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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. Perverselv. the svstem 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

(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 grassroot 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 depth 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 institutional 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
In all seasons									
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	--
Winter									
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	--
Summer									
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	--
Monsoon									
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+tro-gh	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 satisfaction 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-connector 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-connector 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	Range up	As is
	As is	Range up	Improved
A2: those who have access but haven't connected	Range down	As is	As is
	Low	Range up	As is
	Low	Range up	Improved
SANCTIONED SCHEMES			
B: those who will have access	Range down	As is	As is
	Low	Range up	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

Table 5.3.2

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 indifferent 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 indifferent 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:

$$(1) \quad \ln (p^{jt} / p^{t1}) = X^t B^j$$

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:

$$(2) \quad P^{ot} = 1 / \{ 1 + \sum_{j=0}^{2} \exp (X^t B) \}$$

$$(3) \quad P^{jt} = \exp (X^t B^j) / \{ 1 + \sum_{j=0}^{2} \exp (X^t B^j) \}$$

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

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(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

$$(4) \quad P^i = F(Z^i = X^i B) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{Z^i} e^{-\frac{s^2}{2}} ds \quad i = 0, 1$$

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:

$$(5) \quad U(S1, \text{income}) = U(S2, \text{income} - MWTP_i^*)$$

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^{1} 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:

$$(8) \quad MWTP^{i} = 1 \text{ if } MWTP^{i*} < R1 = 10$$
$$= 2 \text{ if } 10 = R1 <= MWTP^{i*} < R2 = 20$$
$$= 3 \text{ if } 20 = R2 <= MWTP^{i*} < R3 = 30$$
$$= 4 \text{ if } 30 = R3 <= MWTP^{i*} < R4 = 50$$
$$= 5 \text{ if } MWTP^{i*} >= 50$$

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 $\frac{\text{probability of using yard tap}}{\text{probability of using well}}$) = (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).

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(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 (not 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]

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(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

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(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.

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(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

* 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 6.5.22

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.

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(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.

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(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.

---

(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).

