URBAN WATER SUPPLY MANAGEMENT: A STUDY OF CENTRALISED AND COMMUNITY BASED SYSTEMS IN CALICUT CITY

Thesis Submitted To The
Cochin University Of Science And Technology
For the Award of the Degree of
Doctor of Philosophy in Economics
Under the Faculty of Social Sciences

By

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November 2003

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DECLARATION

I declare that the Thesis entitled **"Urban Water Supply Management: A Study Of Centralised And Community Based Systems In Calicut City"** is the record of bona fide research work carried out by me under the supervision of **Dr.M.Meera Bai**, Reader, Department of Applied Economics, Cochin University of Science and Technology, Cochin, Kerala 682 022. I further declare that the Thesis has not been submitted earlier anywhere else for the award of any Degree, Diploma, Associateship, Fellowship or other similar title of recognition.

(Radhakrishnan. N.)

Cochin – 22,
20.11.03

ACKNOWLEDGEMENT

Dr.Meere Bai, my supervisor Guide had extended profuse motivation and incessant assistance while I assumed this study. Her sheer professionalism and integrity in a premise of academic freedom deserve deep expression of gratitude from my part.

The Head of the Department of Applied Economics, Cochin University of Science & Technology, **Dr. D. Rajasenan** and his colleagues on faculty, **Dr. M. K .Sukumaran Nair, Dr. Arunachalam** and **Dr.Martin Patrik** are to be profoundly acknowledged for their unconditional help.

In an age when all kinds of epistemological barriers transcend, any research thesis is an outcome of reception from any relevant area. My indebtedness is due to scholars of high repute **Dr. Joni .C. Joseph**, research guide, P.G. Department of Sociology, Zamorin's Guruvayurappan College, Calicut -14, and **Dr. Pushpangathan,** Faculty, Centre for Development Studies, Trivandrum.

In designing statistical tools for systematic analysis and in interpretation of the collected information and data, **Dr.C.Baburaj**, Research Guide, Department of Statistics, Government College, Kasaragode, **Dr. Saleem**, Department of Economics, EMEA College, Kondootty and **E. D. Sani**, Department of Statistics, Zamorin's Guruvayurappan College, Calicut have given immense help to make me obliged.

Dr. P. Ibrahim, Head, Department of Economic, Pondicherry University, Mahe Centre and **Dr.R.Hari Kumar**, Reader of the same department are thankfully remembered for their endeavours to help me.

Many Government officials have contributed possible documents and information for this work. Special reference are to be given to the Managing Director, Kerala Water Authority, Trivandrum and officials in its regional office at Kozhikode. **Dr. James,** Executive Director, Centre for Water Resource Development and Management, Calicut and **N.Vijayakumar**, Principal Research Officer, NATPAC, Calicut also helped me extensively.

Since my deviates from theoretical cerebration to practical contexts, the Worshipful Mayor, Deputy Mayor and Councillors of Calicut Corporation, the Secretary, and **Hari Govind**, Engineer, were of high help to me.

I fondly acknowledge the invaluable friendship **Mohanakrishnan T.M,**. Director, Zamorin's Computer Centre showed for me while he did the design, layout and other computer jobs. I thank **M/s. Print O Fast** for its printing.

I could utilize the library materials of School of Management Studies and Department of Applied Economics to the optimum, as the concerned staff members, **Ms. Elizabeth, Ms. Deepika** and **Mrs. Shobhanakumari** were very magnanimous in their attitude. The members of office staff in Department Of Applied Economics also are here by acknowledged.

My wife **Devika** and Children **Anand** and **Akhila** have been conditioned to all the restrictions I imposed on family life. I feel deeply obliged to them also.

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INTRODUCTION

Today the most important problem that the economies of the world have to confront is the process of rapid urbanisation and the consequent task of scientific management of urban growth. Urbanisation is a societal process of transforming a rural economy into an industrial and service economy (Heggade Odeyar. D., 1998, p.p.2-3). It is a direct concomitent of the process of economic growth. The demographic structure of both developed and developing countries exhibit the increasing share of their urban population. Urban development involves not only the character and development of a city or town but also the welfare and prosperity of its inhabitance. In the era of advanced science and technology followed by population growth and industralisation human beings migrate to cities in search of better amenities of life. As a result urban conglomerations emerged and spread all over the world.

Nearly twenty per cent of world population lives in one lakh urban centers, while half of the world population lives in the suburban areas. During the last four decades the number of urban dwellers of the world almost increased threefold. The urban population of the world in 1991 was 230 million and the projected figure for 2000 A.D.is 320 million (Radhakrishnan.N., 1994, p.p. 8-9). It is a fact that the major share of world's urban population is sheltered in the developing and economically backward countries of the world. Between 1950 and 1990 urban population of developing countries grew four fold from under 300 million to 1.3 billion. The projected figure for 2000 A.D. is 2 billion. As many as 17 out of 21 mega cities of the world with a population of 10 million each will be in the developing countries. In the 20^{th} century developing countries have experienced rapid urbanisation and the mushrooming of huge metropolis. Thus management of urban growth is now in the forefront of the policy concerns of developing countries.

1.1 Urbanisation in India

India is not an exception to this process of rapid urbanisation. In 1961, 78.94 million persons lived in urban areas of the country. In 1991 their number increased to 217.61 million, an increase of over 250 per cent in a period of 30 years (Mathur, M.P., 2001, p.p. 4-5). The level of urbanisation as indicated by the percentage of population living in urban areas to total population has increased from 17.29per cent (in 1951) to 25.71per cent (in 1991) This again increased to 27.7 per cent in 2001. The country has one of the largest urban system with 217.61 million people in 1991, spread over 3697 towns and urban agglomerations, with the population size ranging from less than 5000 to 12.6 million persons (Vinod. K. Tiwari., 1997, p. 4). The urban population of India in 2001 is 285.36 million. The observed changes in the total and urban population over the past 90 years is a resultant of various historical, economic and demographic factors.

The National Institute of Urban Affairs (NIUA) has examined a number of projections of urban population, worked out on the basis of projected future growth rate of population from past experience, and came to the conclusion that, as things were, India is heading towards an urban population of 405.26 million, which would constitute 31.22per cent of the projected population of 1298.15 million in 2011 and 553.04 million which would constitute 34.40per cent of the projected population of 1607.77 million in 2021 (Mathur, M.P., 2001, p. 9). Another study by Vinod K Tiwari, made an urban population projection of 405.2 million, which constitute 33.83per cent of the projected population of 1197.29 million in 2011 and 549.62 million which constitute 40.74per cent of a projected population of 1348.98 million in 2021 (Vinod. K. Tiwari, 1997, p.8). Regional studies of urbanisation reveal certain shared characteristics as well as regional specificities

1.2 Urbanisation In Kerala

Kerala has a unique pattern of urbanisation among Indian states. As per 2001 census, Kerala's urban population was 82.67 lakhs, which account to 25.97 per cent of the total population, as against the all India Proportion of 27.78 per cent. Kerala has been witnessing rapid urbanisation since 1980. In Kerala there is a heavy concentration of population in class I cities leading to tremendous social problems. The process of urbanisation without industralisation in the state is a grave concern. Further the higher proportion of urban poor along with low infant mortality and a low death rate are peculiarities in the urbanisation process of Kerala. There are 197 towns of which 65 are statutory towns (5 corporations, 57 municipalities, 1 cantonment and 2 town ships) and 132 census towns. According to 1991 census cities with growth rate more than 100per cent are six in Kerala, against twenty in India. Another peculiar picture of Kerala's urban population is that while the natural increase rate of urban population is only slightly higher than that of Tamil Nadu, the growth of cities, both in their number and population is faster in Kerala.

The percentage of urban population to total population in Kerala registered growth rate (1981 and 1991) from 18.74per cent to 26.44per cent. Where as in terms of decennial growth of urban population, Kerala growth rate was above national average. Census data of 1991 show that the decadal growth rate of urban population during 1971-81 was 37.64per cent for Kerala and she ranked 12th among the Indian States, where as during 1981-91, the decadal growth rate was 60.89per cent and she ranked 1st among the Indian States. There is large variation among the districts in the level of Urbanisation (D. Retnaraj, 1994, p.p. 23-24). Among the 14 districts in Kerala, Ernakulam ranks 1st in terms of degree of urbanisation in 1981. The percentage of urban population living in Ernakulam has increased from 39 per cent in 1981 to 48 per cent in 1991. But in 1991, Kannur district ranks first (57.02 per cent) in the level of urbanisation.

Vinod. K. Tiwari made an attempt to project the future growth rate of urban population for 15 states that were selected for the analyse of urban pattern in his research work (Vinod. K. Tiwari., 1997, p. 9). State-wise urban population growth rate was estimated by dividing the assumed all India growth for each decade in proportion of the growth rates of the states for the previous decade. Based on these projections Kerala emerges as the most urbanised state in the country in the census year 2011 (with 54.96per cent of urban population). The urban population projection for 2021 also indicate that Kerala will remain as the most urbanised state in India (81.41per cent of urban population). The populations of towns in the 500,000 to 1 million classes were also projected for the same year. The number of such cities is estimated as 52 by the year 2011 and 75 by 2021. Fourteen more cities are likely to be added to this group by the year 2001. Among these 14 cities, Calicut and Trivandrum figures from Kerala.

During the past eight decades, there occurred six fold increase in the urban population of Kerala. According to the demographic experts, the increase is not due to the general factors like migration, industralisation etc. There was no intensive migration to big cities and towns in Kerala. Another peculiarity of Kerala's urban scene is that no town can be said to have developed fully on an industrial base. Most of the urban centers have developed either as trading or marketing centers or as administrative centers. Industrial units are generally scattered through out the State except in the Alwaye – Ernakulam belt where there is a heavy concentration of manufacturing and trading concerns. The Calicut city acquires its importance as a trading centre, where as the city of Cochin, as an industrial centre and Trivandrum being an administrative centre.

Even though the pattern and structure of Kerala's urbanisation process differ drastically from the national mainstream, the problem associated with urbanisation exists with all its severity in Kerala also. The major urban problems confronted by the urban local bodies in Kerala are; over crowding, housing problems, generation of slum settlements, shortage of drinking water, drainage problem, environmental degradation and pollution, unhygienic living condition, bad roads and traffic congestion and other allied problems like alcoholism, drug addiction, prostitution, beggary etc.

1.3 Urbanisation And Economic Growth

The accelerating trend of urbanisation is a global phenomenon to which the developing countries are no exception. Globally, the urban areas form the backbone of the economy serving as reservoirs of skills and engines of growth. The urbanisation process has created major economic and structural changes. Research studies shows that although the proportion of urban work force in relation to rural work force is small, over 65per cent of the total manufacturing employment, 64.7per cent of the employment in trade, commerce and financial services and 68per cent of the transport sector employment are concentrated in urban areas (Om Prakash Mathur, 1993, p.p. 5-6). In India the per capita productivity ratio between the urban and rural population is 7:2.(Ministry of Urban Affairs and Employment 2001, p.5). This is clear from the fact that in 1950-51 the contribution of urban economy to net domestic product was 29per cent. It grew to 41per cent in 1980-81 with a population share of 23.3per cent and 55per cent in 1991 with a population share of 25.7per cent and is expected to increase to 60per cent in the year 2001 with a population share of 30.5per cent. Similarly on account of the different forms of scale, agglomeration and specialization economics, the level of labour productivity are uniformly high in the urban areas. So it is fair to conclude that productivity of urban sector is high.

1.4 Problems Of Urbanisation

The aforesaid positive aspect of urbanisation is really over shadowed by the chronic problems associated with urbanisation in India. The wide spread poverty and deprival of the basic necessities of city life to the urban poor draws the real picture of urban India. To quote the Report of the National Commission on Urbanisation (1988, vol.2) "by the most brutal and inhuman living conditions with large sections of the citizens (almost half in Bombay and Delhi) living in squatter settlements." The analysis of the urbanisation pattern and the projection for the next twenty-five years indicate a trend of increasing urbanisation and its spatial spread and a large concentration of population in big cities. However the provision of infrastructural facilities and services required to support such large concentration of population is lagging far behind the pace of urbanisation(Vinod. K. Tiwari., 1997, p.p. 13-15). As a consequence, the urban environment, particularly in bigger cities is deteriorating very rapidly.

The urban local bodies responsible for urban governance and provision of services lack financial resources, the authority to determine and collect adequate level of service charge, autonomy and the capacity for planning and management (Vinod. K. Tiwari., 1997, p.17). Financing and delivery of essential services in cities are a crucial problem in urban India, especially after the introduction of New Economic Policy coupled with the decentralization process in the planning system, initiated with Eighth Five Year Plan. Urban bodies are already under considerable pressure to cope up with the maintenance requirement of existing services. The revenue base of these urban bodies have been eroding consistently while their responsibilities to augment existing services has been growing. The operation and maintenance of existing services and increased provision of basic services in the rapidly growing urban areas call for lumpy investments that are beyond the means of urban governments (Mukesh. P. Mathur, 1997, p.16).

Thus inadequacy of financial resources create much stress upon urban governments. It leads to widening gap between demand for and supply of basic services and its quality deterioration. The situation leads to the sharing of too few public goods by too many claimants. As a result there appear a conflict between the users and suppliers of civic amenities. The users include urban citizens, industrial and commercial establishments, where as suppliers of civic amenities constitute the policy makers, planners and various layers of government especially urban local bodies. Civic amenities / urban basic service are facilities provided for the comfortable life of the citizens of urban centre by the society/public authorities at a cost or free of it. Drinking water, reasonable shelter, health care facilities, sewerage system, sanitation and solid waste disposal, environmental protections, transport and communication facilities etc are some of the major civic amenities needed for the healthy and comfortable life of urban community. The interaction between the users and suppliers of civic amenities decides the quality of urban life. The urban governments are not in a position to meet the increasing service needs of the fast growing urban population, because of their weak financial position.

The problem associated with rapid urbanisation are numerous. In general urban poverty and unemployment, growth of slums and housing shortages, congestion and over crowdedness linked with transport and land inadequacies, environmental pollution, road accidents and quantitative and qualitative inadequacies of various types of urban amenities are identified and recognized as urban problems in developed and as well as developing countries (Mathur, M.P., 2001, p.9). There are however definite differences in the nature extend and intensity of these urban problems between states in India. Within the States variation can be found between different urban settlements.

The problems associated with urbanisation widens the gap between the demand for basic amenities of life and available basic services provided by the urban government. Variation in the demand and supply position of basic amenities can be seen between states and within the states between different urban centers. Moreover variation can be found at the intercity level between different size class of population and localities. (Om Prakash Mathur, 1993, p. 10). Among these basic amenities water is to be singled out as the very existence of humans depends on it. The distributional and consumption variation are more acute and visible in the case of urban drinking water supply. More over urban water supply is a necessary part of the urban infrastructure required to attain the goals of social and economic development. Water supply is a public good because of its inter relationship with health status. Moreover water problem is global but has regional differences in nature. Regional differences arise due to differences in climatic conditions or in the pattern and levels of social and economic development.

