the rural context must reflect three important concerns of the households, i.e., tariff, connection costs and the quality of service. The bidding games designed by us captured all these three concerns.

For those who were already connected, connection costs were a matter of the past and, therefore, only two games were played. In the first game the monthly charge was increased (from the average current level of Rs. 5 per month upto a highest level of Rs.50 per month) and the respondents were asked whether, at each specified tariff level, they would continue to connect, or disconnect and use other sources. The second game was almost identical, except that the respondents were asked for their responses on the assumption that pipe water was available for about 8 hours a day (rather than for one or two hours which is the case at present).

For those who were within reasonable access to the distribution pipeline but had remained unconnected three bidding games were developed. In the first the monthly charges were kept at the current level and the respondent's reaction to lowered connection costs was assessed. In the second game the connection cost was reduced to a nominal level (Rs.100) and the reaction to an increased monthly charge was assessed. The third game was similar to the second, i.e., a fixed low connection cost and higher monthly charge but the quality of service (in terms of number of hours of availability, reliability and taste) was improved and the reaction to this constellation of factors was assessed.

For the households in the sites where pipe water supply was yet to commence, two bidding games were played. The first game, while keeping the monthly charge at the current level prevailing in other sites with pipe water service, assessed the reaction to a range of connection costs (including the costs which would actually be incurred under current policies). The second game assessed reaction to a financing scheme which would reduce the initial (connection) cost but raise the monthly charges.

Table 5.3.1

Bidding Games

	Connection Cost	Tariff	Service Level (Reliability)
EXISTING SCHEMES			
A1: those who are connected	As is As is	Range up Range up	As is Improved
A2: those who have access but haven't connected	Range down Low Low	As is Range up Range up	As is As is Improved
SANCTIONED SCHEMES			
B: those who will have access	Range down Low	As is Range up	As is As is

It might be appropriate at this point to report on our field experience in conducting these bidding games. The bidding games constituted the most significant aspect of investigator training, particularly in terms of time spent. Once the investigators were able to perceive that the apparently complex bidding games were really quite simple, and had had sufficient opportunity to practice the technique in mock interviews with the principal investigators and then with the each other, they handled the games in the field with ease. The trials of the bidding games during the initial visits to the field in the course of site selection, training of investigators in the field and pre-testing, also gave the team a glimpse of how the sample households were likely to respond. The bidding games were among the liveliest aspects of the household interviews, as respondents easily and spontaneously fell into the spirit of the games.

The responses to different bidding games are presented below in Tables 5.3.2. to 5.3.7 for the relevant categories of households.

Connectors

<u>Table 5.3.2</u>

Response of Connectors To Higher Monthly Charges at the Prevailing Level Of Service.

Average Monthly Charge (Rs.)	Percent Connectors in			
	Area with adequate/good quality water	Area with scarce/good to indifferent quality water	Area with abundant/ saline quality water	All areas combined
> 50	--	54.7	9.2	22.4
30-40	--	4.6	6.1	4.0
20-30	--	17.4	13.2	11.2
10-20	1.5	10.5	25.5	14.0
5-10	90.9	3.5	42.9	42.0
Do not know	7.6	9.3	3.1	6.4
Total	100.0	100.0	100.0	100.0

Table 5.3.3

Response of Connectors To Higher Monthly Charges at Improved Level of Service

Average Monthly Charge (Rs.)	Percent Connectors in			
	Area with adequate/good quality water	Area with scarce/good to indifferent quality water	Area with abundant/ saline quality water	All areas combined
50	3.0	57.0	14.3	26.0
30	7.6	4.7	15.3	9.6
20	27.3	17.4	31.7	25.6
10	30.3	8.1	22.4	19.6
5	21.2	1.2	14.3	11.6
Do not know	10.6	11.6	2.0	7.6
Total	100.0	100.0	100.0	100.0

Among connectors willingness to pay higher charges would appear to be mainly distress oriented. Only in the water scarce area did a majority of households respond positively to the water charge being linked to a level of Rs.50 per month. As against just 3.5 per cent of households with yard taps which have resisted bidding beyond the current level in the water scarce area, 91 per cent of households with yard taps located in the area with adequate/good quality water have responded in a similar vein. Even in the area with abundant but saline water as many as 43 per cent of households with yard taps have resisted bidding beyond the current level of water charges. They were, however, willing to raise their bids under the assumption of an improved level of service, i.e., if supply were raised from one / two hours a day to 8 hours a day and reliability improved; in the area with adequate/good quality water 30 per cent of the households with yard taps were willing to double the existing charges and another one-third were willing to pay four to five times more than the current levels. In the area with abundant but saline water from traditional sources the percentage of households who resisted any bid beyond the current level of water charges declined from 43 per cent to 14 per cent under the assumption of improved supply. A majority of them were now willing to accept a two to four-fold hike in water charges. In the water scarce area the response to higher bids under the assumption of increased supply improved even further. Now, only one per cent of the households with yard taps were unwilling to go beyond the current level of water charges and nearly two-thirds were willing to pay between 6 to 10 times more than the current rates.

Non-connectors

Based on the assumption that the connection cost (which worked out to an average of around Rs.1000) was the major factor inhibiting these households from applying for yard taps, we elicited their responses on the question of willingness to pay under the assumption of lower connection costs. Their responses to the first game where connection costs were reduced without altering the current level of water charges and service revealed that a majority of the non-connecting sample households in the water scarce area are willing to go in for yard taps even at a mere 30 per cent reduction in connection costs. It would appear that under such environmental conditions a large proportion of households are willing to stretch themselves to pay relatively higher tariffs as well as the prevailing connection costs. Here the inability of the water system to provide yard taps to a larger number of households would appear to be the main factor in explaining why the majority of households within the vicinity of the distribution pipelines remain unconnected. Only about a quarter of non-connecting households in the water scarce area were unable to decide whether or not to go in for a yard tap at lower connection costs. The lowered connection costs have the greatest appeal among the non-connectors in the area of poor quality water. Nearly 90 per cent are willing to go in for yard taps at the existing monthly charge even with the prevailing highly unsatisfactory quality of service if the connection costs are reduced substantially. Even in the adequate / good quality water zone a majority of non-connectors are willing to pay the current charges for the none too satisfactory quality of services but only if the connection costs are reduced by 50 per cent or more.

Table 5.3.4

Response of Non-connectors to Lowered Connection Costs at Existing Level of Service and Water Charges

Connection costs (Rs.)	Percent Sample Non-connector Households in			
	Area with adequate/good quality water	Area with scarce/good to indiffer-ent quality water	Area with abundant/ saline quality water	All areas combined
700	28.0	49.0	21.0	32.7
500	15.0	7.0	17.0	13.0
200	14.0	15.0	27.0	18.7
100	3.0	3.0	24.0	10.0
Do not know	40.0	26.0	11.0	25.6
Total	100.0	100.0	100.0	100.0

Table 5.3.5

Response of Non-connectors to Low Fixed Connection Costs (Rs. 100) at Higher Monthly Charges and Existing Level of Service

Average Monthly Charges (Rs.)	Percent Sample Non-connector Households in			
	Area with adequate/good quality water	Area with scarce/good to indiffer-ent quality water	Area with abundant/ saline quality water	All areas combined
50	3.0	13.0	3.0	6.3
30	4.0	7.0	3.0	4.7
20	4.0	16.0	3.0	7.7
10	24.0	21.0	21.0	22.0
Do not know	65.0	43.0	70.0	59.3
Total	100.0	100.0	100.0	100.0

Table 5.3.6

Response of Non-connectors to Low Fixed Connection Costs (Rs.100) at Improved Level of Service and Higher Water Charges

Average Monthly Charge (Rs.)	Percent Sample Non-connector Households in			
	Area with adequate/good quality water	Area with scarce/good to indifferent quality water	Area with abundant/ saline quality water	All areas combined
50	5.0	19.0	2.0	8.7
30	3.0	9.0	2.0	4.6
20	6.0	16.0	2.0	8.0
10	22.0	14.0	21.0	19.0
Do not know	64.0	42.0	73.0	59.7
Total	100.0	100.0	100.0	100.0

Probable Connectors

Table 5.3.7

Response of Probable Connectors to Lowered Connection Costs At Prevailing Level of Service and Water Charges

Connection Costs (Rs.)	Percent Sample Probable Connectors			
	Area with adequate/good quality water	Area with scarce/good to indifferent quality water	Area with abundant/ saline quality water	All areas combined
700	48.5	21.0	15.5	28.4
500	4.0	5.5	2.0	3.8
200	4.5	15.5	8.0	9.3
100	11.0	15.0	24.5	16.8
Would continue with the current source	28.5	32.5	45.5	35.5
Would rely on the public tap	0.0	1.0	2.5	1.2
Undecided	3.5	9.5	2.0	5.0
Total	100.0	100.0	100.0	100.0

Apart from the sample households in the adequate/good quality water zone, only a small proportion of all probable connectors is willing to connect at a cost of Rs.700 or so. Surprisingly, 45 per cent of sample households in the poor quality water area are inclined to stay with their current source. In the remaining areas this is the case with about one-third of the sample households. It seems, therefore, that in the proposed sites at lowered connection costs and at the current tariff the connection rate would be in the range of 55 to 70 per cent. Further, it would appear that the prospect of offsetting the effect of reduced connection costs by raising the monthly charge is not a very promising one as it could well lead to a substantial decline in connection rates. The evidence, however, does indicate the scope for a marginal increase in the current level of charges. A nominal connection cost and an average monthly charge of around Rs.10 is likely to result in about a fourth of the rural households hooking up to the improved service.

5.4 The Model

For determining the influence of household characteristics and source attributes on the household's willingness to pay for the improved water scheme, two discrete choice models are developed and estimated : one for water source choice and the other for maximum willingness to pay for an improved service, based on information from bidding games. The model of discrete choice of water source which is based on utility maximization is estimated by multinomial logit and probit procedures. The other model pertaining to the maximum willingness to pay for the proposed water system is estimated through the ordered probit procedures.

5.4.1 Multinomial Logit Model of Unordered Choices.

As observed earlier, about one-third of our sample households use an improved water source (yard tap or public tap), 60 per cent use wells and the remaining 6 to 7 per cent use other sources such as a trough or river.

In the sites where improved water supply schemes are already in operation, the households with access could be regarded as facing the full set of water source choices: yard tap, public tap, well and trough, etc. Although water can and is obtained from these sources simultaneously, we treat the main source of water as an exclusive choice. There are two types of logit models, the so-called conditional logit (or McFadden's model) in which the independent variables measure characteristics of the choices, and the multinomial logit, in which the independent variables measure characteristics of the households. Because the two approaches are mathematically equivalent, they can also be mixed, in which case some of the variables are characteristics of the choices and some are household specific. McFadden has proved that the conditional logit is consistent with utility maximisation, so the empirical model can be derived directly from a typical random utility framework in which source choice reveals the highest constrained utility level the household can reach.

We use the simple multinomial approach because we do not have source-specific characteristics. The water source choice has the three categories already mentioned: yard tap, well, and other (lake, stream, and so on). We take the case of three values for the dependent variable with probabilities P^0, P^1, P^2. Then the multinomial logit model can be written as follows:

$$(1) \quad \ln (p^{jt} / p^{t1}) = X^t B^l$$

where j = 0, 1, 2; t is the observation index, X is the t th observation on a 1 x k vector of explanatory variables, and B is a k x 1 vector of parameters. The three equations in (1), plus the requirement that the probabilities for every t sum to one, determine the probabilities uniquely. Assuming the errors have a Weibull distribution:

$$(2) \quad P^{0t} = 1 / \{ 1 + \sum_{j=0}^{2} \exp (X^t B) \}$$

$$(3) \quad P^{lt} = \exp (X^t B^l) / \{ 1 + \sum_{j=0}^{2} \exp (X^t B^l) \}$$

where j = 0, 1, 2, and t = number of observations. The last equation (3) can be used to simulate changes in the probability of choosing each water source for different values of the independent variables.

5.4.2 The Binary Probit Model for Water Source Choice

In addition to the logit model for the choices facing consumers in the sites where improved water schemes are in operation, we are interested in ascertaining the probability that a household would take a yard tap. This too is done on the basis of information obtained through the bidding games. In order to use the information from all the sites we simplified the choice framework to a decision between the current source and a yard tap, a binary choice. As in the last section, this choice is determined by attributes of the current source and the improved source as well as socio-economic characteristics of the household. Source characteristics include quality of water, taste of water and distance to water source. Household characteristics include income, assets, education, wealth,and occupation.

If the error terms are assumed to be normally distributed, this problem requires the probit model (1). We observe a 0 or 1 for the dependent variable (such as whether or not to use a yard

---

(1) Maddala : 1983

tap), but the observed variable is a signal that some underlying continuous variable (such as desire for a modern water connection or desire for higher quality water) has passed a certain threshold and put the household into the yard tap category. This model estimates a continuous probability P^i.