---

(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

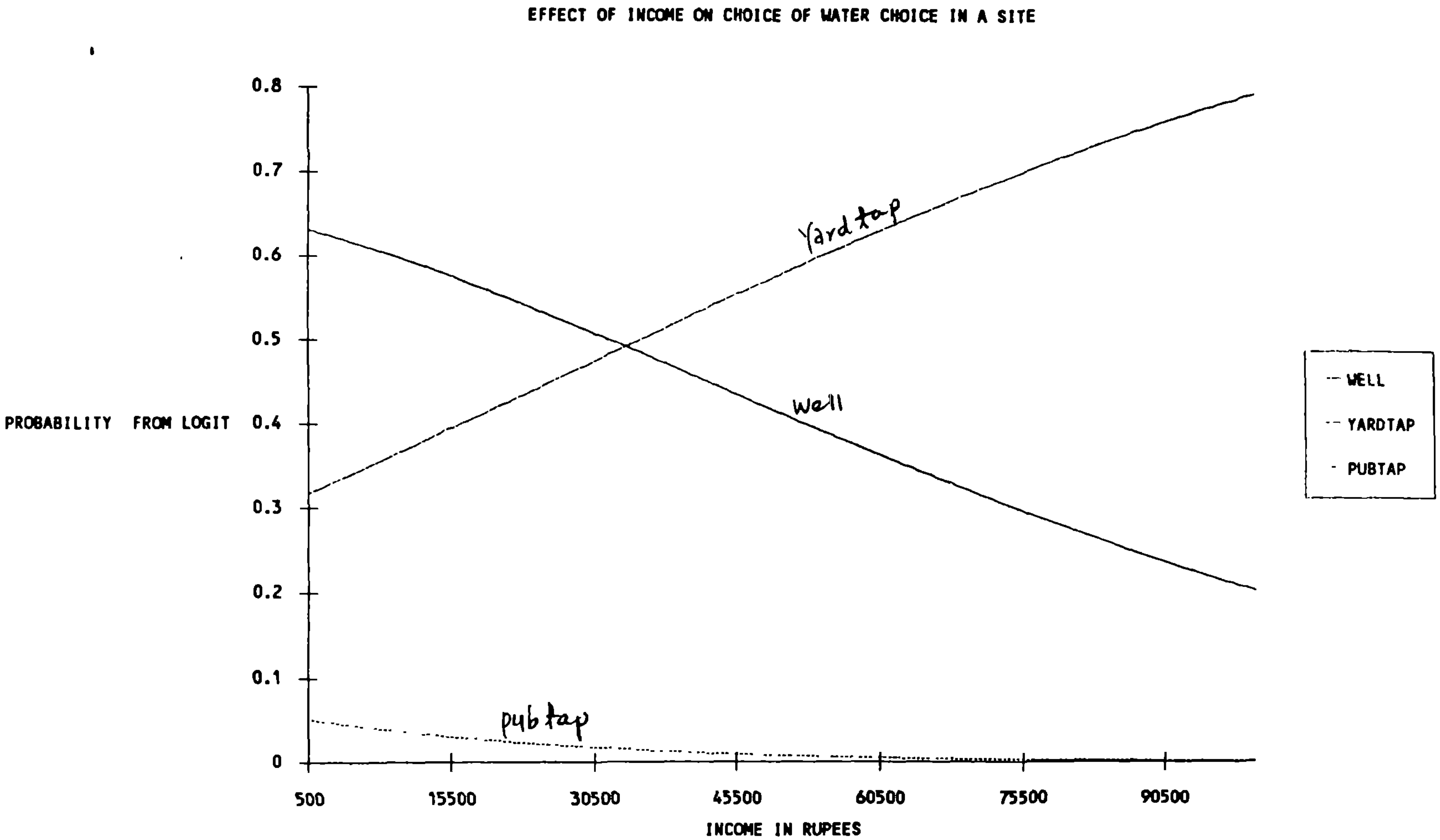

EFFECT OF INCOME ON CHOICE OF WATER CHOICE IN A SITE
PROBABILITY FROM LOGIT
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
500
15500
30500
45500
60500
75500
90500
INCOME IN RUPEES
Yardtap
Well
pubtap
WELL
YARDTAP
PUBTAP