1.5 Urban Water Supply – An Overview

Urban settlements by their very nature need a minimum of basic services for their healthy existence. Of all the shelter and environmental issues facing cities in developing countries the provision of adequate quantities of clean and affordable water is the most fundamental need (Bidyut Mohanthy, (ed), 1993, p.3). Safe drinking water supply is a vital human need for health and efficiency. Disease and death particularly of children every year and drudgery of women are directly attributable to lack of this essential service. Water supply is a necessary part of the infrastructure required to attain the goals of social and economic development. Water supply is a public good because of its interrelationship with health status (Logan, John, 1960, p. 475). The development literature abounds these days with statements that reflects the gravity of water crisis as it is existing or that may arise in the foreseeable future in many countries, regions and urban areas. However the state of most of Indian urban areas in this respect is far from satisfactory. By most standards Indian cities rate among the lowest in the world – the environment, infrastructure, land prices and general livability – all have much to be desired. Increasingly however various aspects of urban India are being paid more attention both by policy makers and academicians. One such issue is related to access to water in urban India (Peeyush Bajpai, Leveesh Bhandari, 2001, p.1). Thus the problem of water supply is more disturbing in the urban areas of India. Moreover the distributional and consumption variation are more acute and visible in the case of urban drinking water supply. An array of literature is available regarding the different aspects and dimensions of urban water crisis.

1.5.1 Components Of Urban Water Supply System

The water supply system, possess the following components.

(a). Source of Water supply :

This includes quantity and quality of various sources of water, collection of water and its conveyance from the source to the town. A naturally clean water supply needs a clean water source.

(b). Purification of Water

This covers physical, chemical and bacterial treatment of raw water. Regardless of the quality of raw water, desired quality of effluent needs to be produced by suitable treatment methods. Chlorine residual keeps down the bacterial growth.

©. Transmission and distribution system

This includes storage of treated water, its conveyance, distribution and prevention of wastage. The aim of any water supply system is to provide potable water to the consumers. The benefit of the system is available to the public only when they get adequate quantity of water at sufficient pressure at their points. This is achieved through the distribution system. The purpose of the distribution system is to convey fulltime water to the consumer at convenient points. Water reaches the consumer through his house connection pipes, which is connected to the street mains, which itself form a vast net work of pipelines called trunk mains, branch mains, sub branches, street mains etc. The distribution system forms the most expensive component of any water supply scheme and account for 50 – 70 per cent of the cost of the scheme. It is also the link between the consumer and the water distribution agencies. The distribution system consists of a network of pipes of varying diameters with several valves, meters and appurtenances connected to it. It may also have intermediate sumps, break pressure tanks, standpipes etc. connected to the same. The numerous stand posts also form part of the distribution system.

1.5.2 Water Resources – World Scenario

About 70per cent of earths surface is covered with water. Only 2.5per cent of this is fresh water, however and therefore in theory capable of maintaining terrestrial life. The great majority of the water is in a frozen state or is situated very deep in the earths crust making it difficult to exploit. In the final analysis only 0.26per cent of the total fresh water reserves – 93,000 km^3 - is actually suitable for use (The Netherland Development Assistance, 1998, p.4). A country or region will experience (periods) of shortage when the quantity of renewable water available in less than $1700m^3$ per person per year. Water resources are being depleted and contaminated due to excess usage and pollution. Hence water of good quality is becoming increasingly scarce and much costly. Further more the available fresh water is distributed unequally over the world..

The water available to mankind on earth today is not different in quantity from what were available thousands of years ago. That finite quantity has to be juxtaposed against increasing demand from a growing population (Rama Swamy. R. Iyer, 2001, p.1114). The population of the world, currently around 6 billion, is expected to exceed 8 billion by the year 2050. Apart from sheer number, the process of urbanisation and development are also expected to result in a vast increase in the demand for fresh water leading to acute water scarcity.

The two most common form of taping drinking water are the pumping up of ground water and the taping and purification of surface water. For central taping of water a system of distribution, maintenance and management is essential. The water reaches the consumers via. house installations or public stand pipes (as hand pumps or connected to the net work) or water sellers.

1.5.3 Water Resources Of India – Supply And Demand

With a population that is 16per cent of the world, India has 2.45per cent of the worlds land resources and 4per cent of its water resources. The average annual precipitation by way of rain and snow over Indian landmass is 4,00,000 km^3 but the annual water resources of the country are measured in terms of the "run off" in the river system. This has been estimated by the National Commission on Water (2001) as 1953 km^3 (ie supposed to include both surface and ground water resources). The ground water potential is put at 432 km^3 .

It has been estimated by the National Commission on Water that the annual "usable" water resources of the country are 690 km^3 of surface water and 396 km^3 of ground water, making a total of 1086 km^3 (Rama Swamy. R. Iyer, 2001, p.1116). It follows that in absolute terms the position is not comfortable. However, this will obviously change with the growth of population and process of urbanisation and development. The National Commission has made various assumption in regard to these matters (high medium and low rate of changes) and come to the conclusion that by the year 2050, the total water requirement of the country will be 973 to 1180 km^3 under low and high demand projection. This means that supply will barely match demand. If a number of constructive and concrete measures are not taken on both demand side and supply side a crisis will emerge in future. Moreover apart from demand putting pressure on the available supplies, the supply may also be seriously affected by the growing incidence of pollution and contamination of water sources. There are also wide variation, both temporal and spatial in the availability of water in the country.

1.5.4 Water Resources Of Kerala

Kerala which accounts for 1.1 per cent of the land area has about 4.8 per cent of the water resources in the country (State Planning Board, Government of Kerala, 1998, p.2). The state has abundant natural water bodies spread all over the state catering to the various water need of the community. Kerala is endowed with a network of 44 rivers, 54 dams with more than 10 meter height, 28 lakhs wells, 910 tanks and ponds with more than 0.5 ha. areas and 236 springs. Rivers are the main drinking water source in Kerala. Most of the urban water supply schemes have their drinking water source on the river tanks. The density of well is 120sq. km. Though it may appear that water resources of the state is impressive, there is severe water scarcity in summer.

The demand for water in Kerala is mainly for drinking, agriculture, generation of electricity, aquaculture, as well as for prevention of salt-water intrusion. As per the rough estimate of the projected demand for water, Kerala would require around 30,000 million cubic meter of water for agriculture, 7500 million for domestic use and 12,200 million cubic meter for prevention of salt water intrusion. All put together the total requirement would work out to 49700 million cubic meters, where as the availability of surface water is only around 42000 million cubic meters. The water balance in respect of surface water does not therefore show a surplus situation (State Planning Board, Government of Kerala, 1998, p.4). The water available through rain is estimated to be around 72000 million cubic meters where as the quantum that could be made use of would be around 40000 million cubic meters. The actual utilization is only 25per cent of the potential. The ground water resources available in Kerala is estimated to be 11800 million cubic meters out of which tappable resources is of the order of 5900 million cubic meters. Kerala's 41 west flowing and 3 east flowing rivers convey 72000 million cubic meters of water to the Arabian Sea and neighbouring states.

Only 4 to 5 per cent of the run off is stored in reservoirs meant for Hydel Power generation and drinking water (Pushpangathan. K., (ed), p.87). The major portion of the run off is during monsoon season and it last till the month of March beginning. The summer season begin from March and end in May. Drinking water scarcity is keenly felt in the urban areas as well as rural areas right from March till the outset of northwest monsoon in June. Supply of drinking water to households is a real and growing problem in Kerala particularly during summer when water reservoirs fall below levels and when ground water levels decline (Vijayakumari M.S., 1996, p.19).

Nine out of fourteen districts of Kerala are coastal districts and the availability and use of water in these districts are larger than that of non-costal areas. The portion of the available ground water in the costal districts is being utilized through open wells and filter points. Shortage of potable water is a severe problem in coastal area due to the salinity intrusion. This problem of salinity, reduce the scope for drawing drinking water from open wells, tube wells and other spot sources.. The highland areas of Kerala have a different set of problem. The open well are few in number because the digging of open well is economically unviable since the ground water table in these areas is, in general, well beyond fifteen meters in depth and the attempt to dig a well is itself risky since the chances of getting water are comparatively low. In several places in the high ranges, people bring water from natural spring through rubber tubes by gravity flow. The dependence on open well is very high in the mid land areas of Kerala particularly in the districts of Kottyam and Malappuram and in some portions of Ernakulam and Pathanamthitta districts.

1.5.5 Water Supply Requirement Norms

The present system of piped water supply was introduced about 100 years ago in the country. Recognizing the need for potable water supply for the survival of mankind at global level, water supply standards have been designed by various agencies after making an assessment of water for different purposes and checking up the physical and financial feasibility for attaining these requirements. The different types of water demand of a city may be broken down into domestic water demand, industrial water demand, institutional and commercial water demand, water demand for fire fighting, demand for public uses and water required to compensate losses. The domestic water demand includes the water required in buildings for drinking, cooking, bathing, cleaning, washing, lawn sprinkling, gardening, vehicle cleaning, sanitary purpose etc.(Santhosh Kumar Garg, 1997, p.7). The amount of domestic water consumption per person shall vary according to the living conditions of the consumers.

The water supply standard will vary from one region to another according to functional, climatic and other characteristics including habits of the people. As per the Indian Standard (I.S. 1172-1993) Code of Basic Requirements for Water Supply, Drainage and Sanitation, the minimum domestic consumption for a town or city with full flushing system should be taken at 200 liters per capita per day (lpcd); although it can be reduced to 135 lpcd for economically weaker sections and low income group (LIG) colonies depending upon the prevailing condition (Indian Standard Institution, 1993,p.3). The I. S. Code in fact lays down a limit on the domestic water consumption between 135 - 225 lpcd with 200 lpcd being minimum under ordinary circumstances with flushing system. The Manual of Water Supply, Central Public Health and Environment Engineering Organization (CPHEEO) states that in urban area the norms vary from 150 to 200 lpcd (Ministry of Urban Affairs and Employment, Government of India). That is, cities with a population between 50,000 – 1,00,000, the requirement is fixed at 150 lpcd and class I cities with population above one lakh it is fixed at 200 lpcd. Where as the National Master Plan of India has suggested a water standard of 70 to 250 lpcd with an average supply of 140 lpcd irrespective of population size. On the other hand the World Health Organization norms insist that the average consumption of water in urban area should be 250 lpcd. However the standard norms fixed for the public stand post is 80 lpcd.

1.5.6 Qualitative Aspect Of Water Supply

In so many countries of the world, the level of water supply is below the standard requirements in both quantity and quality. Studies shows that 30 per cent of all reported cases of illness and 40 per cent of death in urban areas in

Pakistan are attributed to water born diseases. In Nigeria poor colonies get 12 liters of water per capita per day and because of the unhygienic source of water, water borne diseases are common. These include typhoid, dysentery, diarrhea, cholera and guinea worm. India is not an exception to this. Highest infant and child mortality rate reflects the poor state of public health and environmental hygiene in urban areas. It is estimated that in India 26 per cent of child death are caused by water borne diseases like diarrhea, and dysentery (NIUA 1991) (Bidyut Mohanty, (ed), 1993, p.147). These two diseases are again predominantly responsible for child and infant morbidity. Five hundred per thousand infants and 200 per thousand pre-school children suffer from these diseases in India. World Bank and World Health Organisation (World Development Report, 1993) have estimated that in India 21 per cent of the communicable diseases (11.5 per cent of all diseases) are water related. It is estimated that every year 1.5 million children under 5 years die in India due to water related diseases and the country looses 1800 million person hours (Over 200 million man days) each year due to these diseases (Ministry of Rural Development 1993). A quantitative measure that integrates premature deaths and temporary disability due to diseases is Disability Adjusted Life Years (DALYs). About 30.5 million DAYLs are lost each year in India due to poor water quality and unhygienic living condition.

Using human capital approach, the statistical value of one DALY is equal to the annual average productivity of Indian workers (Since DALY implies one year in which a worker cannot work due to either sickness or premature death). Taking the economic value of a life year at the average per capita G.D.P. of RS.12.000/- per person, the annual loss of 30.5 million DALYs is worth Rs.36000/- crores. Thus the country should possess the willingness to spend that much amount annually to provide clean drinking water to all. Improvement in water supply and sanitation can substantially reduce the incidence and severity of their diseases, as well as the infant mortality associated with diarrhea (Table No.1.1)

Table No.1.1.

Burden of Water – Related Diseases in India –1990 (In million DALYs)

Disease	Female	Male	Total
Diarrhoeal Diseases	14.39	13.64	28.03
Intestinal helminths	1.00	1.06	2.06
Trachoma	0.07	0.04	0.11
Hepatitis	0.17	0.14	0.31
Total water related diseases	15.63	14.88	30.51

Source: World Development Report 1993. p.219.

1.5.7 Investment Requirements For Water Supply

The required investment on water supply system depends upon the norms and standards for provision, operation and maintenance of urban services.

Only a few financial norms are available at the national level for provision of urban water supply. Financing of drinking water supply programme is a crucial issue in urban areas in view of the massive investment required.

The planning commission has estimated the additional investment needs for water supply for the Ninth plan period to be in the range of Rs.86.12 – 129.8 billion. As against this Operation Research Group (ORG) gives the range of Rs.56.55 –148.77 billion (The Indian Infrastructure Report, 2001 volume 3, Chapter 6, page 7). The figures estimated by the Zakaria Committee and Gujarat Government based on their own norms are Rs.61.5 billion and Rs.109.15 billion respectively. Another set of estimates is available from the Society for Development Studies (SDS), Delhi. The S.D.S. estimates for the additional investment need for 1995-2001, placed the most conservative estimate at Rs.39.9 billion and on the higher side at Rs.82.5 billion, based on census date (1981-1991) on access to pipe water and the per capita cost of water supply from 55 HUDCO financed schemes (Bijlani. H.U. an Kyeong Ae Choe, 1997, p.8). The estimated investment needs to meet the backlog, was in the range of Rs.700-1500 billion.

Further the National Commission on Urbanisation (NCO) has estimated that in order to provide 145 lpcd water in class I cities and 100 lpcd water in the rest of urban area by the year 2001, approximately 1600 million cubic meter of water would be needed. Presently supply is 9500 million cubic meter.

The elimination of the gap that is 6500 million cubic meter of treated piped water supply, would require approximately Rs.2000 billion by the year 2001. Urban planners agree that this is a huge investment by any standards. In the face of fast increasing urban population, this huge investment requirement for supply augmentation, rehabilitation and expansion of urban water supply services at the local levels is beyond the public sectors financial capacity.