The probit probability model is associated with the cumulative normal probability function. The standardized cumulative normal function is written

$$(4) \quad P^i = F(Z^i = X^i B) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{\varepsilon_i} e^{\frac{-s^2}{2}} ds \quad i = 0, 1$$

where s is a random variable which is normally distributed with mean zero and unit variance. The probability P^i resulting from the probit model is an estimate of the conditional probability that a household will hook up given household characteristics and source attributes X^i. This is equivalent to the probability that a standard normal variable will be less than or equal to $X^i B$. The probit model will be used to estimate the probability of hooking up to an improved water source instead of continuing to use an alternative water source, with the monthly tariff and water source choice derived from the bidding game.

5.4.3 The Ordered Probability Model for Maximum Willingness To Pay

This is the direct approach to analyzing maximum willingness to pay. Although the value households place on the proposed water system is a continuous variable, the data generated from the bidding game are a set of yes/no responses to questions about specific, discrete tariffs. Thus, the observed dependent variable obtained from the bidding game procedure is not the maximum amount the household would be willing to pay, but rather an interval within which the "true" willingness to pay falls. Linear regression is not an appropriate procedure for dealing with such an ordinal dependent variable because the assumptions regarding the specification of the error term in the linear model will be violated. The probit model could be used, but it discards the additional information we have about the end points of each interval and thus will be less efficient than the ordered probit model.

It is assumed that the improved water scheme provides the household with additional utility such that the household's utility function might look as follows:

$$(5) \quad U (S1, \text{income}) = U (S2, \text{income} - MWTPi*)$$

Where $MWTP^{i*}$ represents maximum willingness to pay and S1 and S2 represent two different water sources. If S1 is an improvement over S2 and a market exists in which the individual could obtain S2 instead of S1 for less than $MWTP^{i*}$, he would purchase S2 and utility would increase. If the new water source costs more than $MWTP^{i*}$, it would not be purchased. From the utility function, a bid curve could be derived as follows:

$$(6) \quad MWTP^{i*} = f(X^{i})$$

where X^{i} is a vector of households' socio-economic characteristics and attributes of water source. This is the equation that is to be estimated by ordered probit.

Again let $MWTP^{i*}$ be the maximum willingness to pay of household i for the proposed water system. Based on consumer demand theory, we hypothesize the $MWTP^{i*}$ is a function of the attributes of the new and existing water sources and the household's socioeconomic characteristics, as follows:

$$(7) \quad MWTP^{i*} = X^{i} B + e^{i}$$

Where X^{i} is a vector of the household's characteristics and the attributes of the sources. B is a vector of parameters of the model and e is a random term with a standard normal distribution. $MWTP^{i*}$ is not observable from the bidding game, so this equation cannot be estimated. However, from the interview responses we know the ranges within which $MWTP^{i*}$ will fall. Let R^{i} R^{m} be the m tariff levels which divide the range of MWTP space into m+1 categories, then the observed dependent variable $MWTP^{i}$ is categorized in such a way that the following holds:

$$
\begin{aligned}
(8) \quad MWTP^{i} &= 1 \text{ if } MWTP^{i*} < R1 = 10 \\
&= 2 \text{ if } 10 = R1 <= MWTP^{i*} < R2 = 20 \\
&= 3 \text{ if } 20 = R2 <= MWTP^{i*} < R3 = 30 \\
&= 4 \text{ if } 30 = R3 <= MWTP^{i*} < R4 = 50 \\
&= 5 \text{ if } MWTP^{i*} >= 50
\end{aligned}
$$

The R^{i} are known threshold values: the values shown are the ones actually used in the Kerala survey instrument (in rupees). From equation (6), we have $MWTP^{i} = 4$, if, for example:

$$(9) \quad R3 <= X^{i} B + e^{i} < R4$$

$$\text{or} \quad (R3 - X^{i}B)/\sigma <= e^{i}/\sigma < (R4 - X^{i}B)/\sigma$$

where σ is the standard deviation of e^{i}. Assuming e^{i} follows a standard normal distribution:

$$(10) \quad P(MWTP^{i} = 4) = P(R3 < MWTP^{i*} < R4)$$
$$= P(R3 - X^{i}B < e^{i} < R4 - X^{i}B)$$
$$= F(R3 - X^{i}B) - F(R4 - X^{i}B)$$

where F(.) is the cumulative standard normal density function. The equation (10) is the ordered probit model.

5.5 Estimation Results : Water Source Choices

5.5.1 Multinomial Logit Model : variables and results (actual water source choice)

In this section the choice of a yard tap, public tap or well (traditional source) is estimated only for the households in the sites with existing schemes for pipe (improved) water supply. All of these households are regarded as having these three options in their choice sets. Because this estimation depends on actual behaviour (not on bidding game responses) only the households in these sites face this choice set, including the yard tap, and the households in the sites where the pipe water supply is yet to commence were excluded from this estimation.

The choice of water source is regarded as a function attribute of sources and the characteristics of the individual households. Table 1 contains the variables used in each specific model and the expected signs.

The estimated multinomial logit model is the following:

Log odds ratio of dependent variable (= log (probability of using yard tap) / probability of using well) = (attributes of sources, socio-economic characteristics of households, site dummy)

where dependent variable = 0 if well or other traditional source

1 if yard tap

2 if public tap

The relevant attributes of the water source are as follows:

Tariff : average monthly charge from the bidding game

Connection cost : initial cost of connecting

Distance : in metres from the non-yard tap alternative water source

The relevant socio-economic characteristics of households are:

Education = 1 for the presence of any adult in the family with secondary education

0 if no adult in the family has attained this level

Occupation = 1 if engaged in cultivation

0 otherwise

Income = total household income per year

Assets = house, specifically the number of rooms, is used as a proxy for the variable representing household wealth

Dummmy 1 = for water scarce area

Dummy 2 = for poor quality water area

Dummy 3 = for proposed sites, i.e., piped water forthcoming

Dummy 4 = for reliability of service in sites with existing piped water supply (1 if reliability is improved).

Choice probabilities under this estimation technique are given relative to an excluded category, which in this case is the 0 category (use of a well or other traditional source). Income, assets and education are hypothesized to increase the probability of using the yard tap. Informal sector activity including agricultural activity should have a negative effect on choosing a pipe water system; this variable is used as a proxy for the value of time, under the assumption that farm households are less constrained for time devoted to fetching water than formal sector households, i e., mainly those doing salaried jobs. Households farther away from their current water source (or in the case of connector households, their most important alternative to the piped water source) are hypothesized to be more likely to choose piped water, so the sign on distance is expected to be positive. Households in water-scarce or saline water areas should be more likely to use an improved water source than will residents of relatively good water supply areas, other things being constant. The households in the proposed sites, who have never used a piped water source, may be less likely to choose a piped water source simply because they are less familiar with that option than the households in sites with existing piped water service. The former also have a strong incentive for strategic bidding behaviour because they do not have a new water system as yet and may end up paying what they say they would pay when it finally commences.

Table 5.5.10 shows the results of the multinomial logit estimation of water source choice without a tariff variable, including coefficients, t-statistics, marginal probabilities, and elasticities. The marginal probabilities are affected by the scale of the independent variable, but they show the total effect of each independent variable on the probability of choosing each source, rather than the relative effects provided by the t - statistics. The sample size for this estimation is 530 households (1).

---

(1) The coefficients in the top part of Table 5.5.10 show the effect of the independent variable on the log odds of choosing a yard tap relative to a well (or traditional source). The marginal probability and elasticity columns show the total effect of the independent variable on choosing a yard tap (<u>not</u> relative to a well). The bottom of the table is interpreted similarly, but for a public tap.

Table 5.5.10

Multinomial Logit Estimates for Sites with Existing Piped Water Supply System (1)

Dependent Variable Log [prob (yard tap)/prob (well)]

Independent Variables	Coefficients	T - Value	Marginal Probability	Elasticity
Constant	-6.38163	-7.908*	-1.44004	-3.063
Yearly Income	0.00002	2.663*	0.00001	0.124
Number of Rooms	0.12743	2.154*	0.04421	0.268
Sex of Respondent (female = 1)	-0.42414	-1.682*	-0.10572	-0.125
Education Level	5.52842	7.702*	1.35050	1.987
Occupation (farming = 1)	-0.03222	-0.064	0.13011	-0.018
Distance to Source	0.00116	0.520	0.00035	0.015
Dummy for Scarce Area	0.81849	3.129*	0.00907	0.132
Dummy for Saline Area	3.83499	6.593*	0.74757	0.661
Dependent Variable : Log [prob (public tap) / prob (well)]				
Constant	-1.62302	-2.710*	0.30654	-1.33
Yearly Income	-0.00003	-1.860*	-0.00001	-0.319
Number of Rooms	-0.14395	-1.886*	-0.03356	-0.518
Sex of Respondent (female = 1)	0.00639	0.022	0.03815	0.003
Education Level	0.23036	0.528	-0.44847	0.141
Occupation (farming = 1)	-1.57624	-1.436**	-0.24241	-0.065
Distance to Source	-0.00075	-0.316	-0.00022	-0.017
Dummy for Scarce Area	2.213	5.125*	0.27261	0.612
Dummy for Saline Area	2.320	4.263*	0.02502	0.681

Log-likelihood .... -395.84
Number of observations 550
[well and others = 194, yard tap = 250, public tap = 106]

---

(1) Since only households in the sites with existing piped water system can have access to different water sources including yard tap, sites where piped water system is proposed are excluded here.

The farm household variable is not statistically significant, but the coefficients of the other variables have the expected signs and are significant. There is one initially surprising exception. The distance variable is not significantly different from 0. The distance variable measures distance to the current source (except for those who are connected; in that case, distance is to their alternative source). Thus we cannot differentiate distance by potential source (such as the distance of each house to the same river or central well), and the variable consequently reflects a household characteristic rather than a source characteristic. Even so, greater distance from the household to its current source (whatever that might be) would presumably increase the probability of choosing an improved water system, but it does not appear to matter significantly in this sample as the variations in distance to traditional water sources are very small. In Kerala most households have access to these sources within 400 to 500 metres from their house. Higher income increases the probability of using a yard tap but lowers the probability of using either a well or a public tap. The number of rooms in the house, our proxy for wealth or assets, has the same effect. The results also suggest that residence in a water scarce area increases the probability of choosing improved water sources such as private tap and public tap and decreases the probability of using other water sources.

Figure 1 illustrates the way choice probabilities change as income increases over a range approximately 1 standard deviation around the mean level of income for the sample (1). Around an annual income of Rs 31,000 the probability of connecting a yard tap surpasses the likelihood of choosing a well. Clearly the main effect of income is to increase the probability of using a yard tap at the expense of choosing a well or other traditional source.

5.5.2 Results of Probit Model(Hooking upto yard tap in Bidding Game)

Explanation of Procedures and Overview of the Tables

In contrast to the previous section, the estimations discussed below refer to data from the bidding games. In one bidding game, connection costs were held constant and the tariff was varied;

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(1) The simulation of the effects of changes in income, monthly tariff, and connection cost on connecting that is shown in the figures is constructed by holding all other variables constant at the overall sample mean.

then the connection cost was varied as the tariff was held constant. Table 5.2.10 contains the probit results for choosing or not choosing a yard tap in the bidding game for all sites. This table results from "stacking" the data. Each household appears as five observations, one time for each monthly tariff quoted in the bidding game. This procedure creates some unmeasured spatial correlation among the errors because they are not independent for each set of 5 observations from the same household. The coefficients in this table will consequently be correct, but the standard errors will be underestimated and the t-statistics overestimated.

We have adopted the following strategy to correct this problem (1). We took the large sample just described (4596 observations) and randomly picked one observation from each group of observations for a single household, reducing the sample size back to the original sample (1149 observations). This method preserves variation in the monthly tariff and yard tap variables but eliminates the spatial correlation in the larger sample. It also discards some information. Table 5.5.21 reports the probit for one such random draw . The important thing to notice in this table is that the large t-statistics reported in Table 5.5.20 are reduced, but they are still quite large. Despite the fact that we took only a single draw from the larger sample, the coefficients in Table 5.5.21 are remarkably close to those reported in Table 5.5.20. As a consequence, in the discussion of the results, we will use the latter table because it uses the full set of information in the sample, and we are confident that except in few cases, the spatial correlation problem does not change the outcome of significance tests.

The variables in Table 5.5.20 are the same as those used for estimating the logit model in Table 5.5.10 except for the addition of the monthly tariff from the bidding game. The model was estimated by probit for households in sites with an existing piped water service with a dummy for reliability of service included on the right hand side to assess the effects of a more reliable service (in terms of number of hours per day that water is available) on willingness to pay (results are reported in Table s 5.5.22 and 5.5.23. In addition, the model was estimated

---

(1) Spatial correlation can be modelled and the standard errors corrected analytically. However, that approach requires that the analyst impose a specific functional form on the process that is assumed to create the spatial correlation (as is done for autocorrelated errors).

by probit for non-connectors in the sites where the piped water system exists and households in sites where it is proposed; both connection cost and monthly tariff added as explanatory variables to see how the impact of those two policy variables affect the probability of hooking to an improved water system (reported in Tables 5.5.24 and 5.5.25) (1). Each of these tables contains marginal probabilities and elasticities for the model. As before, the marginals are the instantaneous changes in the probability for an infinitely small change in the independent variable. Both are dependent on the scale of the independent variable. Elasticities are unitless measures of the effect of an infinitely small change in the independent variable on the probability of hooking up. Both are calculated at the means of the independent variables.