Figure 2

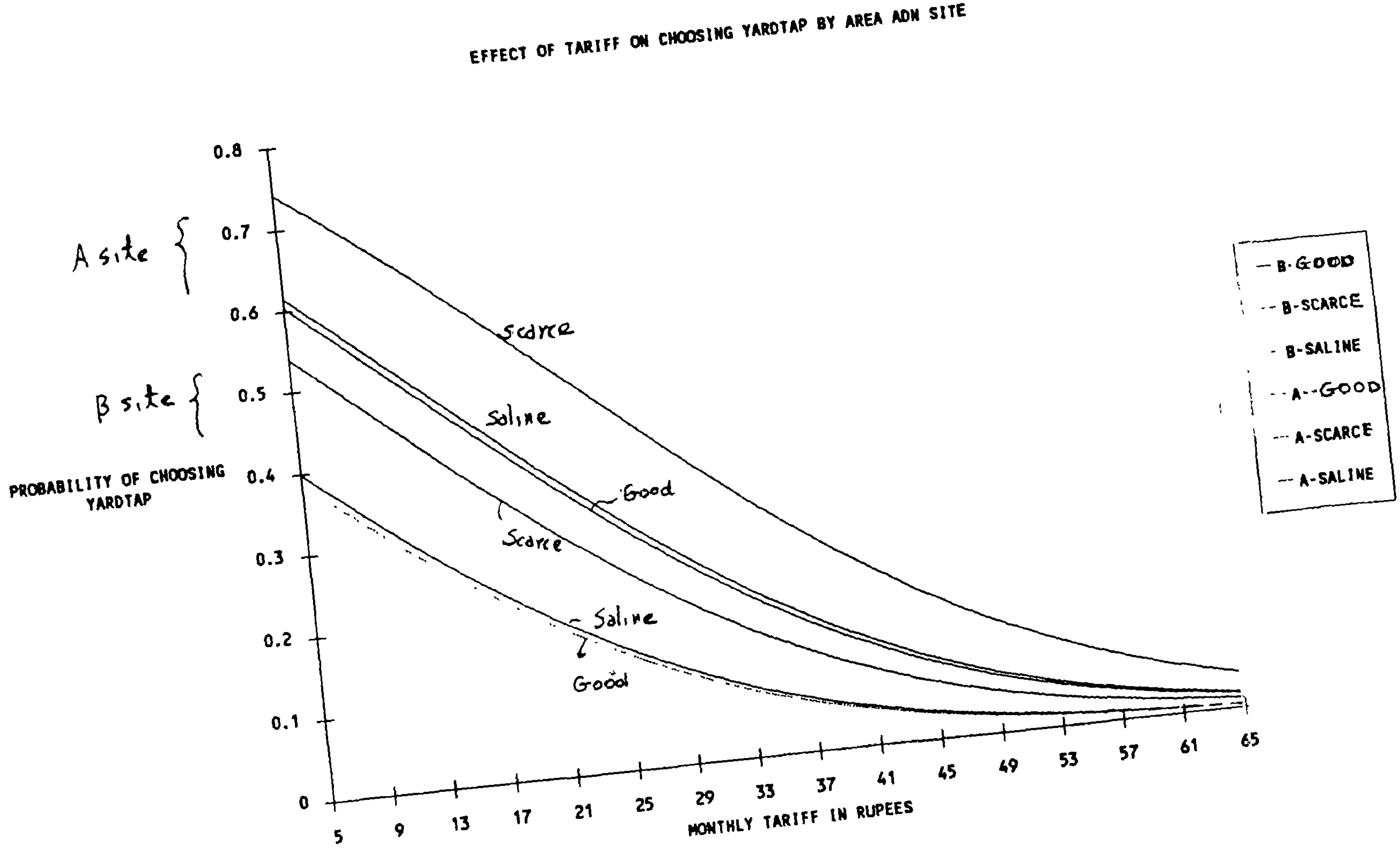