1.5.8 The Decade Achievement In Urban Water Management

Realizing the severity of the problem of water supply and sanitation, serious concerns were expressed about the state of these two services prevailing in the developing countries at the United Nations Conference on Human Settlement in June 1976 at Vancouver. In the water conference at Mardel Plata, Argentina in March 1977 it was decided that the 10-year period (1981-90) would be declared as the 'International Water Supply and Sanitation Decade'. The conference on primary health care at Alma Ata, USSR in September 1978, approved the recommendations of water conference. India as one of the signatory to the Alma Ata Convention launched the decade programme with much fanfare. Detailed Master Plan was chalked out and specific targets were set to meet rural and urban needs.

The urban population covered by protected water supply was 72 per cent at the time of the launching of the decade programme in 1981. The target was to cover the entire urban population by March 1991.

The data received from Central Public Health and Environmental Engineering Organisation (CPHEEO), the central monitoring authority of the programme reveals that the percentage of urban population covered by organized water supply has increased to 82 per cent in 1988. In 1990 the coverage figure reached 83.80 per cent. The target fixed for 2000 A.D. was 96 per cent coverage in urban water supply. What the Human Development Report (HDR) of the UNDP terms as "the human expenditure ratio" which is a percentage of national income devoted to human priority concerns, continuous to be low in many developing countries like India. The Human Development Report has also presented an index of rural – urban disparity. Taking the urban average of access as 100, the HDR reports the disparity as 62 for water and 45 for sanitation (Bidyut Mohanty, 1993, p.6). As of 1991, 81.38 per cent of urban households covering 85 per cent of urban population had access to safe drinking water.

1.5.9 Five Year Plans And Urban Water Supply

In the initial period of planning, from the first to fifth plan, the outlay on urban drinking water was considered substantial with respect to the size of the urban population (17.3 to 19.9 per cent). But thereafter, the thrust in the plan programme was diverted to rural water supply and sanitation, inspite of the rapidly increasing proportion of urban population, which was 25.7 per cent at the time of the Eighth plan. The proportion of the sectors outlay to total public sectors plan outlay marginally increased from 1.28 per cent to 1.38 per cent between the first plan (1951-56) and the Eighth plan (1992-97). The task in the Eight plan was to increase the coverage of access to safe drinking water to about 94 per cent of the urban population from 84 per cent at the end of the seventh plan. While the full feed back on coverage is not available, it has been estimated that in terms of estimated 1997 population, the coverage of urban population is unlikely to increase from the level attained in the seventh plan. Adequate investment would be needed to meet the requirements of incremental population for drinking water and sanitation services.

In this perspectives, a new programme was launched in the Eight Plan for urban water supply, namely, the Accelerated Urban Water Supply Programme (AUWSP), which was targeted to small towns (Population less than 20000, 1991 census) as these towns had been excluded earlier, had encountered severe problems of water scarcity, and the revenue base of the urban local bodies in these was weak. The AUWSP was launched in 1993-94 with a modest outlay of 50 crores which envisaged funding by central and state government in the ratio 50:50. Out of the 2151 eligible towns (1991 census), project report was approved by the Central Ministry for 227 towns for an estimated cost of Rs.218.50 crores and Rs.68.62 crores was released to State Government up to March 31st 1997. The progress was modest, partly because the scheme was launched in March 1994, and there were delays in the acquisition of land, change of water source, procurement of materials and equipments, timely submission of physical and financial reports by the states and release of funds by the State Government to the implementing agencies. Hence efforts have been initiated to mitigate the problem and stream line the activities in the Ninth Plan.

The Urban drinking water supply strategies in the Ninth plan addresses the priority concerns of universal coverage, adequacy in terms of minimum per capita consumption, norms, quality, distance from source as well as regularity of supply bringing into wake the policy and operational issues of drying inaccessible source of water, recycling of waste water and sewage for non-domestic use, water harvesting among others. Moreover the strategies to promote and strengthen decentralization of production and distribution, privatization and participation of the community in management and maintenance are expected to not only induct higher efficiency levels and effective reach out but also counter line leakages and wastage (Ninth Five Year Plan Document (1997-2002), Government of India, p.3). According to the plan document city water .nanagement system should have at least a 20-25 year development perspective.

Even though there has been a significant improvement in availability of water, during the last two decades (1980-2000), there is no room for complacency for the following reasons: (a) The averages are deceptive and hide large distributional inequalities between states, between cities within a state and settlements within a city. (b) The per capita water consumption is still below international norms. (c) The quality of water leaves a lot to be desired both in terms of level of treatment and regularity of supply.

1.5.10 Distributional Variation In Water Supply

The responsibility for maintaining the capital Assets providing drinking water and sewerage disposal facilities and of collecting water tax and user charges generally lies with local bodies. In situations were local bodies are financially weak or organizationally weak, state Government departments or State level bodies take up the maintenance responsibility for short or long duration. Thus the responsibility for maintenance generally lies with local bodies. The role of vested interests and local elites in this selection of infrastructure projects cannot be ruled out. So we can find significantly higher investment in per capita terms and better maintenance of the facilities in relatively well off areas. Thus the distributional net work by its very design tend to discriminate against low income colonies particularly those residing away from posh localities (Kundu Amitab, 1994, p 76).

Research studies give different statistics regarding the per capita availability of potable water through public distribution system. The daily per capita availability of water in class I cities (population 100000 and above) of India averages 142 liters (Sivaramakrishnan. K. C., 1993, p.4). A considerable number of cities have only 50 liters of water availability per capita per day. As against this supply, the average demand is 231 liters per capita per day leading to a short fall of 89 liter per capita per day in class I cities (Sivaramakrishnan. K. C., 1993, p.6).

The National Commission on Urbanisation in its report (1988) has brought into sharp focus not only the lack of basic services but also the inequality in distribution which further exacerbates the situation (Government of India, Ministry of Urban Development, 1988). Statistics regarding coverage of the urban population by public water supply and systems of hygienic conservancy do not give the whole picture. The states of Hariyana, Tamil Nadu, West Bengal, Utter Pradesh, Karnataka, Rajastan, Gujarat and Madhya Pradesh will have a general below average supply of water to urban centers. In much of Tamil Nadu and large part of Andhra Pradesh especially in large cities such as Madras and Hyderabad the water sources are totally inadequate to meet the demands of even domestic sector, with the result that there is very limited piped water supply. Even in the Capital city of Delhi, there have been major water constraints and in many of the suburbs the water is either inadequate or of very poor quality. In most of the older urban centers the supply systems are well past their normal age-span and require major overhaul.

In recent years as part of an increasing awareness of gender issues studies have been undertaken in several countries to assess the time and effort that women and children have to spend to secure fuel and water for the households. In a recent study of Delhi, Hyderabad and Ghaziabad in India, Vinay Lal (1993) report that on an average a women has to spend 3.8 hours per day in fetching water for the household (Sivaramakrishnan. K. C., 1993, p.9). Leakage and unaccounted for water in many cities, in many countries is 40 per cent. Distribution arrangement and existing tariff systems have hardly any relevance for water conservation, wastage reduction or recycling.

A part of the problem in measuring coverage is that, the data are limited to simple arethematic. Usually most National Reports describe the total population of a whole town as covered if there is some kind of water supply system functioning in the city. Per capita figure of supply are calculated even more simplistically by dividing the total installed capacity by population. Sivaramakrishnan reports that in Delhi itself the per capita water supply as officially reported is about 200 liter per day (Sivaramakrishnan. K. C., 1993, p.5). This comfortable average, however, doesn't mean much to about 30 per cent of the city's nine million people who have access if at all to about 25 liters or less.

Even in cities claiming 100 per cent reach, the per capita availability varies as much as 10 times between marginal settlements and the so-called better off localities. Even a planned city like Rourkele faces the problems of unequal distribution of water supply. In such a situation the worst affected are the low-income settlements. The inequalities in distribution are just not a statistical problem. They seriously distort cost recovery, apart from creating a sense of complacency in the minds of decision makers.

One striking fact that is evident from the more recent survey conducted by the National Institute of Public Finance and Policy (2000) is that in a sizable number of urban centers, the availability of water is even less than 100 liters per capita per day. Out of a total of 249 urban centers surveyed only 21.7 per cent of the sample municipalities have reported supplying over 100 liters of water per capita per day [Table No.1.2]. Approximately 28 per cent of the municipalities provided less than 50 liters per capita per day, which is less than half the norms recommended by the Zakaria Committee for towns of less than 20000 persons.

Table No.1.2

Distribution Of Urban Centres By Per Capita Water Supply Levels (1997 –98)

Water levels (Litres per capita daily)	Number of urban Centers	Percentage of total
No Information	59	23.7
0 - 25	24	9.6
25- 50	47	18.8
50 – 75	36	14.5
75 – 100	29	11.7
100 and above	54	21.7
Total	249	100.00

Source: National Institute of Public Finance and Policy (2000): Quoted in India Infrastructure Report (2001) Chapter IX: 'Finances and Functions of Urban Local Bodies' – A Situation Report. Oxford University press. Sebastian Morris (ed) p.249.

1.5.11 Intercity Variation In Water Availability

The availability of water supply services in Metropolitan cities is much better than in Class I and Class II towns, although there is sharp intercity variations in availability. Misra and Sharma (1979) in their survey on Delhi found that per capita supply by the Municipal Corporation of Delhi (MCD) was 40 gallons per day (gpcd) or 180 litres per capita per day (lpcd), where as in the New Delhi Municipal Committee (NDMC) area, the supply was 78 gpcd or 350 lpcd (Archana Ghosh, 1993, p.157). Even within their respective jurisdictions, there is differential level of access to services across localities. The same survey shows that with in the MCD area, the South Delhi Zone (III) had the highest average monthly consumption of water (56.22 kl) per connection. Another study conducted by the Delhi Water Supply and sewerage Disposal undertaking (DWS & SDU) corroborates the above finding. The study reveals that the availability of water in colonies inhabited by affluent people is much higher compared to the poor localities. While 60 to 70 per cent of the households in the posh colonies record consumption levels of more than 30 kl per month, the position is just opposite in the other category of colonies where 70 to 75 per cent of consumers do with less than 30 kl per month and nearly 50 per cent of water connections in these localities have a supply level of less than 20 kl per month. The two surveys conducted by the Central Board For The Prevention and Control of Water Pollution in 1979-80 and in 1988-90 reveals that the supply situation in class II towns is much worse.

The operation Research Group (ORG) study (1995) reveals that on an average water supply varied from 165 lpcd in class I cities to 54 lpcd in class IV towns (Indian Infrastructure Report, 1995, p.15). Even in Class 1 cities, there are sharp variations depending on the location of the habitat, jurisdiction of the local body and income decile of the household.

.5.12 Public Delivery System Of Water And The Urban Poor

The distributional net work by its very design tend to discriminate gainst the low income colonies, particularly those residing away from posh ocalities (Kunda Amitab, 1994, p.77). The poor especially people residing in ow-income colonies and slum settlements face a lot of problems regarding the ublic delivery system of water. Water is available through Public Stand Post PSP) for short durations at a low pressure and supply is often erratic. Various esearch studies on slum population show that as the number of persons per P.S.P. s very high in low income colonies, long queues and hours of waiting becomes nevitable to collect water. The number of persons per stand post in slum areas is nuch above the maximum recommended, under different Slum Improvement Programme. The Environmental Improvement of Urban Slum (EIUS) norm is one ap for 150 persons, in all large cities (Kunda Amitab, 1994, p.247). A survey conducted by the Town and Country Planning Organisation (TCPO) 1984, showed that the number of slum dwellers per stand post was 170 in Rajkot, 200 in Ahamedbad, 421 in Kolhapur, 454 in Miraj and 692 in Godhera. A significant finding of the TCPO study covering 30 urban centres belonging to different size classes was that a substantial segment of the slum population in many of these cities was doing without the public water supply (Kunda Amitab, 1994, p.248).

Accessibility to a water source does not necessarily mean that it is available near the premises. In many localities, public stand post is situated at a considerable distance from the hutments. The NIUA survey (1988) showed that as many as 31 per cent of the sample households had to walk between 50 to 100 feet to collect water and many among the poor – women and children – had to cover the distance not once but several times a day to collect the daily requirements. Kundu Amitab reports that in the eastern part of the city of Ahmedabad the poor had to walk ½ a km to get one bucket of water from the roadside taps where the water supply is very eratic and is available for a short period of time (Kundu Amitab, 1994, p.248). In Delhi 37.3 per cent of the population surveyed also identified the water source being away from their houses, as the major difficulty in getting water (Kundu Amitab, 1994, p.249).

The public water supply in urban areas is heavily subsidised through Government grants advanced from time to time to meet the capital as well as current expenditure. The system however does not show a significant bias in favour of the households in the lower consumption fracticles. In terms of coverage, the percentage of people below the poverty line is significantly below the figure for the whole population. Disparity comes out much more sharply when the per capita consumption of water by people in different consumption fractiles estimated through micro level survey is considered. Various studies conducted from time to time shows that a large majority among the poor do not get minimum quantiity of water for their daily use. This is primarily because the existing organizational structure, pricing policy etc have not been designed to provide the ninimum quantity of water necessary for their daily use despite the claim made on his account (Kundu Amitab, 1994, p.282). There is no significant progress in the ›ricing of water in most of the states and cities and as a result a large portion of his subsidized facility is used by the higher income population. The result is vastage and non-priority use of water. Moreover the problem of affordability is mportant for the poor in the context of the capital expenditure involved in obtaining a new domestic connection.

1.6 Urban Water Supply System In Kerala State

Kerala receives very high rain fall exceeding 3000mm, which is, in fact, one of the highest rates in the country. But steep topographic gradient and absence of sufficient facilities for taping and storing of rain water, most of the water (about 92per cent) is lost as run off into the sea. The changes in land use pattern during the last few decades have also played havoc with the surface and ground water potential of the state. Vast agricultural lands mainly paddy fields, which used to serve as water storage and acquifer recharge zones, have shrunk considerably due to their conversion into dwelling plots and coconut groves. Fast pace of urbanisation and the resultant increase in roads, buildings, compound walls and other concrete and cement structures not only reduced the surface area for ground water discharge, but also resulted in blocking of natural drainage causing water logging and flooding in many areas. Many ponds and tanks which used to serve as perennial source of water in the countryside has been left unused or silted

Several river and lakes are under threat of pollution. On the other hand, and for fresh water has increased many fold due to unprecedented growth in ılation and number of urban centers in the state during the second half of the century. In Kerala's development scenario the most over looked aspect is :r resource management.

Hence supply of drinking water to households is a real and growing ılem in Kerala particularly during summer when water reservoirs fall below ls and when ground water levels decline. It is indeed a paradox that inspite of high rainfall, we have been experiencing acute problems in providing drinking :r for urban and rural households. This is not in conformity with the :tacular progress the state has achieved in other fields of service sector namely acy, family planning, public health etc. Now a days the traditional source of :r have become an undependable assured source of water. Such circumstances : led to the installation of public water supply systems aimed at assuring water a permanent basis to the people (Jacob John, 1997, p.29). The need for ecting water supply has increased since the quality of water is adversely cted in many parts of Kerala especially in the costal areas due to salinity and :kishness. There are some areas which are endemic to diseases like cholera the quality of water is seen affected by the excess of iron, flourines, and other c element. Coupled with this, rapid growth of population and the resultant increase in urban areas also raised the need for public water supply schemes in Kerala.