---

(1) The questions associated with connection cost and monthly tariff in the bidding game were asked only for non-connector and probable connector households, so the connector households were excluded from this estimation.

Table 5.5.20

Probit Estimates For All Sites

Independent Variables	Estimated Coefficient	T - value	Marginal Probability	Elasticity
Constant	-0.83945	-7.848*	-0.1819	-1.3507
Yearly Income	0.000014	11.347*	0.000003	0.4179
Number of Rooms	0.08578	6.348*	0.018600	0.4922
Sex of Respondent (female = 1)	-0.27794	-5.352*	-0.060264	-0.2406
Education Level	0.60763	9.195*	0.131753	0.6919
Occupation (farming = 1)	-0.12243	-1.275	-0.026547	-0.0202
Monthly Tariff	-0.03915	-19.218*	-0.008488	-1.7324
Distance to Source	0.00011	0.508	0.000024	0.0061
Dummy for Scarce Area	0.58453	8.901*	0.126742	0.3144
Dummy for Saline Area	0.18736	2.526*	0.040625	0.1042
Dummy for B Site	-0.54815	-9.728*	-0.118855	-0.4599

Log-Likelihood .. -1620.4 Restricted (Slopes = 0) Log-L .. -2471.9

Chi-Squared (10) ..... 1703.9 Significance 0.322E-13

Number of Obs 4596

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* indicates the 95 % level of statistical significance.

Table 5.5.21

Probit Estimates For All Sites

Independent Variables	Estimated Coefficient	T - value	Marginal Probability	Elasticity
Constant	-0.72325	-3.588*	-0.17481	
Yearly Income	0.00001	5.249*	0.000003	0.3533
Number of Rooms	0.07709	2.988*	0.018633	0.4196
Sex of Respondent (female = 1)	-0.31185	-3.101*	-0.075375	-0.2558
Education Level	0.54293	4.322*	0.131230	0.5860
Occupation (formal sector =1)	-0.13601	-0.740	-0.032875	-0.0213
Monthly Tariff	-0.03429	-9.048*	-0.008288	-1.4172
Distance to Source	-0.00045	-0.933	-0.000108	-0.0238
Dummy for Scarce Area	0.51509	4.066*	0.124500	0.2629
Dummy for Saline Area	0.12830	0.907	0.031011	0.0675
Dummy for B Site	-0.49723	-4.624*	-0.120182	-0.3952

Log-Likelihood .. -443.6 Restricted (Slopes = 0) Log-L .. -641.8

Chi-Squared (10) ..... 396.5 Significance 0.322E-13

Number of Obs 1148

---

* indicates the 95 % level of statistical significance.

Table 5.5.22

Probit Estimates for Connectors and Non-connectors in Sites with Existing Piped Water Supply (1)

Variables	Coefficient	T-Value	Marginal Probability	Elasticity
Constant	-0.86659	-5.597*	-0.29157	-1.0424
Yearly Income	0.00001	5.002*	0.000004	0.2645
Number of Rooms	0.05862	3.418*	0.019724	0.3095
Sex of Respondent (female = 1)	-0.37467	-4.927*	-0.126062	-0.2753
Education Level	0.62381	5.514*	0.209888	0.5621
Occupation (farming = 1)	-0.10006	-0.551	-0.033667	-0.0061
Monthly Tariff	-0.04036	-14.222*	-0.013579	-1.3349
Distance to Source	-0.00139	-1.129	-0.000466	-0.0289
Dummy for Reliability	1.66084	13.514*	0.558807	0.4431
Dummy for Scarce Area	0.84529	9.281*	0.284407	0.3420
Dummy for Saline Area	0.14936	1.117	0.050254	0.0644

Log-Likelihood ... -809.07 Restricted (Slopes = 0) Log-L ... -1415.4

Chi-Squared (10) ... 1212.7 Significance ... 0.322E-13

Number of Obs ... 550

* indicates the 95 % level of statistical significance.

---

(1) Each household appears four times in this estimation. The dependent variable and the monthly tariff were derived from the bidding game.

Table 5.5.23

Probit Estimates for Connectors and Non-connectors in Sites with Existing Piped Water Supply (1)

Independent Variables	Estimated Coefficient	T - value	Marginal Probability	Elasticity
Constant	-0.99674	-3.201*	-0.337024	-1.1926
Yearly Income	0.00001	2.295*	0.000003	0.2302
Number of Rooms	0.05754	1.751*	0.019457	0.3022
Sex of Respondent (female = 1)	-0.48369	-3.229*	-0.163549	-0.3536
Education Level	0.66799	2.877*	0.225866	0.5987
Occupation (farming = 1)	-0.05704	-0.156	-0.019288	-0.0035
Monthly Tariff	-0.03330	-6.261*	-0.011259	-1.1345
Distance to Source	-0.00079	-0.413	-0.000266	-0.0163
Dummy for Scarce Area	0.84677	4.581*	0.286316	0.3408
Dummy for Saline Area	0.34445	1.279	0.116467	0.1476
Dummy for B Site	1.47986	6.544*	0.500378	0.3928

Log-Likelihood ... -208.5 Restricted (Slopes = 0) Log-L ... -349.9

Chi-Squared (10) ... 282.81 Significance ... 0.322E-13

Number of Obs ... 550

* indicates the 95 % level of statistical significance.

---

(1) Randomly selected data. The "stacked" data used previously were used in estimating this model.

Table 5.5.24

Probit Estimates for Non-connectors in Existing Sites and Probable Connectors in Proposed Sites

Independent Variables	Estimated Coefficient	T - Value	Marginal Probability	Elasticity
Constant	-0.059905	-0.652	-0.023654	-0.0535
Yearly Income	0.000019	14.126*	0.000007	0.2725
Number of Rooms	0.110388	8.614*	0.043574	0.3086
Sex of Respondent (female = 1)	-0.210425	-4.838*	-0.083062	-0.1030
Education Level	0.300549	5.918*	0.118638	0.1695
Occupation (formal sector=1)	-0.066498	-0.862	-0.026249	-0.0067
Monthly Tariff	-0.005572	-0.908	-0.002199	-0.1368
Connection Cost	-0.001297	-3.431*	-0.000511	-0.4342
Distance to Source	0.000342	2.038*	0.000135	0.0118
Dummy for Scarce Area	0.226565	4.032*	0.089433	0.0673
Dummy for Saline Area	0.046759	0.797	0.018457	0.0139
Dummy for B Site	-0.402515	8.748*	-0.158888	-0.2394

Log-Likelihood ... -2599.9 Restricted (Slopes = 0) Log-L ... -2899.3

Chi-Squared (10) ... 678.82 Significance ... 0.322E-13

Number of Obs ... 3596

* indicates the 95 % level of statistical significance.

Table 5.5.25

Probit Estimates for Non-connectors in Existing Sites and Probable Connectors in Proposed Sites

Independent Variables	Estimated Coefficient	T - Value	Marginal Probability	Elasticity
Constant	-1.20065	-4.967*	-0.193290	-2.1728
Yearly Income	0.00002	6.246*	0.000003	0.4812
Number of Rooms	0.10114	3.290*	0.016283	0.5734
Sex of Respondent (female = 1)	-0.26983	-2.478*	-0.043439	-0.2675
Education Level	0.56127	3.930*	0.090357	0.6413
Occupation (farming = 1)	0.12751	0.674	0.020528	0.0259
Monthly Tariff	-0.00382	-0.210	-0.000615	-0.1874
Connection Cost	-0.00231	-2.121*	-0.000372	-1.5482
Distance to Source	0.00032	0.741	0.000051	0.0223
Dummy for Scarce Area	0.52447	3.774*	0.084434	0.3160
Dummy for Saline Area	0.24944	1.541	0.040157	0.1503
Dummy for B Site	-0.39219	-3.304*	-0.063138	-0.4726

Log-Likelihood ... -388.07   Restricted (Slopes = 0) Log-L .. -421.84

Chi-Squared (10) ... 67.58   Significance ... 0.98E-12

Number of Obs ... 898

* indicates the 95 % level of statistical significance.

The model being estimated is shown below:

Prob (yard tap is chosen)	=	F (source attributes, household characteristics)
dependent variable	=	1 if the response is that the household would connect at the stated tariff and connection cost in the bidding game.
		0 otherwise
F(.)	=	cumulative probability function

Source attributes and household characteristics are same as defined earlier.

Results

All of the coefficients in Table 5.5.20 except distance and occupation have the expected signs and are statistically significant. The probability of choosing an improved water service in water scarce and saline areas is higher than in areas with a relatively good supply of water. The results suggest that yearly income, wealth (as measured by number of rooms) and education have positive effects on connection probabilities. Monthly tariff has a negative effect.

Figure 2 displays the results of a simulation for this model in which all continuous variables are held at their mean values while the monthly tariff is varied across its range. The dummy variables are set for agricultural occupation, education = 1, and male respondent. If the dummies were set differently, they would affect the vertical placement of the lines in the group but not the slopes. The coefficients come from Table 5.5.20 but for each separate site (existing versus proposed piped water supply) and area (scarce versus adequate water from traditional sources), the overall sample mean values are used (1)

Figure 2 contains 6 lines. The top set of 3 lines are for the sites with existing piped water supply and the bottom set of 3 is for the sites where the improved water supply is proposed. The 3 lines in each group refer to water abundant, water scarce, and saline water communities.

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(1) Using the mean value specific to the site also give similar results.

The probability of hooking up in the existing sites is substantially higher at every monthly tariff and for every type of water condition. This is useful information because it suggests that despite the unsatisfactory experience the households in the existing sites have had with improved water supplies, they would still be extremely likely to connect. It also suggests that in the proposed sites more households will hook up at each monthly tariff after the water system is actually available. The existence of the water system itself appears to have a positive effect on the probability of using it; that is assumed to be a knowledge effect.

The rankings within each site for water availability are also as might be expected. Households in good quality water areas are the least likely to hook up at each monthly tariff, those in saline areas are somewhat more willing to use a yard tap at each tariff, and those in water scarce areas are significantly more interested in hooking up at any tariff level. The probability of hooking up in the proposed sites is below 50 percent at every monthly tariff.

Figure 5 is constructed in exactly the same way as Figure 2, but income is varied across the range reported in the sample. Even at the lowest incomes the probability of hooking up is substantially above 0.5 in the existing sites. It does not exceed 0.5 for the proposed sites until income levels well above those reported by most of the sample. The rankings across good, scarce, and saline areas are similar to what was shown in Figure 2 (1).

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(1) An important caveat should be attached to these figures. They show continuous probabilities, but the probabilities underlie a discrete choice decision. As the continuous probability increases, a household will eventually decide to hook up. Conventionally it is assumed that households fall into category 0 if the probability is below .50; they fall into category 1 if the probability is equal to or greater than .50. The threshold is arbitrary. Accordingly, in these figures, it is much safer to concentrate on the rankings and the slopes of the lines rather than the exact probabilities although very high or low probabilities may be good indicators of the discrete choices that would be made.

Service Reliability (For Connector Households only)

Figure 3 is constructed from Table 5.5.22 in a manner similar to the procedure followed in arriving at Figure 2, but reliability of service is taken into account. It also contains six lines. The top set of three lines reflects the probability of connecting under a more reliable water system, and the bottom set of 3 lines shows the probability of connecting without a change in reliability. The probability of connecting under the improved water system is substantially higher at every monthly tariff level and for every type of water condition. Interestingly the different curvature of the simulation indicates that the likelihood of connecting is more sensitive to changes in monthly tariff under the existing service than to changes in monthly tariff structure under the improved system. The rankings within each site for water availability are also as might be expected. Households appear willing to pay even double the prevailing rates for an improved level of service.

Connection Cost Versus Tariff (for non-connectors and probable connectors only)

The primary interest in Table 5.5.24 is the differential effect of varying the hookup charge relative to the tariff. The probit results suggest that the monthly tariff is not a statistically significant factor influencing the decision to connect to the system in the presence of the initial connection fee. In contrast, the connection cost is a statistically significant, negative influence on the likelihood of connecting to the improved system. This finding provides a useful policy implication in the sense that it shows that there may be considerable scope for amortizing the connection cost in the monthly tariff. In addition, the price elasticity for the monthly tariff is -0.14, while the price elasticity for the connection charge is -0.44. A one per cent increase in the monthly tariff structure results in 0.14 per cent decrease in the probability of connecting, while a 1 per cent increase in connection level causes a 4.4 per cent decrease in the probability of connecting. The sample is more sensitive to changes in the hookup charge than to small changes at the mean in the monthly tariff.