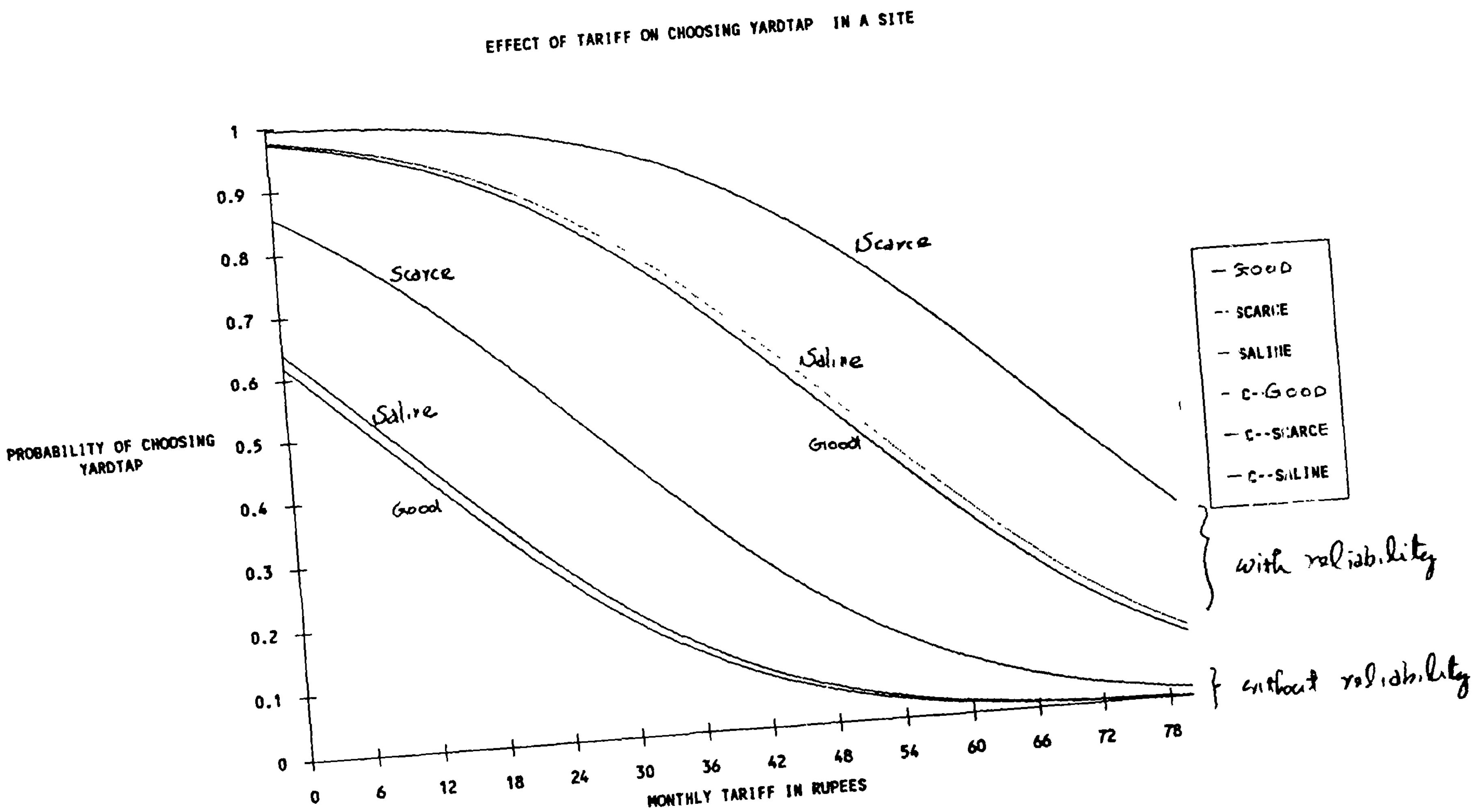