During the pre-independence era, Trivandrum, Cochin, and Alapuzha were the only towns which had protected water supply system. Since the attainment of independence, Government of India has been formulating and implementing various programmes inorder to install piped (public) water supply system through out India. In the state of Kerala, no appreciable progress is noticed, however, in the matter of urban public water supply schemes till 1964 (Government of Kerala, State Planning Board, 1984, p.122). Since that year significant improvement have taken place in the state in this matter. With the help of Government of India and various financial institutions, the state Government has began a large number of water supply systems through out Kerala. Kerala obtained substantial loan assistance from the Life Insurance Corporation of India (LIC) to venture on a massive water supply programe. As a result during the period 1970-71 to 1980-81, 33 urban water supply schemes were brought into operation in Kerala with a 63 per cent urban population coverage. Since 1980 Kerala has made substantial efforts to install water supply schemes aided by various financial institutions and overseas agencies like LIC, HUDCO, WORLD BANK, The Netherlands, Danish and OECF (Japan). As a result by 1992-93 Kerala was able to provide protected drinking water to 50.5 lakh people in urban areas, that is 66 per cent of urban population (Government of Kerala, State Planning Board, 1993, p.160).

There were 50 urban water supply schemes in operation in the state covering 60.23 lakh population in 2000, which represented 69per cent of the urban population. Compared to 1999, there was an increase of one per cent coverage in 2000. Statistics shows that urban water supply coverage increased from 49.7 lakh in 1992 to 60.24 lakh in 2000 (Government of Kerala, State Planning Board, 2000, p.167). The district wise population covered by urban water supply scheme is given in the following Table No.1.3.

Table No.1.3

District Wise Population Covered By Urban Water Supply Scheme (Population in Lakhs)

S.no	District	Year 1992	Year 2000
1	Thiruvananthapuram	7.21	7.63
2	Kollam	3.10	4.63
3	Pathanamthitta	0.84	1.08
4	Alapuzha	4.90	4.95
5	Kottayam	2.46	3.63
6	Idukki	0.11	0.53
7	Ernakulam	8.96	11.35
8	Trichur	5.35	5.78
9	Palakkad	2.31	2.57
10	Malappuram	1.76	2.74
11	Kozhikode	5.54	6.62
12	Wayanad	0.11	0.12
13	Kannur	4.85	6.32
14	Kasaragod	2.24	2.29
	Total	49.74	60.24

Source: Government of Kerala, State Planning Board, Economic Review, 2000,p.5247

There were 9610 stand posts in the three corporation (Trivandrum, Cochin and Calicut) areas of Kerala as on 31-10-2000 and each stand post served 162 persons on an average. In Municipal areas there were 21,203 stand posts as on 31st October 2000.

1.6.1 Demand – Supply Gap In Water Supply In Cooporation / Municipal Areas

According to 1991 census, corporation/municipal areas in Kerala had a total population of 37.78 lakhs. This population was estimated at 42.59 lakhs in 2000. As per lpcd norms, the demand for water in these areas stood at 6952.5 million litres as against a supply of 4050.07 million litres of water during 2000. Demand – supply gap of water in corporation / municipal areas thus stood at 2902.43 million liters of water in 1999-2000 (Government of Kerala, State Planning Board, 2000, p.168).

1.6.2 Production And Supply Of Piped Water

The production of piped water supply has increased from 3,34,759.40 million litres in 1992 to 3,79,600 million litres per day in 2000,showing an increase of 44,840 million litres (13.39 per cent) during the period. Similarly the supply of piped water increased from 2,05,378.34 million litres to 2,86,525 million litres per day during the above period, showing an increase of 39.51 per cent. The leakage in 1992 stood at 1,29,381.06 million litres amounting to 38.65 per cent of the water produced. This declined to 93,075 million litres (24.52 per cent) in 2000. The reduction in leakage is a notable achievement. Table No.1.4 shows the details on production, supply and leakage of water during the period 1992-2000.

Table No.1.4

Production And Supply Of Water Under Piped Water Supply (in million litres)

Year 1	Production 2	Supply 3	Leakage 4	Percentage of column 4 to 2
1992	334759.40	205378.34	129381.06	38.65
1993	360597.12	247924.46	112672.66	31.25
1994	350962.48	253657.43	97305.05	27.72
1995	382116.77	255946.82	12169.95	33.00
1996	387759.86	269799.29	117960.58	30.42
1997	368177.22	266914.13	101263.09	27.50
1998	379600.00	286525.00	93075.00	24.52
1999	379600.00	286525.00	93075.00	24.52
2000	379600.00	286525.00	93075.00	24.52

Source: Government of Kerala, State Planning Board - Economic Review – various issues.

The expenditure on water supply under plan and non-plan amounted to Rs.110 crores in 1992-93, which sharply increased to about Rs.260 crores in 1999-2000. The detailed break –up of the plan and non-plan expenditure spend on water supply schemes is give in Table No.1.5.

Table No.1.5

Expenditure On Water Supply (Plan And Non-Plan)
From 1992-93 To 2000-01
(Rs. In Lakhs)

Year	Plan	Non-plan	Total
1992-93	8131.57	2952.11	11083.68
1993-94	9347.76	3546.36	12894.12
1994-95	10019.22	3550.39	13569.61
1995-96	11194.93	3549.01	14743.94
1996-97	10502.62	3580.36	14082.98
1997-98	16501.86	3578.35	20080.21
1998-99	14859.14	4667.00	19526.14
1999-00	20078.37	5876.56	25954.93
2000-01	22855.00	5965.02	28820.02

Source :Government of Karalla, State Planning Board, Economic Review 1998,1999,2000.

The plan expenditure of Kerala Water Authority (K.W.A) stood at Rs.187.34 crores in 1998-99. Out of it 64.80 per cent was spent for schemes other than ARP / LIC / HUDCO, 15.64 on LIC / HUDCO assisted schemes and 18.86 per cent on ARP schemes. The Non – plan expenditure during 1999-2000 was Rs.235.30 crores as against Rs.79.12 crores in 1993-94, registering an increase of 197.5 per cent during the period. It is interesting to note that among the different components of non-plan expenditure during 1999-2000, expenditure on electricity charges alone constituted 23.08 per cent, operation and Maintenance expenditure

12 per cent and salary establishment cost 39.75 per cent. Table No.1.6 exhibit th item / head wise distribution of non- plan expenditure for the year 1999-2000.

Table No.1.6

Non – Plan Expenditure (Item Wise) For The Year 1999-2000 Of Kerala Water Authority (Rupees in crores)

Components on Non-plan expenditure	Year 1999-2000	As percentage to total non plan expenditure
Salary Establishment	93.59	39.75
Power charges	54.33	23.08
Operation an maintenance	28.25	12.05
Interest on loans (excluding GOK Loans)	38.26	16.26
Repayment of Loans (Excluding GOK loans	15.41	6.54
Others	5.46	2.32
Total	235.30	100.00

Source : Government of Kerala, SPB, Economic Review, Various issues.

The table clearly shows the mounting non plan expenditure of the Keral Water Authority, when compared to the plan expenditure as stated earlier, whic exert a negative impact on production and supply of piped water to the habitants The per capita cost of providing water supply in Kerala has been estimated a between Rs.1500 and Rs.2000 in rural areas and Rs.2500 and Rs.3000 in urba areas. The cost of production of drinking water is worked out at Rs.6 to Rs.7/ per 1000 liters in 1999, but the realization in less than Rs.3/- This clearly show the non-viability of many water projects an its impact on production an distribution of pipe water.

1.6.3 Dcentralisation And Water Supply

The allocation for drinking water projects during the first three years of Ninth Plan by local bodies amounted to Rs.159.25 crores. The details of the project are given in Table No.1.7

Table No.1.7

Drinking Water Projects Prepared By Local Bodies During 1997-2000
(Rupees in Crores)

Item	1997-98		1998-99		1999-2000	
	Number of Projects	Grants – in- aid	Number of Projects	Grants – in- aid	Number of Projects	Grants – in- aid
Drinking Water	5089	58.35	5215	47.69	8706	53.21

Government of Kerala, State Planning Board, Economic Review, 2000.

Water supply and sanitations are recognized as vital inputs into the state of Health and quality of life of the population. In the state of Kerala, this sector suffers from three main deficiencies. (1) Inadequate coverage of the population in both urban and rural areas by piped water (2) Poor quality of water in many areas (3) poor availability of water for many months in the year in town areas and in many villages leading to near drought conditions. Information about quality, availability and pattern of use is very difficult to come by in this sector. Regarding availability and pattern of use of water no serious study has yet taken place in the urban centers of Kerala. Still the water availability problem is grave in cities and many villages of Kerala.

Thus the problem associated with drinking water supply in the state are numerous and complex. Major problems can be listed as; widening gap between demand for and supply of piped water, Resource constraints for funding new projects, mounting non-plan expenditure component of projects, mismatch between production cost and tariff structure leading to low revenue realization, lack of suitable low cost technology, poor maintenance of existing schemes, Absence of suitable water pricing policy, organizational problems, irregularity in supply, variation in supply with in locality, misuse of water, centralisation of power at state level etc.

1.7 Identification Of The Research Problem

The level of urbanisation in India is very much similar to other developing countries and has been increasing steadily decade, after decade. As stated earlier urbanisation helps to contribute to the growth process at large. But this positive aspect of urbanisation is overshadowed by the clear deterioration in the physical environment and quality of life in urban areas on account of widening gap between demand and supply of essential services and infrastructure. Most of the increase in urban population is normally accommodated in slums and squatter communities, the so called informal settlements. In 1995, for which country wide data is available approximately 15per cent of Indias total urban population have no access to safe drinking water and approximately 50per cent of urban population have no access to basic sanitation. The position with respect to collection anc disposal of garbage is also worse. The coverage is very low. About 30-40 pei cent of the garbage was left on the city street uncollected. Even though 50 pei cent of urban population is covered by sanitation services, only 28per cent urbar households are connected to the sewerage system. Though 300 urban centers have a sewerage system only 70 of these have sewage treatment facilities. Thus there are major deficiencies in the provision of urban infrastructure and basic services despite major efforts in the past (Mathur, M.P., 2001, p.9). Moreover there exis a large scale inequality in the distribution of urban basic amenities.

Among these basic amenities water is to be singled out as the very existence of humans depends on it. Water supply is a necessary part of the urbar infrastructure required to attain the goal of social and economic development Water supply is a public good because of its inter relationship with health status Water supply is necessary for sheer survival while other urban basic amenities like transport, power, shelter, health service etc., are all necessary for sustained growtl and prosperity. Water constitute the perennial need of the whole universe. Wate is the elixir of life, says Tiruvalluvar, an ancient Tamil writer, in 'Tirukkural' The common factor in human progress any where has been the optimun availability of water resources – both in quantity as well as in quality. The availability of good quality of drinking water, exerts dreadful impact on humai health and thereby on economy. Emphasizing the need and importance o drinking water supply facilities in an economy, World Health Organisation remarks that 'Water supply should be looked upon as an instrument which build up the economic well-being of the nation rather than, merely satisfying a health requirement (Niyathi. N., 1994, p 2).

Water though a gift of nature is becoming scarce, insufficient and unsafe for human consumption A stage has come when humanity finds it necessary to make collective efforts to conserve the gifts of nature assiduously, even for its survival. Developing countries have a universal need for new and improved water supply system. Thus it has become the responsibility of Government in such countries to produce, collect, process and supply safe drinking water as a public service to the community through budgetary resources.

A partial list of benefits from community water supply project has been give by John Logan (John Logan, 1960, p.p.469-476) (1) health (2) economic development which includes a) growth of commerce and industry b) production efficiency c) development of tourism and d) increase in food production; (3) public cleaning (4) fire protection (5) saving in cost and time over use of primitive water supply facilities (6) encouragement of stable urban development and (7) increase in property values.

All these benefits do contribute directly or indirectly to economic development. The dialectic of public water supply engineers and public health officials tends to emphasize this view by ascribing to water supply, a crucial role in economic development. Logan states: "It can be argued that, if health is fundamental to development, water supply is fundamental to health, and therefore water is key to development" (John Logan, 1960, p.p.469-476). Similarly Abraham Horowitz states : "If a single programme were chosen which could have the maximum health benefit, which would rapidly stimulate social and economic development, and which would materially improve the standard of living of the people, that programme would be water supply with provision for water running into or adjusted to the house" (Abraham Horawitz, 1963, p.954). The water supply system is part of that category of economic activities subsumed under the caption of social infrastructure, or social overhead capital which is not directly productive but is the necessary basis for the successful growth of productive activities. Hence for better and healthy living safe drinking water supply and hygienic sanitation facilities are a must. However, due to ever increasing urbanisation, acute imbalance emerges in the demand supply position of water supply system. Urban water supply management has emerged as the most strident problem in urban management.

A study of the water supply system in Delhi shows that the per capita water supply in Delhi was officially reported to be 200 liters per person per day. But 30 per cent of the population of Delhi (8.5 million in 1991) got only 25 liters or less per day. One striking factor that is evident from the more recent survey conducted by the National Institute of Public Finance and Policy (NIPFP, 2000) is that in a sizable number of urban centers, the availability of water is even less than 100 liters per capita per day, as only 21.7 per cent of the sample municipalities surveyed have reported supplying over 100 liters of water per capita per day. Approximately 28per cent of the municipalities surveyed provided less than 50 liters per capita per day, which again is less than half the norms recommended by the Zakaria Committee for towns of less than 20000 persons (Mathur, M.P. 2001, p 15). As stated earlier, the study conducted by Operation Research Group (ORG 1995) reveals that on an average, water supply varies from 165 lpcd in Class I cities to 54 lpcd in Class IV towns. Even in Class I cities, there are sharp variation depending on the location of the habitat, jurisdiction of local body and Income deciles of the Household (The Indian Infrsstructire Report, 1995, p 18). Even the planned city of Roukela face the problem of unequal distribution of water supply. Micro level studies conducted at different times shows that even in cities claiming 100 per cent reach, the per capita availability of water varies as much as 10 times between marginal settlements and the better of localities (Sivaramakrishnan. K. C., 1993, p.9)

The economic impact of poor water supply is rarely understood and usually not quantified. The actual delivery to the citizenary in terms of both uality and quantity are far less than the capacities, that have been created, both in rms of machines and manpower. Wastage and leakage of water is another roblem in supply side. In many cities leakages are widespread and are not onfined to water mains. It is estimated that in Calcutta about one third of the apacity for water supply is wasted along the transmission line. A large part of the anpower and machinery for various jobs in the system remain grossly under tilized. Civic authorities appear to be more interested in creating facilities and ervices than in their up keep and optimum utilization.