Figure 4 shows effects of connection cost on the probability of choosing a yard tap among the non-connectors and the probable connectors derived from Table 5.5.24. As the estimates indicate, connection cost has a strong negative effect among both groups. Households in the proposed site are likely to be more strongly sensitive to change in connection cost level than the non-connectors in the existing sites. The probability of hooking up in the proposed sites falls below 50 per cent in the connection cost range of Rs. 250 - Rs. 400, connection probabilities in the existing sites does not fall below 50 per cent until the connection cost range of Rs. 550 - Rs. 700.

5.5.3 Estimation and Results of The Ordered Probability Model for Maximum Willingness to Pay

Maximum willingness to pay (MWTP) is also treated as a function of attributes of water source and socio-economic characteristics of households. The MWTP variable comes from the bidding game, with values ranging from Rs. 10 to Rs. 50, assuming the lowest connection cost in games where that is also a factor. An ordered probit model is used, as explained earlier.

MWTP = f (attributes of water source, socio-economic characteristics of households, dummy site variables)

Table 5.5.30 contains the variables used and the expected signs.

Table 5.5.31 shows the results of the estimates of the maximum willingness to pay or bid curve estimation. Both ordinary least squares (OLS) and ordered probit results are shown; the coefficients in the OLS models are strongly biased toward zero. Note first the frequency distribution of responses at the bottom of the table . About 77 per cent of the sample are in the Rs. 10 category, 10 per cent are in the Rs. 20 group, 4 per cent are in the Rs. 30 group, and 9 per cent are in the Rs. 50 group.

Despite the small amount of variation in the dependent variable, the results are consistent with those from the probability models and are highly significant. The large, negative constant indicates the strong effect the independent variables (plus the probability of not being at one of the limits -- below 0 or above 50) have in determining willingness to pay. Income and assets (as measured by number of rooms), education, and the site dummies have strong positive effects in raising willingness to pay for a private water connection. As shown earlier in Figure 2, saline water or water scarce conditions increase willingness to pay for improved water substantially relative to the excluded good quality water zone category.

In addition, as shown in Table 5.5.32, reliability of service is a strongly positive influence on the willingness to pay, confirming the probit result shown earlier.

Table 5.5.30

Hypothesized Effects of Independent Variables

Variables	Hook up to Yard Tap	Maximum Willingness to Pay
Monthly tariff	-	
Connection cost	-	
Distance to water source	+	+
Yearly income	+	+
Number of rooms	+	+
Education	+	+
Agricultural occupation	-	-
Respondent sex (female)	?	?
Dummy 1 (water scarce)	+	+
Dummy 2 (water saline)	+	+
Dummy 3 (B site)	-	-
Dummy 4 (reliability)	+	+

Table 5.5.31

Maximum Willingness to Pay Estimates For Connectors and Non-connectors

Independent Variables	O L S (t - value)	Ordered Probit (t - value)
Constant	-0.8399 (-0.3100)	-22.9780 (-4.7031)*
Yearly income	0.0001 (2.4313)*	0.0001) (1.8747)*
Number of rooms	0.3961 (1.3471)	0.4448 (0.9345)
Sex of respondent (female = 1)	-2.0724 (-1.3761)	-4.4426 (-1.8266)*
Education level	9.8758 (5.0551)*	20.1421 (5.7354)*
Occupation (farming = 1)	1.8348 (0.5740)	2.7157 (0.5328)
Distance to source	-0.0146 (-1.1510)	-0.0488 (-1.9047)*
Dummy for reliability	1.8189 (7.4702)*	24.5680 (8.1163)*
Dummy for scarce area	20.8345 (11.4070)*	33.1001 (10.1056)*
Dummy for saline area	8.4620 (4.3222)*	14.5479 (4.2979)*

Range	Frequency	Percent
MWTP < 10	227	41
10 <= MWTP < 20	106	19
20 <= MWTP < 30	88	16
30 <= MWTP < 50	38	7
MWTP >= 50	91	17

Number of obs 550

* indicates the 95 % level of statistical significance.

Table 5.5.32

Maximum Willingness to Pay Estimates For Existing and Proposed Sites

Independent Variables	O L S (t - value)	Ordered Probit (t - value)
Constant	5.8337 (3.5190)*	-11.0850 (-2.9355)*
Yearly income	0.0002 (7.7018)*	0.0003 (10.4900)*
Number of rooms	1.0440 (3.9350)*	2.3441 (4.4986)*
Sex of respondent (female = 1)	-2.4026 (-2.8707)*	-4.8302 (-3.5851)*
Education level	3.9322 (4.0607)*	9.3442 (4.4365)*
Occupation (farming = 1)	-1.8065 (-1.2576)	-3.5439 (-2.8544)*
Distance to source	0.0007 (0.2262)	0.0070 (1.7065)*
Dummy for scarce area	5.3890 (4.7550)*	6.7513 (3.0946)*
Dummy for saline area	1.0387 (0.9198)	-2.0236 (-0.7953)
Dummy for proposed site	-4.5325 (-4.8019)*	-8.9768 (-5.0530)*

Range	Frequency	Percent
MWTP < 10	585	60
10 <= MWTP < 20	192	20
20 <= MWTP < 30	57	6
30 <= MWTP < 50	45	5
MWTP >= 50	101	10

Number of obs 980

* indicates the 95 % level of statistical significance.

Table 5.5.33

Maximum Willingness to Pay Estimates For All Sites

Independent Variables	O L S (t - value)	Ordered Probit (t - value)
Constant	5.7225 (3.3338)*	-12.3843 (-3.8755)*
Yearly income	0.0002 (7.3792)*	0.0003 (8.4836)*
Number of rooms	0.6645 (2.9889)*	1.2492 (3.6553)*
Sex of respondent (female = 1)	-2.2470 (-2.5830)*	-4.0621 (-2.9045)*
Education level	8.0284 (7.6741)*	17.7464 (8.1884)*
Occupation (formal sector =1)	-1.6322 (-1.0819)	-2.3986 (-0.8132)
Distance to source	-0.0029 (-0.8054)	0.0005 (0.1019)
Dummy for scarce area	10.7988 (9.2941)*	14.7139 (6.7554)*
Dummy for saline area	4.5441 (3.9370)*	4.6526 (2.1792)*
Dummy for proposed site	-8.7625 (-9.2928)*	-16.2990 (-10.2220)*

Range	Frequency	Percent
MWTP < 10	635	58
10 <= MWTP < 20	240	22
20 <= MWTP < 30	121	11
30 <= MWTP < 50	45	4
MWTP >= 50	45	4

Number of obs 1150

* indicates the 95 % level of statistical significance

Figure 1

EFFECT OF INCOME ON CHOICE OF WATER CHOICE IN A SITE

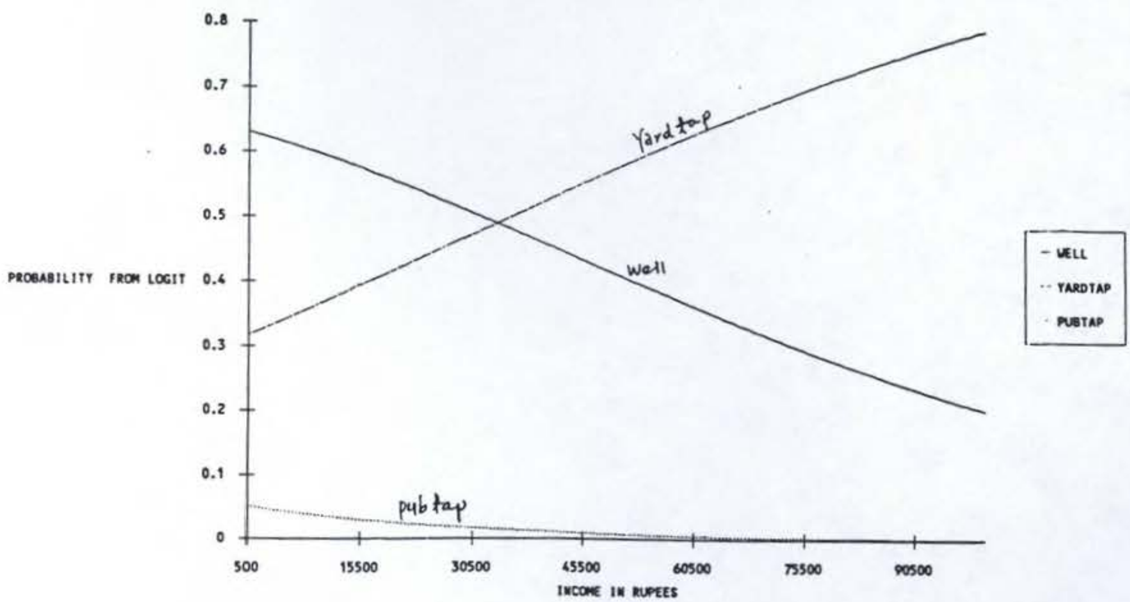


Figure 2

EFFECT OF TARIFF ON CHOOSING YARDTAP BY AREA ADN SITE

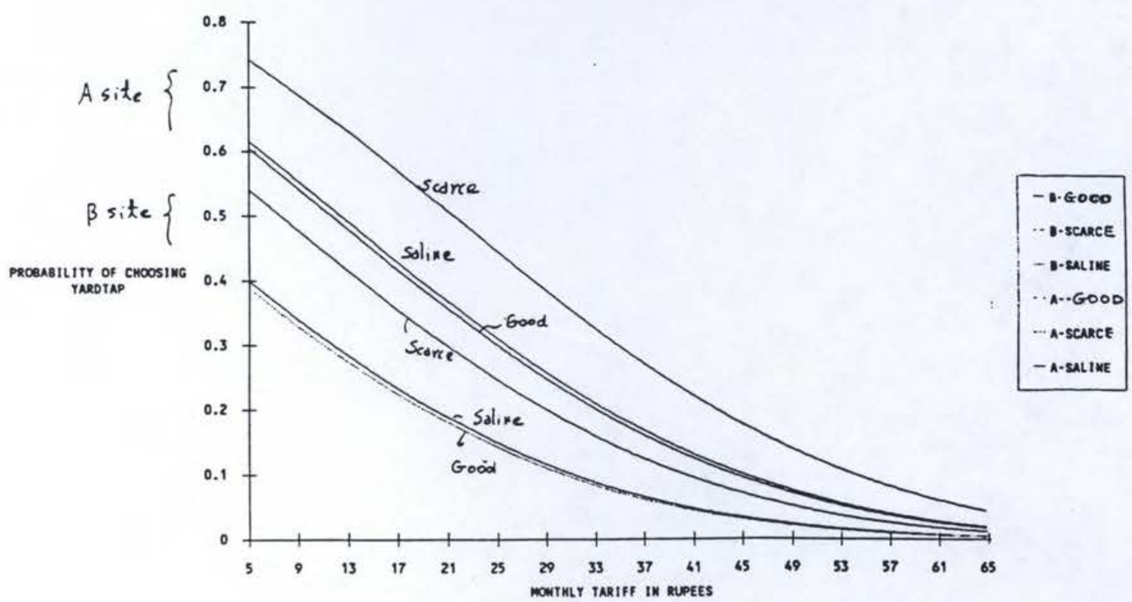


Figure 3

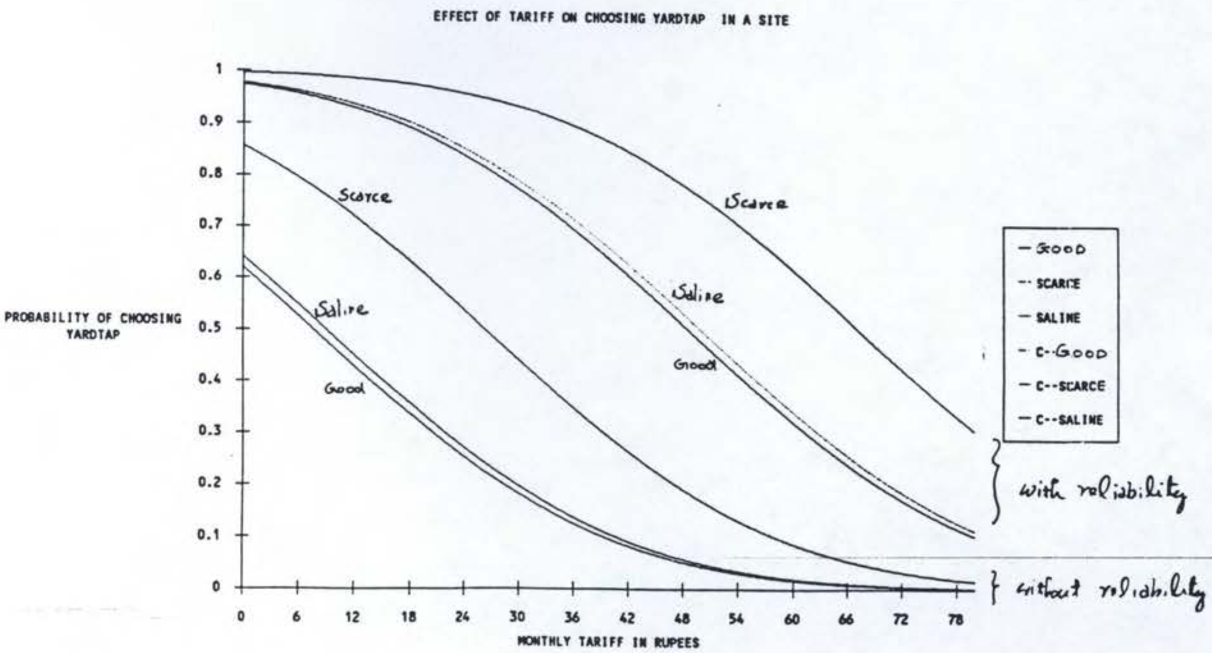

EFFECT OF TARIFF ON CHOOSING YARDTAP IN A SITE
PROBABILITY OF CHOOSING YARDTAP
MONTHLY TARIFF IN RUPEES
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
6
12
18
24
30
36
42
48
54
60
66
72
78
Scarce
Saline
Good
Scarce
Saline
Good
— GOOD
-- SCARCE
— SALINE
— C--GOOD
— C--SCARCE
— C--SALINE
with reliability
without reliability