EFFECT OF TARIFF ON CHOOSING YARDTAP BY AREA ADN SITE
PROBABILITY OF CHOOSING YARDTAP
MONTHLY TARIFF IN RUPEES
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
5
9
13
17
21
25
29
33
37
41
45
49
53
57
61
65
A site
B site
Scarce
Saline
Good
Scarce
Saline
Good
B-GOOD
B-SCARCE
B-SALINE
A--GOOD
A-SCARCE
A-SALINE

Figure 3


EFFECT OF TARIFF ON CHOOSING YARDTAP IN A SITE
PROBABILITY OF CHOOSING YARDTAP
MONTHLY TARIFF IN RUPEES
GOOD
SCARCE
SALINE
C--GOOD
C--SCARCE
C--SALINE
Scarce
Saline
Good
Scarce
Saline
Good
with reliability
without reliability

105

Figure 4

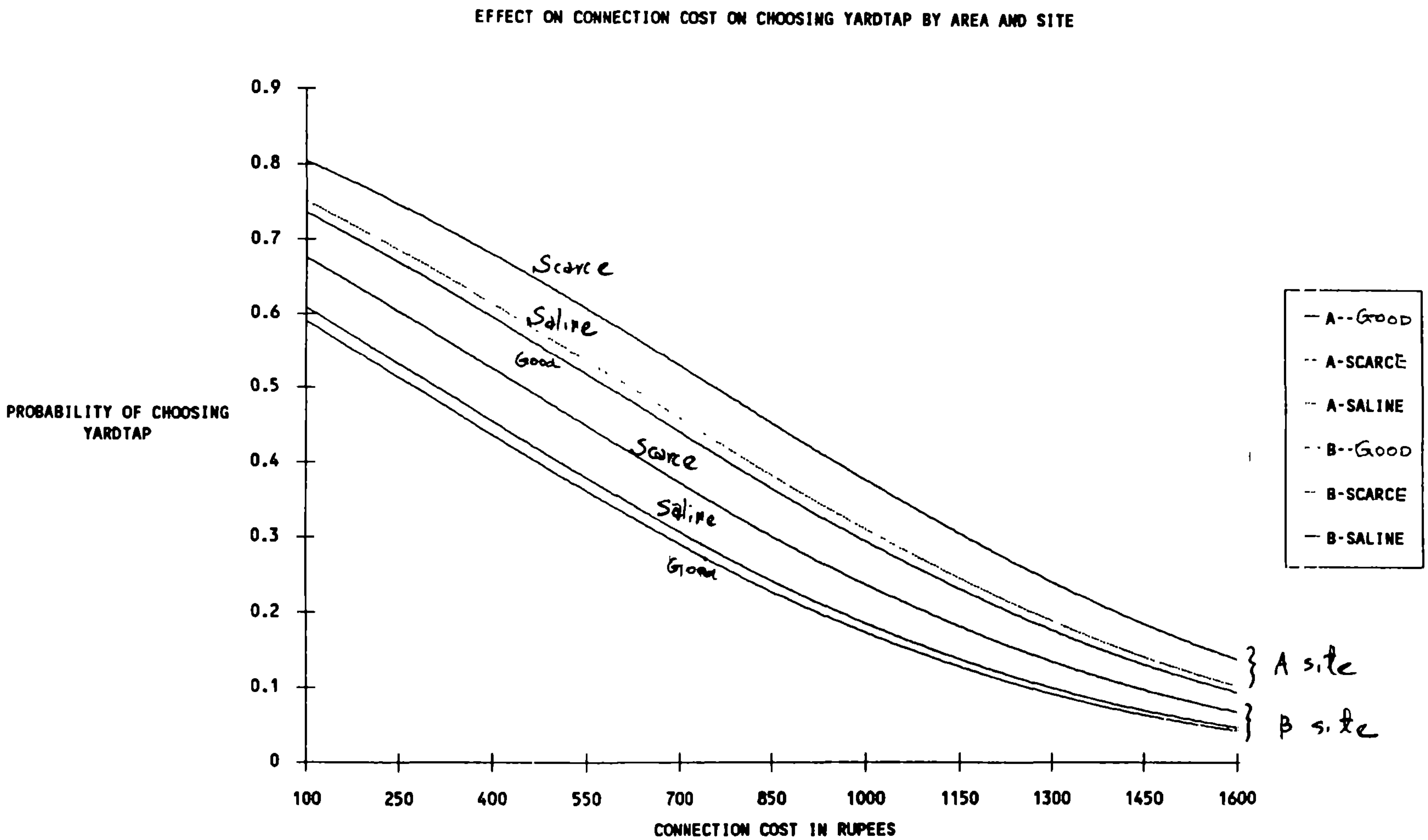
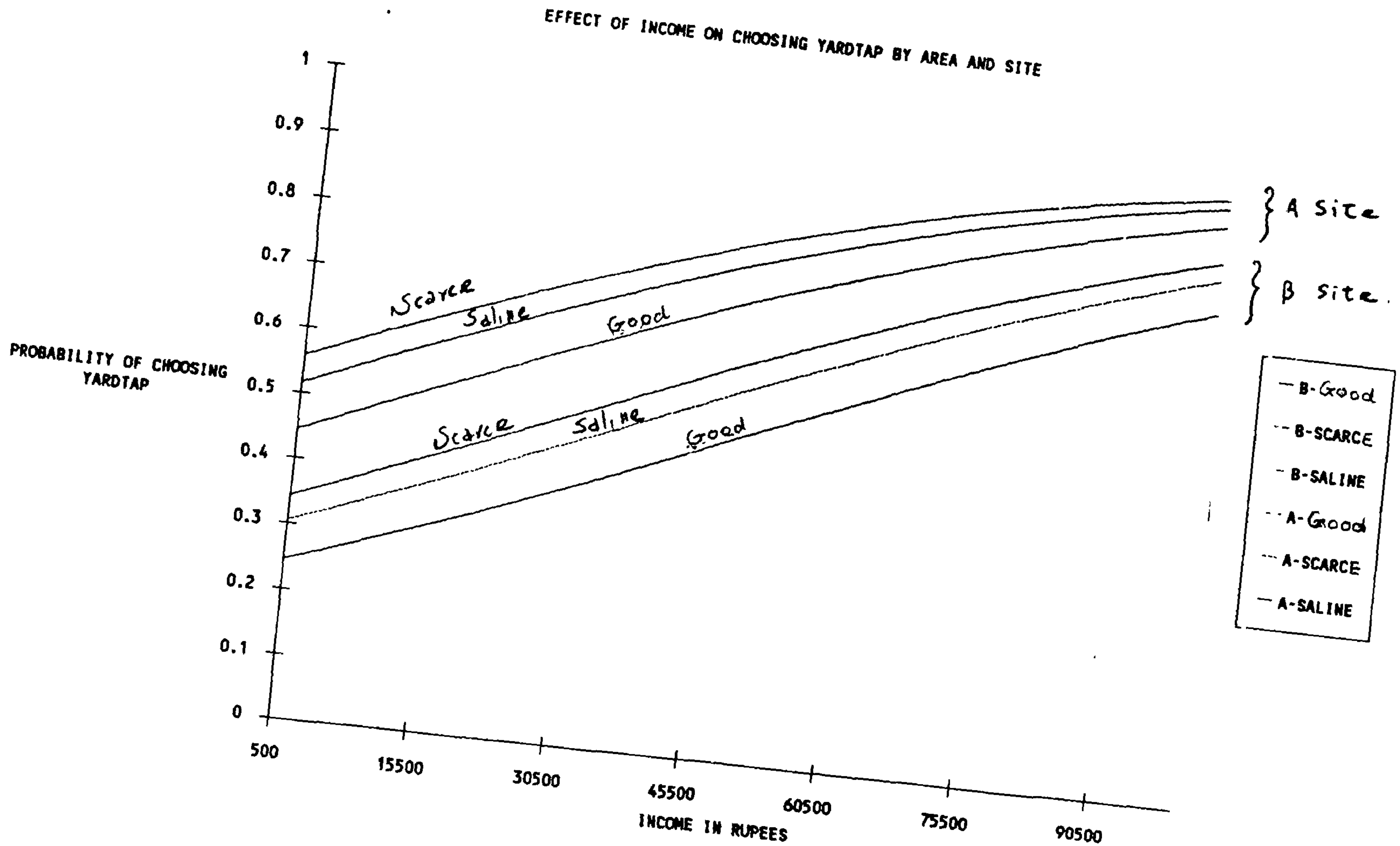

EFFECT ON CONNECTION COST ON CHOOSING YARDTAP BY AREA AND SITE
PROBABILITY OF CHOOSING YARDTAP
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
100
250
400
550
700
850
1000
1150
1300
1450
1600
CONNECTION COST IN RUPEES
A--GOOD
A-SCARCE
A-SALINE
B--GOOD
B-SCARCE
B-SALINE
Scarce
Saline
Good
Scarce
Saline
Good
A site
B site

Figure 5


EFFECT OF INCOME ON CHOOSING YARDTAP BY AREA AND SITE
PROBABILITY OF CHOOSING YARDTAP
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
500
15500
30500
45500
60500
75500
90500
INCOME IN RUPEES
Scarce
Saline
Good
Scarce
Saline
Good
A Site
β site
B-Good
B-SCARCE
B-SALINE
A-Good
A-SCARCE
A-SALINE

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 Kerals; (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 partic ipation 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 1

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	14.3

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 plasuible 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 Perinthalamanna Circle : Palghat, Shoranur, Edappal, Malappuram Divisions