The available service net of leakage are not spread uniformly over he citzenary. Their dispersion tend to favour the urban elite and organized ettlements. While slum dwellers at the bottom of the social hierarchy get only a raction of what those in the top deciles obtain. Compare the per capita water use n a multistoried apartment with that in a slum. Consider the fact that the amount f water used every time a toilet is flushed in a multistoried apartment exceeds what is normally available to a slum dweller in a day. Not only the distribution of hese service is skewed, but also the charges and payments are not at all linked to he quantum and quality of service obtained.

Urban public water supply system thus seems to be plagued by two major problems. Firstly the rapid growth of urban population in our country put a great strain on already installed capacities. When new consumers are connected to existing system at a pace more rapid than the expansion of capacity, the service omes unequal and effects adversely all consumers both already existing and the vly added. A second and related problem is that of poor management, a ection both of under development of technical and managerial skills and of the ficulty of relating costs to benefits. A serious management short comings ich has clear negative implications for public health, is the inadequate attention en to maintenance and repair of existing public water supply systems.

It is possible to envisage two types of public water supply system. Water supply as public service, and (2) water supply as public utility. Water pply could be considered a public service for social welfare reasons, a service ich bestows public health benefits that contribute to economic development. ewed from this angle, water supply would have to be made free of charge or at hly subsidized rates. All uses of water and all sources of water supply could , far practical economic reasons be treated on this basis. The most important imant to this consideration would perhaps be the water taps for public use talled on public streets. The public utility approach would suggest that water plied would be charged at rates covering long run marginal costs. A obvious egory for such treatment would be water supplied to households through private nections. In this case at the minimum water charges should yield the necessary enue required for operation and maintenance cost of the existing installed acities and a surplus pool to sustain future expansion. A more recent approach wards urban drinking water supply strategies in Ninth plan envisaged to promote d strengthen decentralization of production and distribution system, ivatization and participation of the community in management and maintenance water supply system. This approach is expected to induct higher efficiency vels and effective reach out of the supply system and due generation of water eracy in utilization and preservation of scarce water resources. This new proach recognizes the need for participation of the private sector, NGOs and neficiary community in production and distribution of water supply and for stainability of the system.

Thus the coming years are bound to see an array of issues crop up in iter management. Still four key challenges with respect to urban water supply ll over shadow all else. These are

1. How can water consumers be sensitized to the scarcity of water?
2. How can we ensure that a sense of equity pervades in water provision that enables the country to reach this vital resources to every one of its citizens at a reasonable standard and at an affordable price?
3. How can water utilities be made financially self sustaining which will allow continuous investment in water supply capacities?
4. How can we ensure an increased participation of the community in production, processing and distribution of water and for sustainability of the system?

In the context of these challenges, issues relating to the management of scarce water resources and its fair distributions across different size class of population will emerge as the crucial component of our economic consciousness. It is very difficult to ascertain the problem at the national level, by putting certain standard norms. National and international norms tend to be too high and unsuitable to local needs and conditions. Within the country the level, need and availability of water supply widely vary between states. Within the states variation can be found between metropolis, Class I towns and small towns. Moreover distributional and consumption variation can be found even between different size class of population with in a city. Therefore a good deal of research at the micro level is needed to ascertain the availability problem of piped water, shortage in its supply and issues relating to water quality and management problems. However, studies on the different aspects of urban piped water supply system are few. This study is a modest attempt to fill this gap.

1.8 Significance And Importance Of The Study

Studies in urban water supply system are few in the state of Kerala. It is a little researched area. In the case of water pricing a number of studies are available. In Kerala state, exception to Jacob John's study on "Economics of Public Water Supply System", which is a case study of Trivandrum Water Supply System in 1997, no exhaustive research work has so far come out in this field.

[oreover no indepth research study has come up, so far, relating to household ater demand analysis and the distribution system of urban piped water supply. he proposed study is first of its kind, which focuses on the distributional and /ailability problems of piped water supply in an urban centre in Kerala state.

Hence there is a felt need for enquiring into the sufficiency of otable water supplied to people in urban areas and the efficiency maintained in roviding the scarce resource and preventing its misuse by the consumers. It is in iis backdrop that this study was undertaken and its empirical part was conducted ı Calicut city in the state of Kerala. Study is confined to the water supply system ı the city of Calicut. The Calicut city has been experiencing acute water shortage or the last two decades. Due to supply and demand gap, the different parts of the ity, receives water on alternative days and the supply is restricted to a few hours ı a day. No serious study has come up so far, considering the issues related to 'ater availability faced by different categories of consumers within the city. lence the proposed study specifically takes into account the beneficiaries erception about the present system in terms of its shortcoming, availability roblems and issues relating to water quality and management problems. Ioreover a large number of user-friendly mini water scheme, with community articipation has been commissioned in different localities within the Calicut city. 'hese eco- friendly projects are catering to the drinking water requirements of mall clusters of households residing in water scare localities in the city. No study is come up taking into account the socio-economic impact of mini water scheme the supply system. The present study takes into account this aspect also. This udy assumes significance in this context.

9 Objectives Of The Study

he objectives of the study are:

1. To analyse issues related to water availability faced by different categories of consumers within Calicut city.
2. To investigate the water use pattern of the beneficiaries of the system.
3. To identify the socio-economic variables influencing household water demand.
4. To analyse the overall efficiency of the city water supply system and
5. to analyse the feasibility of Mini Water Supply Schemes, as an alternative for solving the water availability problems of the consumers within the city.

.10 Hypothesis

The following hypothesis have been examined.

1. Consumers belonging to the lower income group, who are socially and economically backward are badly affected by the public delivery system of piped water. The water availability problem is acute in this category of consumers, compared to consumers in higher income groups.
2. Given certain conditions, Mini water supply, involving community participation appears to be better than the centralized supply system

managed by the Government, in terms of equity in water availability, economy in water use, cost effectiveness, quality maintenance and generation of water literacy.

1.11 Methodology

a. Sample design

The total group of people which meet certain criteria of interests to the researcher is called the population. In this study the total population consist of metered domestic consumers of water supply and total number of public stand posts through which water is distributed free of cost. Water consumers under KWA consist of both domestic and non-domestic consumers. Non-domestic consumers consist of commercial establishments, institutions and industrial establishments connected to the water supply system. Non-domestic consumers constitute 6.26 per cent of total consumers and accurate water consumption figures pertaining to this non-domestic consumers is difficult to obtain. Hence the study is confined to domestic consumers alone. The total number of domestic consumers as on 31st March 2001, as per KWA, Calicut regional office record is taken as the frame or population. This include ;

Own connection or metered house connection	: 28730
Number of Public Stand Posts (P.S.P)	: 2725
Total	: 31455

The Calicut corporation area consist of 51 electoral wards or 39 /enue wards. For piped water distribution the 39 revenue wards are recognized) four independent water distribution Zones, which are areas classified based on vation, physical and geographical characteristics. The zone wise distribution of population is given in Table No.1.8.

Table No.1.8

Zone-Wise Distribution Of Population As On 31-03-01

Zones	Own connection / metered House connections	Number of Public Stand Posts	Total
I	10,500	800	11,300
II	12,000	1,400	13,400
III	2,540	300	2,840
IV	3,690	225	3,915
Total	28,730	2,725	31,455

urce : Compiled from office records, KWA regional office, Calicut.

In sampling technique certain units from the whole domain of survey selected as being representatives. These selected representatives are studied in tail and the conclusion arrived from these are extended in the entire field or main. Social scientists employ sampling when the population under study is too ge in number.

In the present study, stratified random sampling technique is used. ılicut city area consist of both elevated and plain localities. In the first stage the evated and plain places in each Zone is identified with the help of the Kerala 'ater Authority Officials and ward councilors. In the second stage from each cality the consumers having metered water connection and those depending on S.P. is identified, and considered while drawing the sample.

In the selection of metered consumers proportionate sampling chnique is used. The sample households selected represent one per cent of the tal metered consumers in the book of entry of Kerala Water Authority, as on 31-3-01. However in the case of consumers depending on P.S.P. the non-oportionate sampling technique is adopted.. The dependence ratio of consumers er P.S.P. ranges from fifty to two hundred persons per tap. Moreover many of ie P.S.P.'s are not functioning and many of them is worn and torn. Hence it is ifficult to keep the proportionate sampling technique in the selection of sample onsumers depending on PSP..

In the third stage for the purpose of sampling, total number of ouseholds are classified into three different categories according to the type of ructure such as pucca, semi-pucca and katcha.{The classification of the onstruction of dwelling units and the type of it has been in line with the N.S.S. lassification. Houses with concrete or tiled roof, wall built with burned bricks and plastered with cement mortar and floor made of cement or mosaic or tiles or such other materials have been classified as pucca. Semi - pucca houses are those with wall constructed out of burned bricks and floor out of cement or such other pucca materials but the roofs are thatched. Essentially what is meant by semi – pucca is that such constructions generally have the characteristics of pucca and katcha houses. Houses built with mud walls, walls made out of bamboo, reed etc., or with lesser quality of materials and thatched roof are classified as katcha)

Thus the total sample drawn is 414. Out of this 289 consumers were drawn from metered connection category residing in pucca an semi – pucca house. 125 consumers were selected from the category of consumers depending on public stand post. They were found living in Katcha houses. A large number of such were found living in slum settlements.

Out of 289 metered consumers selected, 152 was drawn from plain area an 137 was drawn from elevated area. Like wise out of the 125 consumers depending on PSP, 51 was drawn from plain area and 71 from elevated area.

The Zonal distribution of the sample size based on the nature of locality (Plain and elevated) and type of source (metered connection or PSP dependents) is given in Table No.1.9

Table No.1.9

Zone Wise Distribution Of The Sample Size

ımber of ones (1)	Consumers having metered connection		Total metered connection (2+3) (4)	Consumers depending on PSP		Total PSP connection (5+6) (7)	Grand Total (4+7) (8)
	Plane area (2)	Elevated area (3)		Plain area (5)	Elevated area (6)		
I	60	46	106	15	20	35	141
II	60	61	121	20	30	50	171
III	13	12	25	8	12	20	45
IV	19	18	37	8	12	20	57
'otal	152	137	289	51	74	125	414

ıurce: Field Survey Data

From the table it is clear that while drawing samples, adequate ɜightage was given to the nature of locality. However no definite proportion was pt regarding the selection of houses viz pucca, semi – pucca and katcha, from ɜ two localities.

Mini water supply schemes commissioned in different localities of ılicut city with community participation constitute another component of the ıdy. Out of the seventeen projects commissioned, Six projects from different ıter scarce location were taken for the study. Purposive sampling technique is ed to select the projects. Ten beneficiary house holds from each project is taken as sample Households residing near to public tap and households residing far away from the public tap is considered while drawing the sample.

b. Data Source:

The present study comes under descriptive survey method. The major source of primary data was interview of 414 heads of households selected on a random basis from the various types of consumers in Calicut city. A well structured interview schedule was used for collecting data from the respondents. For the analysis of the user-friendly nature of the mini water scheme, six representative schemes which are functioning in the various parts of the city were selected. Ten beneficiaries were selected on a random basis from each project for collecting data. Information was collected from the managers and beneficiaries of the schemes.

Sources of secondary data were published materials and experience surveys.

c. Tools used for analysis:

The four important aspects under investigation in the study are:

1. A descriptive analysis of the present water supply system in Calicut city. For studying this aspect secondary data source is used. Personal interviews and discussions were also conducted with corporation council members and

experts in fields to ascertain location specific problems in water availability.

2. A detailed analysis of the efficiency of the water supply system, in terms of water availability, use pattern, quality and management based on the beneficiaries perception on it. For the purpose of analysis, tabular presentation methods is used. The test of significance for the difference in average lpcd for different category of consumers is analysed by using Z-test. To find out the variability in water availability among consumers in the same category, the coefficient of variation is estimated.
3. Household water demand analysis. The socio-economic determinants of water demand is analysed by using a) Tabular presentation b) Empirical estimation by using Multiple Linear Regression Analysis and
4. an analysis of mini water supply schemes. Projects were analysed, based on such profiles of the peoples projects such as water availability, pattern of water use, generation of water literacy, economic viability and cost effectiveness, socio-economic impact, water quality maintenance and extend of community involvement in running the project.

1.12 Pilot Survey

Pilot study provides a better knowledge of the problem under study and its dimensions. It provides guidance and conceptualization and also assists in discovering the nature of relationship between variables and in formulating hypothesis. For the pilot study an unstructured interview schedule was used which helped to increase the quality of interview schedule. In the pilot study, the ward members were consulted. Incorporating the suggestions and experience from pilot study, the well structured interview schedule was prepared on the basis of the preliminary study conducted.

1.13 Pre Test

Pre test is the check of the workability of the schedule prepared. It is tested once again to find if any discripencies have been left out. The advantage of pre – test is that the short comings of the schedule can be discovered.

Pre test was conducted inorder to check whether the schedule suits the practical standards and also for eliminating repeated questions and to add additional questions if necessary.

Interview schedule was finalised after making the necessary modifications in the light of experience gained through pre test. In this study a pretest was conducted among twenty five respondents and a few modifications were made in the schedule.

1.14 Field And Field Work

The field of the present study is the Calicut city area. The field work was conducted during the period January to May 2001 and October to December 2001. The respondents were interviewed at their residence.

1.15 Scheme Of Study

The study is presented in Eight chapters. Chapter one, the introductory Chapter, basically contain the background of the study, along with the objectives and hypothesis of the study, methodology, data source and sample design and also the limitation of the study.

Second chapter contains a survey of the literature on the topics related to the study. A brief profile of the study area and sample population upon which the study is based is presented in the Third chapter.

The Fourth chapter is devoted for a critical appraisal of the present piped water supply system in the city of Calicut, operated, maintained and managed by the Kerala Water Authority (KWA). Chapter five presents a detailed analysis of the efficiency of the water supply system based on beneficiaries perception on it.

In the Sixth chapter, an analysis of the socio-economic factors determining the water demand of households is presented. Chapter seven contains a critical analysis of the Mini Water Supply Scheme commissioned in Calicut city, with community participation, catering to the drinking water requirements of households in water scarce localities. The summary of the findings of the study and major conclusions that emerge from it is presented in the Eighth chapter

1.16 Limitations Of The Study

As stated earlier, the study is by necessity an explorative one, because no other study has come up in the area, in the state of Kerala.

The average use of water per day revealed by metered consumers in the household survey was found more or less accurate. The consumption figures estimated through household survey was compared with their average monthly consumption recorded in the household water consumption card. If any noticeable difference was found between the two figures, water meter was subject to observation and meter reading after the 7th day of household survey was taken and necessary corrections, if needed were made in the raw data. However very few such cases were found during the survey. Hence as far as metered consumers are concerned, accuracy of data pertinent to average water consumption per day is asserted.

However, when the same question was asked to consumers depending on PSP, they showed some big pots which does not furnish the actual measurement. The researcher took the pot of 10 liters and made the measurement in 5 households and the water use of all other households surveyed were calculated based on such measurement. Sometimes researcher's own observation is made to assertain water requirement and availability. Hence there is the possibility of investigating error. Again confusion arose when the distance from and to the water source was asked and the researcher was compelled to make rough estimate of the distance.