Figure 4

EFFECT ON CONNECTION COST ON CHOOSING YARDTAP BY AREA AND SITE

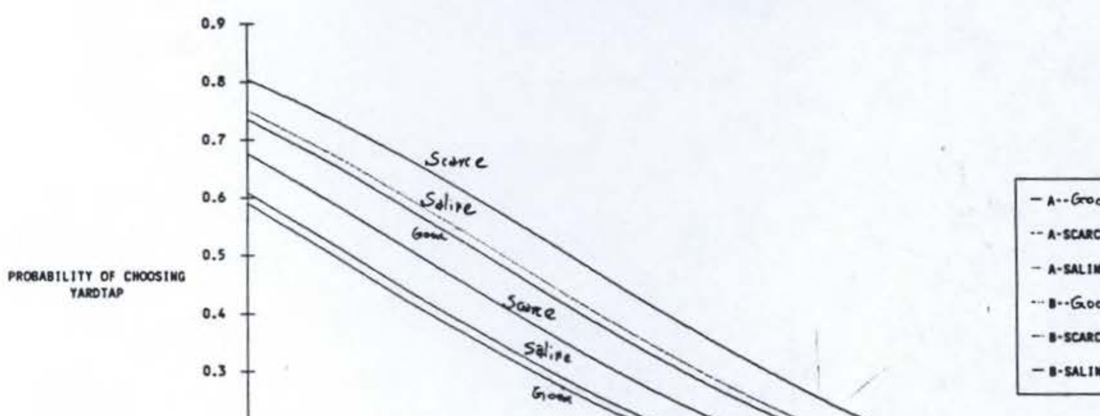
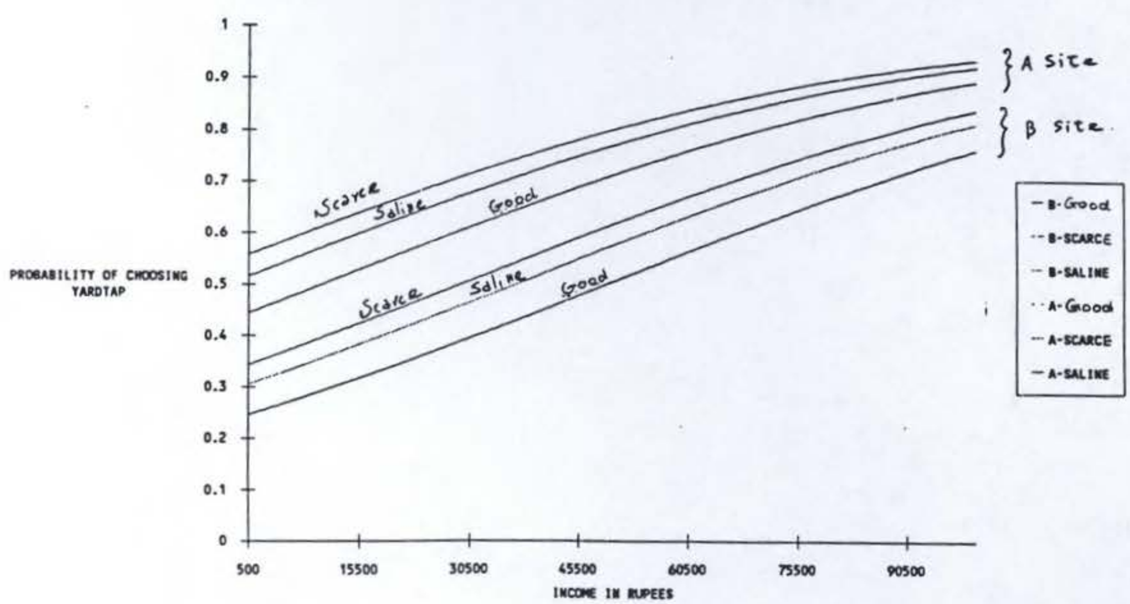


Figure 3

EFFECT OF INCOME ON CHOOSING YARDTAP BY AREA AND SITE



CHAPTER VI

SUMMARY AND CONCLUSIONS

The governments in developing countries are faced with an uphill task of providing safe and clean water to dispersed rural communities where the pressure of growing population as well as environmental factors have rendered the traditional water sources inadequate to meet household needs. The schemes for providing improved water tend to be capital and/or technology intensive and require substantial resources for maintenance. The imperative of intensifying efforts to improve access to safe drinking water in the rural areas has come about at a time when most developing country governments as well as donor agencies are going through a serious resource constraint. The low level of efficiency in the operation and maintenance of the improved water supply schemes makes the task even more difficult. The provision of protected water free of charge has led to unsustainable subsidies ultimately resulting in the condition of those most in need of the service remaining unchanged. Although the responsibility of setting up and providing finances for the system might continue to be with the governments and other outside sources, the local residents are expected to be generally responsible for the maintenance of the system and contribute towards the recovery of operation and maintenance costs.

While huge quantities of financial and human resources have been devoted to solving the technical problems associated with supplying water for meeting household needs in the rural areas, much less attention has been paid to the behaviour of present and potential users of these systems which in the end is what determines whether they will be maintained and used. Designers have paid little attention to the economic and social determinants of water use patterns and resource mobilisation for the improved systems and have instead used rules of thumb (such as a fixed percentage of income people would be willing to set aside for the improved service and/or contributions to labour inputs when systems are built) in planning for such a service. The systems are designed to provide an abysmally low level of service across all environments and social situations.

This study has assessed the impact of socio-economic characteristics of rural households, the environmental situations in terms of supply of water through traditional sources and the quality of the service itself, in the sustainability of the improved system. Sites were chosen to reflect the three environmental settings (to ensure variation in source choice) in northern Kerala; (a) with access to adequate and good quality traditional sources of water, (b) where water scarcity has become a constant feature over the years, and (c) with traditional sources supplying water in abundance but which water is of poor quality due to saline intrusion. In each of these settings our investigation covered two sites. The first group of sites are those in which the improved service is available and where there is a substantial variation in whether households are hooked up to the service through yard taps. The second group of sites are similar to the first group of sites in terms of socio-economic structure and the availability of water through the traditional sources but where the improved service will become available only after a few months.

Our evidence reveals that rural households continue to exercise the choice for multiple sources of water and that variations in the use of the improved system are mainly on account of compulsions imposed by environmental factors and the supply constraint which afflicts the provision of the improved service. The fact that reliance on multiple sources of water is most pronounced among households with a yard tap in all three sites reveals that the improved system in its present form is performing only a supplementary role in meeting the rural water demand. Piped water as a single source is of consequence only in the scarcity area which, again, is a reflection of an overall supply constraint in such sites and does not provide any proof of the ability of the improved service to meet the domestic requirement of water there. Most households use atleast two sources of water and own well and/or neighbour's well figure as a parallel source - to the yard tap among connector households and to public taps among non-connectors. Public wells are of some consequence in meeting the water demand only in water scarce and saline areas. The supplementary character of the improved service is further highlighted by the fact that except in the water scarcity area it accounts for less than half of water consumed by connector households, and only between one quarter to one-third of the demand for water among non-connectors is satisfied through such a source. In fact, in the adequate/good quality area only two per cent of water consumed by non-connectors is through this source.

While the improved service in its present state might not have provided an alternative to the traditional sources of water, it has undoubtedly helped in minimising the hardships faced by rural households in meeting their domestic requirements for water. Those with yard taps have benefited most from the improved system as it has augmented their supply of water to the national norm of 40 litres per capita per day. The connector households in the adequate/good quality water area, in fact, consume water upto the liberalised norm of 70 litres per capita per day. The households which have not taken yard taps but which have access to the improved service through standposts, too, are better off than the households in the sites without piped water supply. However, a vast majority of the non-connector households, except in the adequate/good quality water area still fall short of the consumption norm of 40 litres per capita per day.

We did not observe inter-seasonal variations in water consumption but this is not surprising in a situation where the households find it difficult to meet their water demand even at its lowest ebb. This is also why no relationship is observed between water consumption and factors such as income, family size, presence of higher education, religion or caste. Only under conditions of a relatively greater quantity of water being available as, for example, among the households with yard taps, did we observe a positive relationship between water consumption on the one hand and per capita income and presence of one female member with high school education on the other. The rest would seem to be in a continuous struggle to meet their barest minimum requirements of water making an all out effort to procure water from all possible sources. The situation becomes much worse during the summer season when even in the area with adequate/ good quality water as many as 57 per cent of non-connectors find piped water supply through the standpost severely inadequate.

Since most of the households cannot rely on a single source to meet any of their particular requirements, they tend to switch and shift from one source to another according to the dictates of their environmental conditions. Households in the adequate/good quality water area make free use of traditional sources for drinking and cooking and depend on them heavily for cleaning of utensils, bathing and washing, etc. In the poor quality water sites a majority of the households, while reserving water from the improved service for drinking and cooking, turn to the traditional sources almost exclusively for meeting their other needs, viz. bathing and washing, etc. In the scarcity area, they have to distribute their limited supplies from the improved service over the entire range of end-uses with a relatively greater emphasis on drinking and cooking.

The evidence towards an overwhelming desire for a convenient service among our sample households indicates a vast scope for the improved system, particularly yard taps, in meeting the water demand of rural households. The fact that the preference for yard taps is observed most among those having their own wells and that as many as 45 per cent of connector households in the adequate/good quality water area, 30 per cent in the poor quality water area and 20 per cent in the water scarce area have a system of reticulation, is proof in this direction. Freedom from having to queue up at the standpost and from dependence on others has emerged as another important factor in going in for a yard tap, as the second most important combination in this group of households is the yard tap with neighbour's well.

Public taps (standposts) provide a much-needed relief in the scarce and poor quality water areas. While in the adequate/good quality water area only 2 per cent of the water consumed by the non-connector households comes through this source, around a third of the water consumed by the non-connector households in the water scarce area is through the standposts, and for 35 per cent of them standposts are the only source of water in this area. In the saline area one-fourth of the water consumed by non - connector households is accounted for by standposts.

The sustainability of an improved water system depends on the quality of its service which hinges not only on the technological and administrative back-up from the top but also on the participation of the local population in its planning, operation and through managerial, physical and financial contributions.

While a large proportion of the sample households in the adequate/good quality water area who can afford to be relatively choosy about the improved system expressed dissatisfaction with the general quality and taste of piped water, most of the sample households in the poor quality and scarcity areas did not have any complaints about the general quality and taste of piped water. It was the inadequate quantity of water and the irregularity in the supply of water through the improved service which irked the sample households almost everywhere the situation being exasperating during the summer season. The constraints on the amount of and reliability with which water can be made available to the community are mainly on the supply side and not because of the service being in a state of disuse or disrepair. Most often the schemes are very small, either because of the limitations of the source itself or because the amount sanctioned was too small to permit larger schemes.

This is, however, not to deny the existence of certain features in the design and laying of pipe lines which adversely affect the efficacy of the improved system. For example, in their initial phase the systems have invariably tended to start the distribution pipe lines from those parts of the village which are most centrally located, which are also the pockets where the relatively better-off live. When the distribution pipe lines are extended to other parts of the village the system, due to its initial weakness of being under-designed, has already exhausted its operational capacity. This leads to weaker flows, shorter duration of supplies and longer queues at the standposts all over, more so in the localities which are covered later. Again, the pipes are laid only along one side of the road, which makes the system inaccessible to those living on the other side, as it is a major problem and an expensive one to cut through the road and take a connection across to the other side. The defects in the distribution pipe line and the other factors which make the service ineffective for the majority of the population are a direct outcome of the prevailing top-down approach which does not appreciate the need for consultations with the rural people at the design and implementation stage. Our discussions at the village sites suggest that local people have been observing the planning and laying of the distribution pipe lines with keen interest and have shown a greater anticipation of the problems in this regard than was probably expected of them. The absence of any consultations with the local people is also responsible for inoptimal location of standposts. The plank on which community involvement in the implementation, operation and maintenance of the improved system can be fostered must necessarily rest on a greater communication with and participation by people through the formation of citizens' committees at the level of pockets within the village with a strong representation of women and their training into operation of pumps and other maintenance works.