Another limitation of the study is the lack of similar studies to compare with. Further studies in the wider contest may be needed to strengthen the policy conclusions drawn from the present investigation.

CHAPTER II

REVIEW OF LITERATURE

CHAPTER II

REVIEW OF LITERATURE

The pace of urbanisation in India is at par with the process every where in the world. The phenomenon particularly in developing economies like ours has a peculiar profile. It widens the gap between demand for and supply of civic amenities in urban centers. Among these amenities water is to be singled out as the very existence of humans depends on it. Of all the shelter and environmental issues facing cities in developing countries, the provision of potable water is the most pressing one.

2.1 Studies on Urban Water Supply: Demand And Availability Problem In India And Kerala.

A study about the availability of basic amenities in different localities of Rourkela and its implications for the quality of life of various categories of people residing in the city is the focus of analysis in the article 'Basic Amenities And Quality Of Life In An Urban Industrial Complex' by Rajkishor Meher (1993, p.p.212-232). The study was mainly based on direct and intensive observations of the various localities of the city in connection with the collection of information and field data by the author. The growth of the industrial city of Rourkala, the level and extent of basic amenities like water supply, sanitation rainage and sewerage ; the growth of slums and availability of basic amenities to um population and the quality of life of the urbanities are explained in a lucid nd analytical way in .the article. In conclusion the Researcher argues that the ase study of Rourkela illustrates the planning of a modern Township in the bsence of proper planning of the periphery and adjacent rural areas, leads to an nintended form of urban development with grave problem in the provision of asic amenities of city life especially water supply and sanitation.

In a similar work Samir Ahmed (1995) unveils the status of urban asic amenities especially water supply, sanitation and housing in nine mega cities metros) by using published data from different sources and Census of India ;eport 1991. The various dimensions of the process of deterioration of civic menities and its impact on city dwellers were systematically analysed by the esearcher. To tackle the ongoing crisis in Metros, the need to introduce dministrative decentralization with financial backing to strengthen local ;overnments is highlighted in the article.

Addressing the issues of quality of life in Indian cities, ;ayed..S..Shafi (1995, p.p. 1-17) argues that quality of life is the central theme in ny scheme of urban planning. To the researcher, in the Indian context, the vailability of water, sanitation and housing and the delivery of these basic ervices and facilities within a habitant, medical and health care services, air and water quality, solid waste collection and disposal are the different aspects which should be considered for arriving at an acceptable indicator, reflecting the quality of life. The article looks at the metropolitan cities in the country in terms of various pulls, strains and distortions. Citing examples from the prime metropolis of Delhi, he advocates to rework the equations and indices which should determine the living standards and quality of life in an Indian metropolis. The researcher concludes the article with the suggestion that developing countries do not copy the out of date models that have lost relevance even in the countries of their origin.

State-wise analysis of the level of urban basic amenities, a research work by Kumdu Amithab Soumen Begchi and Debolina Kundu (1999, p.p. 1893-1905) reveals that the disparity in the distribution of basic amenities in urban India is extremely high in the 1990's. The author argues that the government and para-state institution have not shown sensitivity in favour of the .backward states, small and medium towns and the poor. Using population census and NSS data, the trend in the availability, and interstate variations in availability of a limited number of basic amenities like electricity, safe drinking water, toilets was systematically analysed in the article. The authors main argument is that the changed perspective and a consequent decline in public investment, however, are likely to accentuate the disparity in the levels of amenities across the size class of urban settlements.

Samual Paul (1994, p.p. 3131-3134) in the article 'Public Services For Urban Poor, Report Card On Three Indian Cities', makes a comparative analysis of accessibility, adequacy and quality of urban civic services for urban poor taking feed back from slum dwellers in Ahmedbad, Bangalore and Pune. His study focuses on the effectiveness of public services with special reference to the urban poor. The underlying approach was to elicit information from the poor themselves on aspects of effectiveness for which they are the best judges. The purpose of the study was not only to see how India's public agencies are serving the urban poor but also to assess the value of citizen feedback as a means to improve public accountability and performance. The major findings of the study can be summerised as (1) Pune leads in the satisfaction of the urban poor with their access to most public and civic services. Ahmedbad had the least satisfied urban poor and Bangalore is in between. (2) Water supply and sanitation is the least satisfactory of all public services, among the urban poor in all three cities.

Nickum, et.al. (1994, p.218) investigate the nature of water use conflicts in and around a broad sample of metropolitan areas in the Asia – Pacific Region. York – Shiu F. Lee evaluates urban water supply and sanitation in the developing countries. James A. Nickum explores Beijing's maturing socialist water economy. R. Sakthivadivel and K. Venugopal focus on water problems in the Madras Metropolitan area. Francisco P. Fellizar addresses urban water management in metropolitan Manila. Michio Akiyama and Masahisa Nakamura ısider water resource management in Osaka. Euisoon Shin presents water use ıflicts in the Seoul metropolitan region. Ruangdej Srivardhana examines water : conflicts in Bangkok metropolitan region. James. E. T. Moncur explores ter use, reallocation and institutional change in Honolulu. Kenji Oya and Seiji ıyama assess water use conflicts under increasing water scarcity in Yahagi River sin in Central Japan. Nickum and K. William Easter discuss alternative ɔroaches to urban water management.

'Water Supply and Environmental Management: Developing Water ıplications', a study by Munasinghe, Mohan (1992, p.447), outlines an approach more efficient analysis, planning and management of water sector programmes describing the concepts and tools of integrated water resource planning and ınagement, with special reference to drinking water. The research work scribes the hydrological infrastructure, and policy context of sector development ınning, the economic evaluation of water supply projects and programmes using rious tools of cost – benefit analysis, Water Supply Systems and their operation, mand analysis and forecasting and the specifics of rural and low cost urban ıter supply development. A series of case studies that discuss some of the aracteristics of water sector management programme in Africa, Brazil and the ilipines are also presented in this study.

Financing investments in Urban Water Supply and sanitation has been a perennial problem in all countries of Latin America and Caribbean. Lee, Jouravlev (1992, p.p.117-28) explores through statistical analysis, the practicability of financing water supply and sanitation services from income generated by the tariffs. Particular emphasis has been made on the possibility of the whole population paying for sanitation services; an issue of importance given the unequal distribution of income in most cities of the Region.

The development of water resources through local – resource – based techniques is a crucial factor in any economic and social activity. It offers enormous potential for employment creation and income distribution in favour of the most deprived social groups. Van Imschoot (1992, p.p125-37) using four case studies (India, Madagascar, Morocco and the Sudan) examines the technological criteria, institutional framework, methods of implementation and decision-making processes generally governing water projects.

Saleth. R. M. and Dinar. A. (1997, p.39) in their research study examine the economics of several options for increasing water supplies in Hyderbad city, Andrapradesh State, India. The study estimates user specific alternative pricing schemes; calculates the net willingness to pay; demonstrates the lack of Justification for increased supply options and argues that the low, uneconomical rate structure prevents externally imposed water transfers.

The link between rapid urban growth and the tremendous strain on ties in India to provide adequate and clean drinking water supply is highlighted ' Khana and Koshy (1992, July – August, p.11). The authors examine the trend India's urban growth, strain upon urban Governments in providing drinking ater, the resource crunch and identify some solutions to the problem. The ılution suggested by the researchers are integration of water and waste water anagement combined with health education and health promotion, use of remote :nsing and geophysical surveys to locate water resources, protection of Water ›urces from pollution. Waste recycle and reuse, decentralization of water supply, aintenance of the water distribution system etc.

Asthana, Anand. N. (1997, p.p.137-49) examines how a policy of :oviding free domestic water can be unsustainable. Using a conditional logic ıodel, the researcher looks at the demand side and identify the determinants of ıoice, under assumptions normally associated with developing societies. The ıodel shows that the perceptions on the benefits of safe water are significant. ousehold variables like female literacy are important variables determining the ıoice of safe water and the capability to pay and willingness to pay. Hence the :searchers argue that government in poor countries needs to have a fresh look at ıeir policy relating to water supply.

A study by Dun et. al. (1996, p.22) examines whether consumer demand is sufficient to support a full service water supply system without the need for Government interventions to subsidize low income groups in Dehradun city in India. Data were obtained from a survey of 1100 households in Dehradun. The research study was conducted during the regular season, while the costs were highest in dry season. The study assumes that despite the local pattern of cost, the demand functions are the same during the wet and dry season. The major findings of the study are : a) the demand functions are the same during the wet and dry season. b) the willingness to pay of water consumers exceeds the revenue collected by the water works departments. c) a full service water supply is a commercially viable option. and d) the poor community, currently pay higher real costs for water than people with own water connection. The researchers concludes the study with the recommendations that a study be conducted in the dry season in a larger town, among institution and on environmental health condition to derive further information on functioning of water supply system.

The Report on Urban Water Resource Management (1993, p.160) identifies problems and strategies of Water Development and Management in urban areas, discusses urban sanitation and waste water management. The report recommends the need for formulating and implementing a national policy for sustainable and environmentally sound development of water resource in urban areas. The discussions highlight the importance of capacity building, especially at the local level, and the need for community participation in the provision of urban basic service.. The report conclude with the remark that conventional approach to sewage for urban sanitation results in low coverage, poor functioning of infrastructure and gross environmental pollution.

Water resource planning, design and management are the thrust areas of development planning in recent years. But the philosophy of supply side management, fostered and nourished by state policies and institutions may not be appropriate in solving today's problem of water scarcity. Even though conventional approach of supply side management is appropriate, when water is abundant; it is not suited for an era of growing scarcity, degrading environment and capital constraints. 'Demand Management of Water' a research article by Ratna Reddy (1996, p.p.72-90) systematically explores the need and necessity of managing the demand for water for residential and irrigation purpose. The research paper focus on residential and irrigation water demand, even though industrial water demand is also important for over all water budgeting. After making an indepth analysis of the different aspects of demand management of water, the researcher concludes the article with the observation that demand for water can be judiciously managed through adoption of various available technologies fostered with appropriate policies and institutions. In this case author argues that pricing of water is one of the important policy instrument that can trigger conservation mechanism apart from allocating water resources efficiently.

He further argues that appropriate pricing not only helps in conservation of water but also enhances the resources position of the supply agencies, thus making the future supply expansion possible and equitable.

The Water Supply System is a part of economic activity subsumed under the caption of social infrastructure, which is not directly productive but is the necessary basis for the successful growth of productive activities. The Economic aspect of public water supply has remained a little researched area in Kerala state.

Jacob John (1997, p.p. 1-17) made an attempt to analyse the economic aspect of public water supply in the state of Kerala. The study is based on a field survey conducted in the Parassala Water Supply Scheme, which comes under Neyyattinkara Taluk of Trivandrum district. Of the 570 house connections, 50 were selected on a random basis for the survey. The prime objective of this study is to identify the economic variables determining water demand of households and the need for planning the water supply system. Discussing the water pricing pattern in operation, John has also suggested some suitable criteria for water pricing. Concluding the research finding, Jacob John argues that economic aspects of water supply system in Kerala, have not formed, the subject of systematic analysis. He opines that water supply system should be planned and installed on the basis of estimated present and future demand with reference to their determinant. However the water supply schemes in Kerala have not taken into account these aspect either at their initial investment stage or at the later stage of augmentation. In consequence, supply falls short of demand both in the short run and in the long run. Hence the researcher opined that there is urgent need for planning the water supply system on the basis of optimal capacity, optimal timing and sequencing of expansion.

However the study doesn't focus on the distributional variations in the supply system and availability problem among different categories of consumers in the society. The socio-economic variables influencing water demand is not analysed in a systematic manner in the study. Moreover the efficiency of the supply system is not focused in the study. Exception to Jacob John's study, no serious work has so far come forth in this field focusing on water availability problem, use patterns and issues in water supply, demand management. Moreover, even though a series of studies were conducted, regarding community participated rural water supply schemes in Kerala, no research work has come up so far to analyse the role of Mini Water supply system implemented with community participation in urban areas. Hence the present study is a modest attempt to fill this gap.

There is significant variation in the availability of piped water across different consumption fracticles. There is acute disparity in the availability among ferent size class of population and locations within an urban center. From the livery system, the most badly hit are the low-income settlement constituting the ›an poor. Studies pertaining to water supply availability problem, distributional riation with special emphasis to lower income settlements are reviewed in the lowing paragraphs.

Kundu Amitab (1991, p.p.2197-2169) makes an attempt to examine : nature and magnitude of disparity in the access to water supply and sanitation :ilities of people with different levels of consumption expenditure in urban areas ing the data from the 38th and 42nd Round of the National Sample Survey (NSS) e attempts to consider the disparity in the per capita consumption of water by ople in different consumption fractiles estimated through micro level survey nducted from time to time. Systematically and analytically the author argues at a large majority among the poor do not get the minimum quantity of water for eir daily use. He concludes the article with a critical view that the water ailability problem among different size class of population can be attributed to e existing organizational structure and pricing policy, which have not been signed specifically to provide the minimum quantity of water to all section of pulation, despite the claims made on this account. This result in misuse of ater.

Archana Ghosh (1993, p.p. 146-172) makes a critical assessment of the status of water supply and sanitation facilities in urban India by using secondary data and micro level survey results. Assessment of the existing water supply and sanitation facilities in Indian Cities, the inadequacies of these services among different size class of population are done considering the impact of The International Water Supply and Sanitation Decade Programme implementation in India.. The article provides an overview of the situation in urban India as a whole and in different size class of cities as far as these two services are concerned in terms of coverage and quality. Emphasis was given on metropolitan cities, class I and class II towns. After making a systematic and data based analysis the author concludes that the available services are not evenly distributed. Cities of higher order are better served than those of lower orders. Within a city there is a vast differences in the distribution of the service among localities and income groups. Thus Archana Ghosh systematically unveils the distributional imbalances in the provision of drinking water and sanitation facilities among the urbanites.

Justifying Archana, Rama Rao (1994, p.p. 82-102) argues that in the light of the United Nations Drinking Water and Sanitation Decade and the Government of India's commitment to the programme, the performance in increasing the coverage by portable water supply has been poor.

'Cost Recovery Potential for Improved Water Supply Services in Dehradun' by H.U.Bijlani and Kyeong Ac. Choe (1997, p.p. 36-51) presents a case study of water supply services in Dehradun city. The main objective of the research study was to provide a pre-feasibility analysis of the cost recovery potential for improved water supply service in Dehradun city, in India, based on empirical evidence. By making a demand and cost analysis for full water supply, the researchers conclude that by plugging the physical leakages and controlling the administrative and management side of the metering and billing, not only would the availability of water go up but it would generate a good margin of extra revenue after meeting all expenses. However, the article doesn't explain distributional variation in water supply in the city of Dehradun.

In almost all cities and towns in India many households do not have access to water on tap. Of those that do, most have to share it with others. Of those who do not have to share it, may have to transport it from outside their dwelling. For those who have water on tap for their consumption within their dwelling, the supply is erratic and quality poor. The research paper, 'Ensuring Access to Water in Urban Households' by Peeyush Bajpay, Laveesh Bhandari (2001, p.p. 3774-3778) attempts to relate the need for investment in water supply infrastructure with requirements and economic capabilities of the households. The article highlights the policy issues, and impediments in ensuring accessibility to all. After an indepth analysis of the different aspects of access to water in urban households, the authors opine that poor access is accompanied with low levels of expectations of the citizens. Another important issue which the researchers address is the need for an evaluation of water supply requirements prior to any improvement programme to be introduced in urban water supply system..

The research paper is a step in a direction where continuous supply and universal access to water is present for all. However, much more need to be done before an All India comprehensive strategy is put in place. The paper addresses only one end of the water supply process. The equally important, infrastructure improvements in obtaining and transporting water also require serious study to evolve a rational and economical urban water supply system.

Researchers and Urban Economists usually put forth the argument that the urban water supply system, by its very design, is biased towards the urban poor. Out of the delivery system, the most badly hit are the low-income settlements, constituting the urban poor.

The research article, 'Economic Inequality and the Urban Environment: The Case Of Water And Sanitation' by Johnstone. N. (1997, p.22) looks at the relationship between economic inequality and urban environmental quality in developing countries, focusing on the provision of water and sanitation services. It explores the consequence of dual systems, whereby a proportion of a city's residents are served by subsidized water and sanitation facilities, while another section of the city has been forced to develop a variety of onsite strategies through their own efforts. The major findings of the study are (a) the poorer households are generally more adversely affected by low levels of provisions of water and sanitation facilities, (b) the cost structure of service provision implies that equal access to a standardized system is more efficient than the different levels of access and treatment which prevails in urban area. The study concludes that access to water and sanitation and the means by which such systems are financed can be one of the most significant and effective means of distributing resources in the urban context.

In a similar study, Sandelin S. (1994, p.165) describes water and sanitation services in low-income areas in East and West Africa. The case studies highlight the problems of poor institutional frameworks, poorly operated infrastructure, weakness in management, and socio cultural differences, which hamper the provision of water and sanitation services in low-income areas. Although the report shows that programmes have been successful in raising the living conditions of the poor, it is argued that for long-term sustainability in water supply and sanitation, policies and strategies and technologies have to be developed on a local basis.

Black, M (1994, p.30) states that at the present trend of urbanisation in developing countries, the cities will place an immense pressure on fresh water supplies. The report states that prevailing trend could lead to a drinking water and sanitary crisis with global implications and the low income settlements will be badly hit by the delivery system. The researcher argues that to avert this crisis there is not only a need for additional funds but, more fundamentally, a change of attitude and policy.

Mc Granahan, G; Kjellen, M. (1996, Urban Environment Series Report; No.1) makes a comparable cross sectional studies of households environmental problems in those cities with differing proportions of poor households: Accra (majority are poor), Jakarta (moderate) and Sao Paulo (minority). The paper examines issues such as access to water, water source and bacteriological water quality and price inequalities. In Accra, the absence of public infrastructure leads to higher levels of sharing of water points and latrines, where as in Jakarta, this absence is partly compensated by more private solution. In Sao Paulo, the responsibility for providing water supply and sewerage is being shouldered by government. After making a cross sectional study, the researchers argues that limited public resources available for water and sanitation systems tend to be invested in standard systems typically accessible only for the rich while the poorest segments often struggle with the indirect access to the public system. The researchers argue that policies should concentrate on extending the water supply system through differentiated and flexible services in low income areas and emphasising the importance of good management and participation at the lowest level.

Provision of basic amenities, the problem of accessibility and affordability of basic services to the poor in the context of changing policy perspective constitute the central theme of the article by Kundu (1993, p.p.138-144). The problem of accessibility and affordability of water supply and sanitation facilities with respect to poor is critically analysed in this paper. The author concludes the article by stating that the concerned public agencies do not show, the required sensitivity for the needs and paying capacity of the poor. He systematically argues that most of the Government schemes by their very stipulations, norms, instalment rates etc keep the poor out of their purview.

Kundu (1993, p.p.16-21) in his work ' In the Name of Urban Poor-Access to Basic Amenities' analyses the access of the urban poor to five basic amenities – housing, water supply, sanitation, health care and the public distribution system. In this work professor Kundu provides an overview of the existing organizational structure responsible for the provision of these amenities and examines its sensitivity to the needs and affordability of the poor. He concludes that the system has not been designed to meet the minimum needs of the poor and is vulnerable to manipulation by vested interests. Examining in detail the specific programmes and schemes launched by the Government, professor Kundu notes that the stipulations built into them to enable access by the poor are inadequate and superficial.

Gilesh H. and Brown. B (1997, April, p.p.97-109) citing the case study of Delhi, illustrate the day to day problems and solutions of delivery of water to crowded urban poor populations. The authors argue that the most common problem of the urban poor is lack of clean, safe water supply and sanitation. They also argue that urban population growth, especially in mega cities, in developing countries is straining the ability of the government to supply basic services. The pattern of water use practices, the availability of water across different size class of population, especially the urban poor of Delhi, is critically analysed in the article to show the availability problem of piped water for the poor.

2.2 Studies On Issues Of Privatization Of Urban Water Supply

During 1980s there was a shift in government policy on the participation of private sector in providing urban services. In both the developed and developing countries the changed policy favoured the private sector.

Inefficient public sector monopolies are widely blamed for the failure to provide access to safe water and adequate sanitation to the entire population, particularly the poor. The magnitude of the needs of urban sector, has led to an increasing acceptance that wider participation of the private sector is needed in the provision of water and sanitation services. Emmanual Idlovitch and Khas Ringskog (1996) in their article, 'Private Sector Participation in Water Supply and Sanitation in Latin America', examine the different options of private sector participation in the provision of water supply and sanitation. Taking the examples of countries in Latin America, where private sector participation in the provision of water supply is gradually coming up after 1990s, the authors put forth a number of options of private sector participation, which the developing countries can adopt. The researchers conclude the article with the expectation that as the successful experience with private participation in operation and investment area of urban water supply system grows, more government will develop the institutional capabilities to enable a more permanent private sector presence in the water sector.

World Bank (1999, p.78) in a study examines the problems of providing water to the poor in the context of privatized urban water supply system. Hurdles are considered and comments made on contract features and regulatory practice that can make a concession design more "pro-poor". Report also discusses how partnership between regulators, local government, civic societies and utility companies, can make progress in the field. The case studies presented draw on the experiences of the Business Partners for Development – Water cluster", a year old initiative launched by private water companies, NGOs and the 'orld Bank to test innovative methods for providing water supply and sanitation ɪrvice to the urban poor. The case studies cover Argentina, Bolivia, Ecuador and ɔuth Africa.

In view of the prevailing situation of inadequate and deteriorating ɾailability of core urban services (Water supply, sanitation, solid waste disposal, orm water drains, roads and street light) and increasing financial requirements ɪr providing the same in the near future, most urban bodies in the country, ɜcause of their poor base, is finding it difficult to raise the required financial ɪsources.

Mukesh P Mathur (1987, p.p.15-25) after making a detailed analysis f the state of core urban services, across states and financial requirements needed ɪr upgrading these core services, argues that privatisation of municipal services is potential option to improve and strengthen the provision of these services and to :tract private capital and management skills in the provision and maintenance of rban services.

A somewhat similar view is shared by Abhijit Datta (1993, p.p.235-40). He states that although potable water supply, and sanitation are considered ; 'basic needs in the urban area, over the years actual investment on these ɜrvices have been minimal and woefully inadequate. The existing municipal resource environment is not conducive for further investment in this sector. Hence the author opines that for the removal of the existing deficiencies in the provision of urban basic services especially water supply and sanitation, private effort should be mobilized to complement local public responsibilities.

Where as Brook Cowen, P and Tynan .N (1999) in a study pinpoint to the dangers of private vendor system in water supply to low income settlements. The researchers argue that this approach can inadvertently erect barriers to improving service for low-income households. Policy makers therefore need to rethink their approach to private participation transactions and their regulations.

A similar view is shared by A University of Birmingham Research Study (1998, ID 21, 26 October) which examined how water supply is organized in some low income countries. The study report identifies a range of supply strategies, each involving different degrees of private investment. The Report concludes that private intervention is not bound to guarantee instant solutions to water supply problems in poor urban environment.

Webster, M. and Sansoon. K. (1999, p. 23) review the literature on the impact of Public – Private Partnership (PPP) in the water and sanitation sector on service delivery to the poor. The study identifies the potential risks to PPP as: finance and affordability, inadequate supply and allocations of water; lack of collaboration with community group etc. A similar view is expressed by Gil Shildo and Hana Ofek (1990) by drawing the Israeli experience of public-private partnership in the provision of urban water supply.

With the introduction of New Economic Policy, new priorities are emerging in agriculture, industry and urbanisation which will bring changes and pressure on both the water availability and use. Water has always been a common property resource which if now privatized or even considered as an economic good, will give rise to new kinds of tensions.

Sheela Prasad and C.Ramachandraiah (1999, p.p 1251-1256) in their research article examine some issues related to water use at the national level, and more specifically, the implications of the New Economic Policy on the use and availability of water for agriculture and drinking purposes. The article makes a comprehensive analysis of the implications of New Economic Policy on water use especially issues related to privatization of the scarce and valuable natural resources. Considering equity concerns and regard for environmental safeguards (both lacking in private initiative), the researcher passionately argues against privatization and for strict government control of a common resource like water. They argue that the government must initiate policies and a series of measures to replenish and augment the existing source of water supply economically. The research paper is structured around the theme that economic growth under the impact of New Economic Policy is taking place through over exploitation of natural resources and water is one such resource. At the global level threats of war over water cannot be dismissed. In such a situation the researcher argues that the role of the state becomes crucial in being more vigilant and ensuring that both equity and sustainability of water use are maintained. Therefore, what is needed is a greater responsibility by the state instead of encouraging privatization in the water industry to reduce over exploitation and destruction of this scare resource.

2.3 Studies On Participatory Approach (Community Participation) In Solving Water Availability Problem

Water scarcity, problem, escalating costs of developing new supply sources, rapid deterioration of existing water resource base and growing demand for water from non-agricultural uses create an urgent need for modifying water resource policies. The traditional policy prescription for centralised control in allocating water is being increasingly challenged and new approach in water allocation are emerging. Ruth Meinzen and Meyra Mendoza (1996, p.p.25-29) examine the merits of three types of alternative water allocation mechanisms, namely, administrative allocation, user managed allocation, and market allocation and the conditions favourable for the utilization of one alternative over another. The researchers draw lessons from experiences within India as well as other countries where all three mechanisms exist in various locations and across sectors.

After making an indepth analysis of the cost benefit of alternative allocation mechanisms, the researchers conclude that growing water scarcity problems and competition between uses of water pose a serious policy challenge to policy makers in India, as in other parts of the World. The low recovery of the operation and maintenance expenses, mounting costs of developing new source of water and problems with quality of service in centrally managed system has led to a search for alternatives to increase the efficiency of water management. The Researchers opine that the best system is, organized user participation in delivery and maintenance of the system.

Schuebeler, P. (1995, p.95) in a study advocates participatory approach in solving the issues relating to accessibility and availability of water supply. He defines participation as a form of partnership between government and service user community, which may be promoted in the context of programmes for improving service management capacity. The researcher states that participation in infrastructure service management includes goal and policy formulation, planning, programming and monitoring, as well as implementation, operation and maintenance. The study highlights the issue of empowerment of women and the role of partners in participatory infrastructure management which include (a) Community Based Organisations (CBOs), their leaders and, in particular, women as service consumers, infrastructure producers, and managers of community affairs; (b) Non – Government Organisations (NGOs) ; (c) local government authorities who are primarily responsible for the provision of infrastructure and other urban services.

The paper describes the basis and objectives, characteristics and main elements of the four strategic approaches for participation which are (1) community based support strategies; (2) area based involvement strategies; (3) functionally based collaboration strategies; and (4) process based decentralization strategies. The report also highlights the strength and weakness of each approach. It contains case studies, which demonstrate various participatory infrastructure development experiences in 16 developing countries in Africa, Asia and Latin America.

The book on the Development and Management of Community Water Supplies by Davis. J, Garvey, (1993, p.178) provides field experience, primarily from Ghana and Ethopia during 1986-92 and lessons learned from Community Water Supply Programs (CWSPs). Guidelines are provided for planning and managing field work, training community members and preparing programme proposals. The book addresses issues of environmental health partnerships, programme planning, proposal preparation, project implementation, management of community water supplies and planning. The book highlights the need for developing community based supply schemes for better availability and sustainability of urban water supply system

Geoffrey K. Payne (1993, p.p.17-32) analyses the experience of three countries, Pakistan, Turkey and Egypt, each of which illustrates different forms of innovation in the provision of urban services especially clean and affordable water. In reviewing and analyzing these cases, the author pays special attention to issues of community participation, resource mobilization and effective management systems. He concludes the article by highlighting the key considerations in community participation in the provision of urban water supply. The author states that the more, local communities are involved directly in the future development of their neighborhoods, the more they are likely to play their full part in strengthening democratic institutions and contributing effectively to local economy. He concludes the article with the remark that the provision of basic services through community initiatives can play a vital part in the decentralized development process.

Daniel Faudry (1993, p.p95-103) puts forth a general examination of drinking water and the sanitation sectors of Latin America, by studying the economic and the institutional problems of the management services with special emphasis on the experiments of popular participation. The author states that in the most urbanized continent of the Third World, the main problem of drinking water and sanitation is in serving the marginal urban population. He concludes the article with the remark that considering the gravity of the situation, popular participation which in turn pre suppose important political changes can do a lot in attaining distributional justice in water supply.

'Most efforts at urban planning in the post independence period in India have been coloured by notions of ideal standards triggered by the visions of a newly emergent nation. Over the years these utopian exercises have been adopted, albeit very gradually, to the ground realities of fiscal and institutional constraints. However, incorporation of these constraints into the planning and management processes has not been very systematic. One of the most important sectors in this regard is urban infrastructure service, notably water supply and sewerage, while lacuna in urban services are wide spread, equally important are the distributional issues. These suggest serious lapses in our planning and management of urban areas' ; argues Meera Mehta and Dinesh Mehta (1993, p.p.260-280) .

In the article 'Planning for Metropolitan Water Supply and Sewerage: A Case Study of Ahamedbad' the authors attempt to highlight four main issues in planning and financing of urban infrastructure vide: coverage standards, pricing policy, service thresholds and decentralization and community control. Concluding the article, the authors stress the need to recognize the necessity for incorporating the community groups into the activities of supply, operation and maintenance of urban water supply. The authors state that it is only through community experiments, more human and responsive living environments will be generated.