It is clear that the improved system in its present form is able to meet only a very small proportion of the demand for water of rural households. By emphasising solely standposts to the near exclusion of yard taps - as reflected in the poor connection rate of between 7 to 10 per cent - the service has been starved of much-needed finance for augmenting the supplies and improving its reliability through proper operation and maintenance. The yard taps would be an important means of cross-subsidising better quality service at the standposts for those who are not in a position to pay for the service.

Our analysis of willingness to pay based on the contingent valuation method using probit and logit models developed by environmental and resource economists to deal with the provision of public goods, reveals as follows:

income, tariff, education and connection costs are important determinants of whether people would hook up to the improved service;

wells are considered by the households to be highly competitive with yard taps, but yard taps are regarded as a normal good and people tend to switch to them as income and educational levels rise;

in the bidding games in which the connection cost can be controlled, the monthly tariff becomes statistically insignificant. Thus, it is the initial connection cost which would seem to be an important impediment to taking house connections.

Responses from connectors as well as non-connectors in all the three sites where piped water supply has been in existence for the last few years reveal a relatively lower demand for public taps than for yard taps. While meeting of connection costs through loans/subsidies or its incorporation into the tariff structure will enable a large number of households to hook up to the improved service through yard taps, access to potable water for the very poor households will have to continue to be through public taps. Ensuring a longer duration of supply through these taps, better quality heavy duty taps, the use of liberalised consumption norms while planning for these systems and people's participation in the laying of distribution pipe lines and in operation and maintenance of the system, ought to be on the agenda.

Reliability of service has a substantial positive effect on decision to connect to an improved system, and it strongly offsets the negative effect of the tariff.

There are certain aspects of the hardware of piped water systems, too, which deserve more attention than they have received hitherto. The quality of public taps is one. Taps for public use need to be brought in line with the flow, duration of supply and user pressure. Given the generally weak flow, long queues at standposts and heavy handling of these taps within compacted time spans, the taps presently in use tend to break or leak. The absence of back-up mechanisms for prompt attention to repairs such as the ones described above could well act to induce apathy and wastefulness on the part of the people. It would indeed be 'bad development' if women whose experience of traditional sources over centuries makes them the greatest conservers of water, were to become apathetic in the use of this precious resource through the improved system.

Another aspect requiring attention are domestic meters. All private connections in rural northern Kerala are metered. While the problem of defective meters was not widespread among the sample households, in the course of our site reconnaissance we came across situations of dissatisfaction with the quality of the meters. The authorities claimed helplessness in this matter as the market for domestic water meters is limited and there is no pressure for quality control of products. With the expansion of the programme for rural drinking water systems and, inevitably, growth in the number of domestic connections, the market for meters may be expected to widen, redressing this problem somewhat. But it is necessary to stress here the need for government to ensure quality control in domestic water meters as in public taps.

Chlorination of tap water is yet another problem. While the need for pipe water is universally felt and only those in the adequate/good quality water area with access to alternative traditional sources can afford to be finicky about the taste and smell of pipe water, in the course of our field visits we came across complaints about the quality of pipe water due, probably, to excessive chlorination. There would seem to be need for a more flexible policy with regard to chlorination so that taste acceptablity of pipe water can be enhanced particularly for drinking and cooking. It is necessary to allay here any impression that chlorination is major problem; it is not. The availability of more water through pipes makes for general hygiene improvement and cleanliness of the micro-environment, which is as important as water for drinking per se. Of course, the plentiful supply of water in the absence of provision for drainage around taps and for removal of sullage water raises the further problem of creating new and exacerbating existing water borne or water fostered diseases. But that is not our concern here as drainage and environmental sanitation are beyond the purview of this study.

In conclusion, our study reinforces the Government of India's priority in providing improved water systems in scarcity and poor quality water areas. As reflected in our evidence on source choice, source-wise share in household water consumption and willingness to pay, the improved system has a crucial role in reducing the severity of shortage in water consumption in these. areas.

It is the inflexible consumption and investment norms, lack of communication with and participation of the local people and the keeping away from tapping resources through provision of house connections, that have laid a trap of inadequacy and inefficency around the improved service. It is clear that people want house connections for which they have been paying and are willing to pay. Their willingness to pay is further enhanced with rise in incomes, educational levels and reliability of the service both in terms of quantity of water supplied and regularity with which supply is maintained. Apart from this potential for mobilising local funds to augment and improve the operation and maintenance of the improved system, there is also a clear indication of a high level of awareness and preparedness on the part of the local populations to improve the operation and maintenance of the system. Thus, the lessons which come out very clearly are: removal of restrictions on domestic connections, meeting of connection costs through credit facilities or subsidies or its incorporation into the tariff structure, and putting people especially women in the 'driver's seat' for system augmentation, operation and maintenance. Since the source choice probabilities are systematically affected by environmental differences in water condition, a disaggregated approach would be required in the determination of scale, technology and financial choices.

It ought to be noted here that in the DANIDA sponsored improved systems care is being taken to ease the constraints imposed by investment and consumption norms, by designing the system so as to provide water upto the liberalized norm of 70 litres per capita per day. The Socio-Economic Unit is working with the KWA engineers and local groups to ensure the provision of standposts at sites where they are needed most, and to benefit from the locally available stock of knowledge in the matter of laying distribution pipe lines. It also seeks to link the provision of piped water with environmental sanitation and better hygiene practices. We have included one such scheme (Nannamukku) among the sanctioned schemes in our study. How rewarding this experiment has been will be part of the subject matter of our analysis in the second phase of this study.

APPENDIX I

SOCIO-ECONOMIC PROFILE OF SAMPLE HOUSEHOLDS

While some of the household characteristics assuming significance in explaining variations in water use patterns and influencing willingness to pay bids have been dealt with in greater detail and depth in the preceding chapters, this appendix is intended mainly to provide a profile of the population to which this study relates. It would help in providing a holistic understanding of the situation we are discussing by specifying the quantitative dimensions of the socio-economic characteristics such as average household size, sex and age-wise composition, occupational patterns, religious affiliations, asset composition, income, employment and educational levels of the sample households.

1.1 Respondents

To begin with we profile the respondents, i.e., the person(s) who gave the required information on the sample household(s). By a combination of chance and design, at least half our total number of respondents were women, the proportion going upto 70 per cent for the non-connector households. Also, between one-third to one half of the respondents were heads of their households. The average age of female respondents is around 40 years which is only marginally lower than that of the male respondents.

In keeping with the general pattern observed in the Kerala countryside, literacy was fairly widespread among our respondents. What is striking is that the numbers who have completed secondary school or gone beyond are not insignificant. Connectors come out best here (in all three areas) with the highest proportions of high school graduates as compared with non-connectors and probable connectors. In the sites with improved water supply schemes, respondents in general (both connectors and non-connectors) have much higher proportions of those who have gone to secondary school or beyond, than respondents in the sites with sanctioned schemes. Within the group of high school graduates, men outnumber women. With the exception of respondents (both connectors and non-connectors) in the adequate/good quality water area and probable connectors in the scarce area, where women score as high as men in levels of educational attainment, male respondents outnumber female respondents at the higher levels.

Both male and female respondents individually reflected a high level of responsiveness in the interview situation. Under field conditions one might witness attempts at participation in the interview by all interested adult members of the household. Joint participation (by husband and wife) in the interview among our sample households was confined to 18 per cent. It was interesting to note that although providing for the water needs of the family is considered to be primarily a woman's responsibility, men were keenly aware of the quantities drawn and consumed and other details of household use patterns, just as women respondents answered uninhibitedly when interviewed by male investigators. It is only in the section on bidding games that women's participation was somewhat lower than in the other two sections, i.e., household details and water use practices.

1.2 Demographic Profile

There are significant variations in household size among the different groups of households. The average family size varies from 5 to 8 persons among connectors and from 6 to 8 among non-connectors and probable connectors. For all these groups together, average household size is lowest in the water scarce area and highest in the area of adequate but saline water. By and large, men marginally outnumber women in the sample population, the proportion being 96 females per 100 males in the connector population and 95 per 100 in the non-connector and probable connector population. In all categories of households, between 24 to 28 per cent are headed by women.

Children constitute about a third of the population ranging from 27.3 per cent among connectors to 37.2 per cent among non-connectors and 34.2 among probable connectors. The non-connectors have uniformly larger proportion of children than the connector households in all the three areas. Among the probable connectors the proportion of children is about the same in all the areas.

1.3 Religious and Caste Composition

On the whole Hindus predominate among connectors and non-connectors, Muslims among probable connectors. Palghat, our water scarce area described earlier, is predominantly Hindu in character while Malappuram in which can be found both our good quality and saline water zones has an almost equal blend of Hindus and Muslims (although our site for probable connectors in the saline area represents a particularly high concentration of Muslims).

Within the Hindus, the higher and more prosperous caste of Nairs are predominantly represented among connectors. Ezhavas are conspicuous on the whole. Numerically the largest group among Hindus in Northern Kerala, this erstwhile low caste has seen considerable social change in this century due to major movements for social reform which have upheld modern education as a key agent and is, today, an upwardly mobile 'backward caste'. In the area of water scarcity (Palghat) there is a sizable proportion of other intermediate Hindu castes - mainly artisan - and scheduled castes, the latter being more conspicuous on the whole among probable connectors and, generally, in the problematic water zones (scarce and saline).

1.4 Literacy and Education

Connectors as a whole have higher levels of education and the lowest level of illiteracy as compared with the other two categories of the sample population. Probable connectors come out worst with the highest levels of illiteracy (almost a third of the population) and smallest proportion at the higher levels of educational attainment (secondary school and beyond). As expected, the level of education is higher among adult males than among adult females for all groups and in all the sites. The proportion of adult males with a higher level of educational attainment is highest among connectors and lowest among probable connectors. The relatively lower levels of education among the probable connectors could be explained mainly in terms of the concentration of backward castes in the proposed sites.

1.5 Working Force

Workers form a small proportion of the total population in all three categories of households ranging from 20 to 38 per cent. The sample households (all categories) in the water scarce area of Palghat have a relatively larger proportion of workers compared with households in the good quality and saline water zones; this is probably the effect of the fairly significant presence of female workers in the probable connector category dominated by scheduled castes. The relatively low proportion of workers in the total population is explained mainly by a very small work participation rate among females, namely 15 per cent for connectors, 13 per cent for non-connectors and 24 per cent for probable connectors. The number of working members per household is highest in Palghat the water scarce area, more so among the probable connectors (2.5) followed by non-connectors (2.0) and connectors (1.8).

1.6 Occupational Pattern

The range of occupations practised by our sample households in the different sites include cultivation, trade and commerce, salaried jobs and wage labour in agricultural and non-agricultural (factory labour, construction work, shop assistants, etc.,) activities, and village professionals - both traditional and modern.

Contrary to the rural scene in most other parts of the country but quite in keeping with the specific situation of Kerala where villages are like towns as reflected in their population size, level of public utilities, diversification of economic base and higher levels of education, service (salaried jobs) figures among the major occupations in all the sites. Connectors as a whole have a dominant presence in the service group (56 per cent) followed by non-connectors (28 per cent) and probable connectors (15 per cent). In trade, too, the connectors dominate.

It is as we move down the socio-economic scale that other categories of households begin to surface prominently. Fishing, a major occupation among probable connectors dominates the professional profile. Probable connectors also dominate in the group of agricultural labourers, while both non-connectors and probable connectors can be found in sizable proportions doing non-agricultural labour.

Cultivation accounts for a very minor proportion of the workers identified above, below 3 per cent among non-connectors and probable connectors and barely 6 per cent among connectors. Probable connectors on the other hand figure at the top of the list of agricultural labourers (14.6 per cent) followed by non-connectors (7.8 per cent); connectors are virtually absent from this category.

Thus, connectors dominate the better occupations in all the three water zones. Non-connectors are most heavily represented in non-agricultural labour, particularly in the good and saline quality water areas, while in the water scarce area they are to be found in highest proportion in salaried jobs. Probable connectors are more evenly distributed by occupation across areas. While they are to be found strongly in non-agricultural labouring jobs in the saline area and doing both agricultural and non-agricultural labour in the water scarce sites, they are primarily in service jobs followed by non-agricultural labour and then trade in the good quality water zone. The occupational distribution between male and female workers did not appear to be markedly different and it follows the same pattern as observed for the three different groups, i.e., connectors, non-connectors and probable connectors.

1.7 Assets and Income

While in the areas with abundant traditional sources of water a fairly large proportion (43 to 45 per cent) of the sample households with yard taps own farm land, in the scarcity zone only between one-fifth and one-fourth of the sample households are the owners of farm land. The average size of land holding is uniformly lower for the non-connectors. It is also observed that a relatively larger proportion of sample households own land as compared with the proportion of the overall population which owns land. The area on the homestead ranges between 0.2 and 0.5 acres. On an average the households with yard taps have a larger area on the homestead than the non-connectors and the probable connectors in all the three areas. In Kerala most households have fruit bearing trees (coconut, arecanut, jackfruit, cashewnut, etc.) on the homestead. Between 60 and 94 per cent of our sample households have such trees in their yards, and we did not observe any significant differences between the three categories of our sample households in this respect. Kitchen gardening is confined to less than 3 per cent of our sample households.

Almost every household in our sample owned the house in which it lives. Households with yard taps have the most spacious dwellings consisting of about 5 rooms, followed by non-connectors - 4 rooms - and probable connectors. Between 60 to 94 per cent of these houses are firm brick structures. A greater proportion of the households with yard taps have their own latrine and bathroom as compared with the non-connectors and the probable connectors.

Nearly all the sample households with yard taps also have electricity. A majority of the sample households among the non-connectors, too, have electric connections. Except in the area with adequate / good quality water from traditional sources, electric connections among probable connectors is limited to only about one-third of the sample households. The use of L.P.G. for cooking, too, is more prevalent among the sample households with yard taps. This is also the case with respect to items such as television sets, refrigerators and motor cycles.

The households with yard taps by and large have a higher average income as compared with the non-connectors. The probable connectors in the area with adequate / good quality water from traditional sources enjoy the same level of average income as those with yard taps in that water zone. The non-connector sample households have about the same average income in all the three sites. The average income levels are the lowest for the probable connectors in the water scarce area and the poor quality water zone. The distribution of sample households between high, medium and low income levels reveals that while only 36 per cent of the sample households with yard taps are in the low income range, nearly two-thirds of the sample households among non-connectors and probable connectors are covered within this range. The largest proportion in the high income range, too, is from among the connectors. There are, further, some interesting variations in income distribution. Among connectors for example, nearly two-thirds of the sample households in the water scarce zone fall in the very low income range of less than Rs. 10,000 per household per annum. The proportion of sample non-connectors in this range is by and large the same for all the three areas. While between 80 and 85 per cent of probable connectors in the water scarce area and in the poor quality water zone have very low incomes, in the area with adequate / good quality water from traditional sources only 43 per cent fall in this income category.

The factor of earnings from the overseas jobs mainly in the Gulf countries is predominant among the probable connectors in the area of adequate / good quality water, which provides an explanation for the highest average income levels there. However, among the other categories of households, the remittances from the Gulf do not explain variations in household incomes.

Table 1.1

Respondent Profile

Particulars	Area with adequate/ good quality water	Area with scarce/good to indiff. quality water	Area with abundant/saline quality water	Total
I. Proportion of respondents				
Connectors	47.0 (53.0)	49.0 (51.0)	53.0 (47.0)	50.0 (50.0)
Non-connectors	16.0 (84.0)	49.0 (51.0)	24.0 (76.0)	30.0 (70.0)
Probable connectors	47.0 (53.0)	40.0 (60.0)	41.0 (59.0)	43.0 (57.0)
II. Average age of respondents				
Connectors	49 (47)	53 (47)	42 (41)	47 (45)
Non-connectors	40 (38)	45 (39)	42 (40)	43 (39)
Probable connectors	44 (42)	48 (39)	40 (38)	44 (40)
III. Percent respondents who are H.H.*				
Connectors	59.0	55.0	45.0	52.0
Non-connectors	22.0	38.0	32.0	31.0
Probable connectors	45.0	42.0	44.0	44.0
IV. Percent respondents having secondary education				
Connectors	32.0 (46.0)	62.0 (36.0)	50.0 (20.0)	50.0 (53.0)
Non-connectors	31.0 (31.0)	51.0 (24.0)	17.0 (16.0)	38.0 (24.0)
Probable connectors	24.0 (10.0)	9.0 (9.0)	13.0 (0.0)	16.0 (6.0)
V. Percent of all respondents having secondary education				
Connectors	39.0	49.0	36.0	37.0
Non-connectors	31.0	37.0	16.0	28.0
Probable connectors	17.0	9.0	5.0	11.0

* Head of household

N.B. Figures in parenthesis pertain to female respondents

Table 1.2

Demographic Profile of Sample Households

Particulars	Area with adequate/ good quality water	Area with scarce/good to indiff. quality water	Area with abundant/saline quality water	Total
I. Average size per household				
Connectors	7.0	4.7	7.9	6.6
Non-connectors	6.5	6.4	7.9	6.9
Probable connectors	7.3	6.4	8.2	7.3
II. Percent households having female as head				
Connectors	28.8	27.9	27.6	28.0
Non-connectors	29.0	24.0	22.0	25.0
Probable connectors	25.0	19.1	28.3	24.5
III. Females per 100 males				
Connectors	87	92	104	96
Non-connectors	98	84	103	95
Probable connectors	97	94	95	95
IV. Proportion of children in total population				
Connectors	25.2	19.4	32.6	27.3
Non-connectors	35.5	31.6	43.3	37.2
Probable connectors	34.9	33.8	33.8	34.2

Table 1.3

Percent Distribution of Households by Religion and Caste

Particulars	Area with adequate/ good quality water	Area with scarce/good to indiff. quality water	Area with abundant/saline quality water	Total
I. Religion				
1. Hindu				
Connectors	71.2	95.3	40.8	67.6
Non-connectors	68.0	98.0	42.0	69.3
Probable connectors	39.0	75.5	4.0	39.5
2. Muslim				
Connectors	24.2	4.7	59.2	31.2
Non-connectors	29.0	2.0	58.0	29.7
Probable connectors	59.5	20.0	96.0	58.5
3. Christian				
Connectors	4.5	0	0	1.2
Non-connectors	3.0	0	0	1.0
Probable connectors	1.5	4.5	0	2.0
II. Caste				
4. Nair* (Hindu)				
Connectors	59.6	40.2	24.3	41.4
Non-connectors	16.2	25.5	2.4	17.8
Probable connectors	30.8	1.3	0	11.0
5. Ezhava* (Hindu)				
Connectors	29.8	22.0	59.5	32.0
Non-connectors	67.6	21.4	61.9	44.7
Probable connectors	39.7	49.7	4.0	48.1
6. Scheduled castes & tribes* (Hindu)				
Connectors	2.1	0	13.5	3.5
Non-connectors	7.4	9.2	26.2	12.0
Probable connectors	17.9	27.8	0	23.7

* Percent of total Hindu households in each category

Table 1.4

Percent Distribution of Adult Population By Level of Education

Particulars	Area with adequate/ good quality water	Area with scarce/good to indiff. quality water	Area with abundant/saline quality water	Total
I. Illiterate				
Connectors	5.2	8.9	11.9	9.1
Non-connectors	24.0	19.2	19.8	20.8
Probable connectors	15.3	52.2	21.7	28.7
II. Literate				
Connectors	3.2	8.4	5.9	5.9
Non-connectors	13.9	15.9	22.4	17.
Probable connectors	8.5	14.8	37.7	21.
III. Educated upto primary level				
Connectors	12.4	18.6	24.7	19.5
Non-connectors	17.0	16.1	27.4	20.3
Probable connectors	24.7	13.1	24.9	21.3
IV. Educated upto middle level				
Connectors	19.3	9.3	17.8	15.9
Non-connectors	9.0	7.0	6.9	7.7
Probable connectors	26.5	6.0	8.0	13.5
V. Educated upto secondary level				
Connectors	31.7	35.9	25.3	30.0
Non-connectors	25.6	28.4	17.7	23.8
Probable connectors	18.8	11.4	5.8	11.8
VI. Educated beyond secondary level				
Connectors	28.2	18.9	14.4	19.6
Non-connectors	10.5	13.4	5.8	9.9
Probable connectors	6.1	2.5	1.9	3.4

Table 1.41

Percent Distribution of Adult Males by Level of Education

Particulars	Area with adequate/ good quality water	Area with scarce/good to indiff. quality water	Area with abundant/saline quality water	Total
I. Literate				
Connectors	2.7	7.3	7.2	5.8
Non-connectors	11.8	15.1	21.7	16.2
Probable connectors	5.7	15.8	35.3	19.8
II. Educated upto primary level				
Connectors	10.6	11.5	22.3	15.6
Non-connectors	18.6	13.8	26.5	19.8
Probable connectors	24.7	15.3	26.2	22.4
III. Educated upto middle level				
Connectors	18.0	9.7	15.8	14.8
Non-connectors	10.4	5.7	9.5	8.7
Probable connectors	31.8	8.1	9.9	16.6
IV. Educated upto secondary level				
Connectors	36.5	41.2	27.1	34.8
Non-connectors	28.6	33.7	18.3	27.4
Probable connectors	23.2	13.9	8.7	15.1
V. Educated beyond secondary level				
Connectors	29.1	24.2	18.6	23.5
Non-connectors	9.5	17.1	6.9	11.5
Probable connectors	6.9	3.0	2.5	4.1

Table 1.42

Percent Distribution of Adult Females by Level of Education

Particulars	Area with adequate/ good quality water	Area with scarce/good to indiff. quality water	Area with abundant/saline quality water	Total
I. Literate				
Connectors	3.8	10.7	4.7	6.1
Non-connectors	16.2	16.7	23.2	18.8
Probable connectors	11.2	13.7	39.9	22.7
II. Educated upto primary level				
Connectors	14.6	25.9	26.9	23.3
Non-connectors	15.2	19.1	28.4	20.8
Probable connectors	24.8	10.9	23.6	20.4
III. Educated upto middle level				
Connectors	20.9	8.9	19.6	17.1
Non-connectors	7.5	8.8	4.2	6.6
Probable connectors	21.5	3.8	6.2	10.5
IV. Educated upto secondary level				
Connectors	25.9	30.4	23.6	26.0
Non-connectors	22.2	21.6	17.2	20.0
Probable connectors	14.6	8.8	3.2	8.5
V. Educated beyond secondary level				
Connectors	27.2	13.3	10.5	15.7
Non-connectors	11.6	8.8	4.6	8.2
Probable connectors	5.4	1.9	1.2	2.8

Table 1.5

Number and Proportion of Workers

Particulars	Area with adequate/ good quality water	Area with scarce/good to indiff. quality water	Area with abundant/saline quality water	Total
I. Proportion of workers in total population				
Connectors	30	36	20	27
Non-connectors	28	30	22	26
Probable connectors	24	38	25	28
II. Av. no. of workers per household				
Connectors	2.1	1.7	1.5	1.7
Non-connectors	1.8	1.9	1.7	1.8
Probable connectors	1.8	2.4	2.0	2.1
III. Proportion of male workers				
Connectors	85.0	79.0	90.0	85.0
Non-connectors	86.0	88.0	86.0	87.0
Probable connectors	75.0	62.0	92.0	76.0
IV. Proportion of female workers				
Connectors	15.0	21.0	10.0	15.0
Non-connectors	14.0	12.0	14.0	13.0
Probable connectors	25.0	38.0	8.0	24.0
V. Proportion of family mem. working out				
Connectors	8.9	4.8	9.2	8.0
Non-connectors	6.2	4.7	8.3	6.5
Probable connectors	7.7	4.6	2.0	4.6

Table 1.6

Percent Distribution of Workers by Occupation (male and female)

Particulars	Area with adequate/ good quality water	Area with scarce/good to indiff. quality water	Area with abundant/saline quality water	Total
I. Farming				
Connectors	4.3	10.9	2.7	5.9
Non-connectors	2.2	2.0	3.5	2.5
Probable connectors	1.9	3.7	1.0	2.4
II. Service				
Connectors	62.6	50.0	56.9	56.4
Non-connectors	30.4	40.7	12.1	28.3
Probable connectors	31.5	9.0	9.5	15.6
III. Trade and commerce				
Connectors	24.5	22.6	15.2	20.6
Non-connectors	9.4	11.3	5.8	8.9
Probable connectors	21.9	3.5	5.0	9.3
IV. Professions				
Connectors	2.9	8.2	2.7	4.6
Non-connectors	2.2	19.6	2.8	8.6
Probable connectors	16.6	7.2	32.5	18.0
V. Agricultural labour				
Connectors	0	0	1.9	0.6
Non-connectors	1.6	5.7	16.8	7.8
Probable connectors	2.3	36.7	0.3	14.6
V. Non-agri. labour				
Connectors	5.8	8.2	20.5	11.7
Non-connectors	54.2	15.9	58.9	42.2
Probable connectors	25.6	39.8	51.5	39.5

Table 1.61

Percent Distribution of Male Workers by Occupation

Particulars	Area with adequate/ good quality water	Area with scarce/good to indiff. quality water	Area with abundant/saline quality water	Total
I. Farming				
Connectors	5.1	5.2	2.9	4.3
Non-connectors	1.9	2.3	4.1	2.7
Probable connectors	1.5	5.3	1.0	2.5
II. Service				
Connectors	56.8	50.4	54.4	54.0
Non-connectors	26.3	42.1	13.4	27.9
Probable connectors	32.5	13.5	9.4	17.3
III. Trade and commerce				
Connectors	28.0	27.0	17.0	23.6
Non-connectors	10.9	12.9	6.7	10.3
Probable connectors	25.0	5.3	4.6	10.6
IV. Professions				
Connectors	3.4	6.9	2.2	4.1
Non-connectors	2.5	22.8	3.4	10.7
Probable connectors	17.1	7.5	33.4	19.9
V. Agricultural labour				
Connectors	0	0	1.5	0.5
Non-connectors	0.6	4.7	7.4	4.2
Probable connectors	0.7	25.7	0.2	8.6
V. Non-agri. labour				
Connectors	6.8	10.4	22.1	13.6
Non-connectors	57.7	13.5	65.1	44.1
Probable connectors	23.1	42.6	51.2	40.4

Table 1.62

Percent Distribution of Female Workers by Occupation

Particulars	Area with adequate/ good quality water	Area with scarce/good to indiff. quality water	Area with abundant/saline quality water	Total
I. Farming				
Connectors	0	32.2	0	14.9
Non-connectors	4.0	0	0	1.4
Probable connectors	3.4	1.1	0	1.7
II. Service				
Connectors	95.2	48.4	80.0	70.1
Non-connectors	56.0	30.4	4.1	30.6
Probable connectors	28.7	1.7	10.3	10.3
III. Trade and commerce				
Connectors	4.7	6.5	0	4.5
Non-connectors	0	0	0	0
Probable connectors	12.6	0.5	10.3	4.9
IV. Professions				
Connectors	0	12.9	6.7	7.5
Non-connectors	0	21.7	0	6.9
Probable connectors	21.8	7.0	24.1	12.9
V. Agricultural labour				
Connectors	0	0	6.7	1.5
Non-connectors	8.0	13.0	75.0	32.0
Probable connectors	0	54.6	0	33.6
V. Non-agri. labour				
Connectors	0	0	6.7	1.5
Non-connectors	32.0	34.8	20.8	29.0
Probable connectors	33.3	35.1	55.2	36.5

Table 1.70

Ownership of Land and Trees By Sample Households.

Particulars	Area with adequate/ good quality water	Area with scarce/good to indiff. quality water	Area with abundant/saline quality water	Total
I. Percent households owning farm land				
Connectors	45.0	16.0	43.0	34.0
Non-connectors	17.0	16.0	23.0	19.0
Probable connectors	18.0	24.0	6.0	16.0
II. Average land owned (acres)				
Connectors	1.7	4.9	1.4	2.1
Non-connectors	1.0	0.4	0.84	1.4
Probable connectors	1.1	2.2	1.6	1.7
III. Av. area owned around home (acres)				
Connectors	0.9	0.3	0.4	0.5
Non-connectors	0.3	0.3	0.2	0.2
Probable connectors	0.5	0.2	0.1	0.3
IV. Percent households having trees around home *				
Connectors	94.0	69.0	94.0	85.0
Non-connectors	92.0	79.0	91.0	87.0
Probable connectors	94.0	60.0	86.0	80.0
V. Percent households growing veg. at home				
Connectors	9.0	1.0	0	3.0
Non-connectors	12.0	0	0	4.0
Probable connectors	0.5	0	4.5	1.0

* Coconut, arecanut, banana, jackfruit, mango, etc.,

Table 1.71

Ownership of House and Related Information About Sample Households.

Particulars	Area with adequate/ good quality water	Area with scarce/good to indiff. quality water	Area with abundant/saline quality water	Total
I. Percent households owning house				
Connectors	97.0	92.0	92.0	94.0
Non-connectors	96.0	97.0	98.0	97.0
Probable connectors	97.0	98.0	99.0	98.0
II. Average no. of rooms per house				
Connectors	5	5	5	5
Non-connectors	4	4	4	4
Probable connectors	3	3	3	3
III. Percent households owning brick house				
Connectors	78.0	94.0	70.0	82.0
Non-connectors	82.0	95.0	57.0	81.0
Probable connectors	75.0	90.0	62.0	75.0
IV. Percent households having bathroom in house				
Connectors	97.0	87.0	95.0	93.0
Non-connectors	79.0	60.0	53.0	64.0
Probable connectors	74.0	10.0	36.0	40.0
V. Percent households having latrine in house				
Connectors	97.0	81.0	96.0	91.0
Non-connectors	85.0	55.0	52.0	64.0
Probable connectors	77.0	5.0	32.0	38.0

Table 1.72

Ownership of Durables By Sample Households.

Particulars	Area with adequate/ good quality water	Area with scarce/good to indiff. quality water	Area with abundant/saline quality water	Total
I. Motor cycle				
Connectors	14.0	8.0	8.0	10.0
Non-connectors	5.0	4.0	1.0	5.0
Probable connectors	9.0	0.5	2.5	4.0
II. Car				
Connectors	9.0	6.0	8.0	8.0
Non-connectors	0	1.0	0	0.5
Probable connectors	4.0	0	0	1.2
III. Television set				
Connectors	17.0	41.0	12.0	23.0
Non-connectors	1.0	18.0	0	10.0
Probable connectors	14.0	2.0	3.0	6.0
IV. Fridge				
Connectors	20.0	23.0	10.0	17.0
Non-connectors	2.0	9.0	0	4.0
Probable connectors	16.0	1.0	3.0	6.0
V. Gas connection				
Connectors	41.0	37.0	11.0	28.0
Non-connectors	5.0	14.0	0	6.0
Probable connectors	3.0	2.0	0	1.7
VI. Electric connection				
Connectors	95.0	97.0	96.0	96.0
Non-connectors	61.0	79.0	44.0	61.0
Probable connectors	66.0	30.0	32.0	42.0

Table 1.73

Percent Distribution of Sample Household By Income Groups (annual income)

Particulars	Area with adequate/ good quality water	Area with scarce/good to indiff. quality water	Area with abundant/saline quality water	Total
I. Very low (upto Rs.10,000)				
Connectors	16.7	60.5	27.6	36.0
Non-connectors	63.0	58.0	63.7	61.6
Probable connectors	43.0	78.5	85.5	69.0
II. Low (10,000-30,000)				
Connectors	47.2	31.4	48.0	42.0
Non-connectors	28.0	34.0	31.3	31.0
Probable connectors	20.0	18.0	10.0	16.0
III. Medium (Rs. 30,000-50,000)				
Connectors	22.7	8.1	10.2	12.8
Non-connectors	8.0	5.0	4.0	5.7
Probable connectors	18.5	2.0	2.5	7.7
IV. High (above 50000)				
Connectors	13.6	0	14.2	9.2
Non-connectors	1.0	3.0	1.0	1.7
Probable connectors	18.5	1.5	2.0	7.3
V. Average income per household (in Rs.)				
Connectors	29,397	10,800	22,411	19,907
Non-connectors	12,392	12,305	11,701	12,133
Probable connectors	30,547	9,794	9,068	16,470
VI. Percent households receiving remittances from Gulf				
Connectors	21.2	16.3	29.6	22.8
Non-connectors	20.0	1.0	22.0	14.3
Probable connectors	36.0	2.0	5.5	14.5

Appendix II

Welfare Analysis

We assume that a household's choice follows from a comparison of the utilities realized in each option as in (1), with the positive value implying a hook-up.

(1) $U_h(.) + e_h - (U_{nh}(.) + e_{nh}) > 0$, with

$U_i(.)$ -- the observable non-stochastic component of the utility function for choice i (h = hooking up a yard tap, nh = not hooking up).

e_i -- the stochastic component of utility for choice i

$U_i(.)$ can be interpreted as an indirect utility function, so that with a linear specification we would re-write(1) for decision on connecting as

(2) $a_h + b_h(y - t) + d_h Z - a_{nh} - b_{nh} y - d_{nh} Z + e_h - e_{nh} > 0$.

where y is household income, t monthly tariff of hooking up and Z other socio-economic variables related to household and source characteristics.

A probit model for connecting a yard tap follows from (2), assuming normality for $e_h - e_{nh}$. Equation (3) defines the probability of hooking up.

(3) Prob(hook-up) = Prob($e_h - e_{nh} < a + by - ct + dZ$), where

$a = a_h - a_{nh}$, $b = b_h - b_{nh}$, $c = b_h$, $d = d_h - d_{nh}$

This formulation can be used to recover a Hicksian welfare measure for hooking up a yard tap. That is, maximum willingness to pay which would imply indifference between hooking up and not hooking up in expected value terms is given as[1]

(4) $CV = (a + by + dZ - ct) / c$

Using (4) to estimate the Hicksian compensating variations for hooking up implies plausible estimates, on average, for those households in different sites.[2]

Mean compensating variation of maximum willingness to pay in Rupees

Site	Mean of C.V.
A	11.87
B	5.39

1. Hanemann(1984b) discusses three alternative definitions welfare measures from a random utility framework. Our approach is based on the analysis's expectation of what is needed to hold utility constant((interpreting the source of the stochastic errors in the model as analyst's knowledge of individual preferences).

2. We considered a variety of specifications for the random utility models including a very simple specification with only income and monthly tariff as determinants of the choice. The benefit estimates for this simple model applied to each site are

site	Mean C.V
A	12.75
B	5.20

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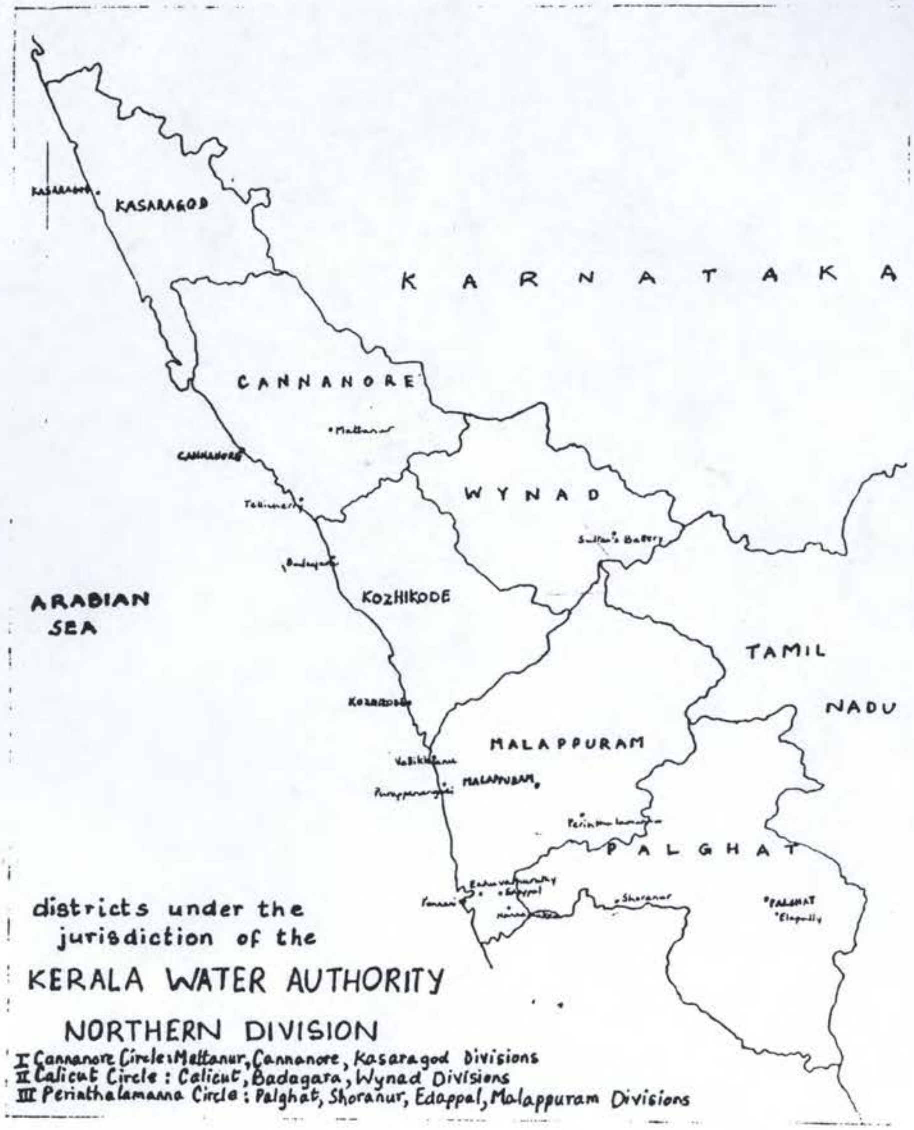

districts under the jurisdiction of the

KERALA WATER AUTHORITY

NORTHERN DIVISION

I Cannanore Circle: Mattanur, Cannanore, Kasaragod Divisions
II Calicut Circle : Calicut, Badagara, Wynad Divisions
III Periathalamanna Circle : Palghat, Shoranur, Edappal, Malappuram Divisions