M.N.Buch (1993, p.p.37-45) makes a critical assessment of the role of municipal bodies in the provision of urban services, particularly water supply. The article makes a critical analysis of the urban water supply system, the distributional imbalance, between different size class of population and localities of an urban center by making micro level data for different states/ urban centers. The urban water demand and supply gap is critically analysed in the article. He concludes that many of the urban services are amenable to decentralised management at community level and a system of community participation must be developed in each locality in the provision and maintenance of basic service, especially, water supply.

A similar view is expressed by K.C. Sivaramakrishnan (1993, p.p.6-16) in the article ' Water and Sanitation Facilities in Urban India: Issues Concerning Management and Finance'. The economic impact of poor water supply, accessibility of the system to the poor sections of population, projection of future water demand are analysed critically in the article. He argues that the distributional arrangement, leakage and unaccounted for water and existing tariff systems have hardly any relevance for water conservations, waste reduction and urban water management. The article concludes with the remark that for proper ınagement and better financial performance of the water supply system, centralization is the best alternative, which alone can sustain large societies.

Biplab Das Gupta (1993, p.p.18-30), while analyzing the problems sociated with the delivery of urban basic service examines the need for local vel participation in delivery and maintenance of core basic service. He argues at for a reasonable delivery of urban basic service, the quantum and quality of rvices in a particular urban area would be guided by the strength of the local onomy.

'Strategies For Sustainable Water Supply For All: Indian xperience' an article by V.Suresh (2001, p.p. 1-9) examines the present scenario urban water supply system in India. The various factors inhibiting the velopment of sustainable water supply system in India, with particular emphasis ı unrelated links between cost, price and consumption, absence of regular aintenance, poor delivery system etc is systematically analysed in the article. he need for a realistic pricing and feasibility of rainwater harvesting in urban eas is also highlighted in the article. The various avenues of community articipation with successful examples in unbundling the urban water supply stem, for an equitable, user friendly and rational distributions of scarce drinking ater is the major issue, taken at length in the article. The article clearly provides theoretical background for community initiative in the provision of water supply at different layers, for planners and creators of the system, to evolve a strategy for sustainable water supply for all.

Rapid urbanisation results in the manifestation of teeming slums in the center of cities and mushrooming shanty habitats at their periphery. The urban poor are usually alienated from the main urban social fabric. Moreover out of the public delivery system of basic service, especially potable water, the urban poor are worst hit. L.N.P.Mohanty (1993, p.p.345-359), while analyzing the accessibility of basic service especially potable water to urban poor, argues that the major thrust for integrating the poor in the urban fabric is the community management approach – a principle to execute schemes and projects through the community.

A number of projects under participatory approach is executed in the urban areas of Kerala. These projects are catering to the water requirements of small clusters of households. No systematic study has so far come up analyzing their role in solving the availability problem among different income strata in the society. The present study specifically takes into account the socio-economic impact of user friendly Mini Water Supply Scheme commissioned with community participation in the city of Calicut.

CHAPTER III

PROFILE OF THE STUDY AREA AND SAMPLE

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The empirical part of the present study was conducted in Calicut Corporation area. A brief description of the study area is given in this section.

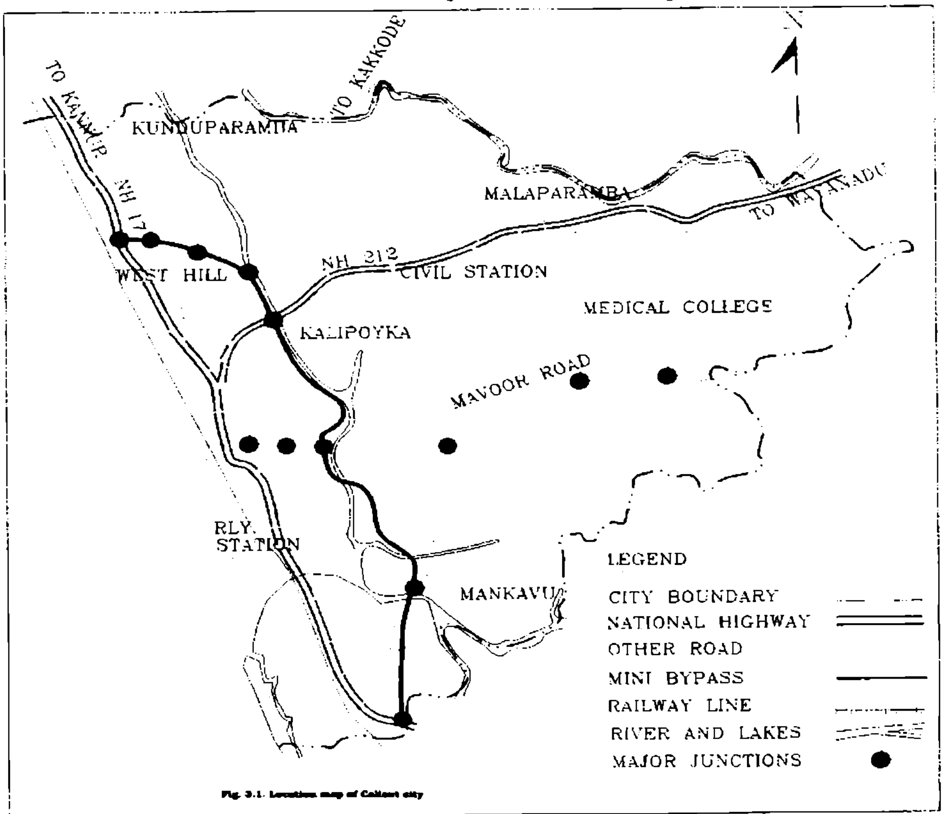
3.1 Calicut City: An Overview

Calicut city has a majestic history of being the head quarters of the Zamorin's, the rulers of the earstwhile Malabar. The dreamy coastal area of Kappad which lies at the outskirts of the city gave the red carpet welcome to the westerners to this country in 1498 by offering rich hospitality to Vasco-Da- Gama, the Portugese navigator. As everybody knows, the incident determined the developmental trajectory of Malabar, nay, the nation.

3.1.1 Geography and History

Calicut City is situated between $11^{0} 10^{1}$ - $11^{0} 15^{1}$ North latitude and $75^{0} 45^{1}$ - $75^{0} 52^{1}$ East Longitude in the Northern part of Karala State. The location Map of Calicut City is given in Figure No.3.1.

Figure No.3.1.
Location Map of Calicut City



From time immemorial Calicut has served as a trading centre. Its important past goes back to 1000 BC to the time of king Soleman of Isreal. Between the 7^{th} and 15^{th} centuries the Chinese monopolized trade in the Malabar region after which the Arabs and Moors held away. The development of Calicut is inextricably woven with the social, economic and political events of the Malabar region.

Calicut starts figuring in the political history of Malabar with the advent of the Zamorin's. Therefore the ups and downs in the fortunes of Calicut were closely interwoven with those of the rule of the Zamorins, which started in the 14^{th} century AD.

Calicut, the Palace city of the Zamorins was given much priority in development. The palace located near Mananchira, was at the city heart, and the same was made the centre of fastly growing suburbs, suburbs into actual urbans and gradually Calicut city positively encroached into neighbouring villages. It was not only urban development and town planning, but also all human facilities like education, Fine Arts and cultural activities were perpetuated by the Zamorin's. As stated and as tradition goes, the Zamorins of Calicut even stood for realization and recognition of education and scholasticism.

The political history of Calicut is a story of treacherous and ill-conceived conspiracies hatched by the western power. From the arrival of Vasco da Gama in 1498 to the early 19^{th} century Calicut experienced a series upheavals. The Portuguese built a fort and had several clashes with Arabia till their power finally declined in 1565 due to hostile relations with the Zamorins. There after the Dutch established trading godowns in Malabar. They were followed by the English and the French. In the 18^{th} century, the Mysore ruler, Hyder Ali and his son Tippu Sulthan attacked the Malabar region successively and annexed several of its kingdom. In 1792 Malabar was conceded to the British by Tippu Sulthan under the Treaty of Sringapatnam.

In 1866 Calicut was made a Municipal town. From 1947 to 1966 Calicut functioned as the headquarters of Malabar District of Madras State. After the reconstitution of States in 1956, it was declared as the headquarters of Kozhikode District in Kerala State. The city continued to prosper and grow. The growth of the town however was in an unplanned manner. On 1-11-1962 Calicut was raised to a Municipal Corporation, consisting of 39 revenue wards.

Calicut enjoyed certain advantages due to its geographical position. In the earlier days, it became a centre of Maritime trade. As an international centre, Calicut became very popular both in the east and in the west. In the earlier days the Zamorins liberal and tolerant policies had played a potent factor in the growth and prosperity of Calicut as a great port. Every one enjoyed the right to trade, without the distinction of caste, colour, creed or nationality. Freedom of worship was allowed to all. Even today the past glory of culture, plurality and tolerance is retained by the society.

3.1.2 Urban Form And Structure

The linear urban form of Calicut has been distorted by natural as well as man-made features. The city is contained mainly between the Arabian sea in the west and the hills in the east. The National High Way from Madras to Mangalore runs longitudinally through the city and can be termed as its spine. The broad Guage Railway line is to the west of and almost parallel to the National High Way. The railway line is a major impediment to urban development as it forms a physical barrier between the west and the east of the city.

The Kallai river flows through the southern half of the city. The canolly canal, an artificial navigation channel connects Kallai river with Elathur puzha, 9.5 km to the North. Another artificial canal from Nallalam links Kallai river with Beypore river 9.5km to the south. India's largest timber centre is located along the Kallai river and the Canoly Canal.

The major centres of economic activity are the wholesale and retail commercial areas at Big Bazar, S.M.Street, Mavoor Road and Palayam, timber yards in Kallai and Industrial areas in Beypore, Feroke and West Hill. In the last few years hilly areas along Wynad Road in the north east have also developed.

The major employment opportunity in the city is trade, commerce and construction activity field. Tile industry and various small-scale industrial units located in the suburban areas of the city provides employments to a large number of people. Another major employment provider is the agricultural sector. Fishing is another area of employment. The city has very high potential in marine esources. The local economic activity is supported by the tertiary sector of ervices like any other urban center.

.1.3 Demographic Features

As per the 2001 census, the population of the Corporation is .36.527. The sex ration of the city is 1061 females/1000 males. As per 1991 ensus the effective literacy rate is 96.43 per cent for males and 90.00 per cent for emales.

The area of the city is 84.23sq.km. The corporation area consists of 9 revenue wards. As per 1991 census, the total number of households is 67468 nd number of occupied residential houses is 64842. The density of population is 078 persons per sq.km.

3.1.4 Social Overheads

Roads

Corporation is divided into six sectors for the public works purpose. The city has a total road length of 792kms, out of which a length of 70kms are owned and maintained by the State Public Works Departments. The city corporation maintains the balance.

Railways

Approximately the length of the railway line in the corporation area is 15 km. The Shornur - Mangalore rail line go through the city and it is under a developmental programme of track doubling.

Water Ways

At present the city is not having any fully operational water way. Earlier, there was a waterway existing between Elathur and Kallai.

Communication Facilities

The total number of post offices operating in the corporation area is 63, which includes two head post offices, thirty-five sub post offices and twenty-five branch post offices as on 31- 05-1995. The telecommunication facilities are quite adequate. City network under telephones have 5 inner exchanges and 8 outers to cover the city area. BSNL, the service provider extends Integrated Service Digital Network (ISDN) and is an Internet Service Provider (ISP). Other facilities include call offices and prepaid telephone cards.

Social And Cultural Institutions

In the Corporation area there are around 17 cinema theatres. Two public libraries, one reading room, fifty community reading clubs and 268 Anganvadies.

News Papers In Circulation

There are altogether 18 newspapers having circulation in Calicut as per the information made available by press council. They are Mathrubhumi, Malayala Manorama, Madhyamam, Mangalam, Kerala Kaumudi, Chandrika, Deshabhimani, Veekshnam, Pradeepam, Calicut Times, Genma Bhoomi, Punya-Bhoomi, Deepika, Indian Express, Hindu, Times of India, Express and Janayukham.

Electricity

Power supply is undertaken by Kerala State Electricity Board. Since sub stations are not supplying power exclusively for the corporation area, the information on the total power requirement and total watts supplied by the Board for the corporation is not available. The available information is only about the total connected load and the total number of customers. The total connected load is 104.977 MW and total number of connection are 78528.

Water Supply

Kerala Water Authority is in charge of the supply of water in the corporation area. At present a quantity of 54 MLD from Koolimadu, 6.75 MLD from Moozikkal and 4.5 MLD from Poolakadavu are available. The total quantity of water made available is 65.25MLD. But the total requirement is estimated at 114.3 MLD.

Medical Facility

Several major private hospitals are in the city. However, for lower income group Government Medical Hospital is the relief. Allopathic, Ayurvedic and Homeo systems of medical facilities are available. Calicut corporation collaborates projects like Kudumbasree and World Bank Aided RMC centres taking care of children, mothers and family welfare including health.

Hygiene Management System

Hygiene Management system is under the control of the Health Officer. There are 16 Health circle offices and each circle office is under the charge of Health Inspector. These circle offices are undertaking the collection of rubbish and there are 9 sub depots for collecting solid waste materials. The total labour strength of these circle offices is 212 sweepers, 87 drain cleaners and 128 sanitation workers. For removing the waste materials, there are 120 cartmen and 67 mazdoors. It is transported to the trenching yard and converted to fertilizer. It is sold out through auction. There are 25 mazdoors in charge of trenching ground. Rubbish will be collected at sub depots. Many households manage by burning waste in their own premises. Others dump it in convenience location. The accumulation of solid waste in the terrain is of great concern. The collection and transportation of solid waste is not up to the mark. About fifty per cent of solid waste collected is non-bio-degradable materials including plastic. The corporation owned 16 numbers of markets and slaughterhouse.

Public Distribution System

Ration shops are functioning under the control of Civil Supplies Corporation. The corporation is divided into North and South regions for the administrative purpose. There are 80 ration shops in the northern region and 76 ration shops in the southern region. There are 12 Maveli stores in the corporation area, six each in South and North regions. Apart from this, there is one mobile unit. In the corporation area there are 6 gas agencies, serving for a total number of 32129 consumers.

Banks

There are 95 bank counters in the corporation area including Co-operative banks. Canara Bank is the lead bank of the district.

Educational Facility

City is an education centre. Educational facilities are quite adequate in the city with 141 schools, 15 colleges and other technical institutions. Calicut University campus is twenty kms south of the city. City is dotted with primary and secondary level institutions both in private and Government sectors. Higher education in engineering is available with two colleges. Legal and Health Science can also be pursued.

An institutional area for research and education is being developed in eastern periphery of the city with national level prestigious institutions like Indian Institute of Management, National Institute of Technology and Indian Institute of Spices.

School education is also an improved sector in the city, however, infrastructure facilities in individual cases needs attention, such as, attempt on computer literacy and education, setting up of labs etc. Equally there is a necessity to modernize higher education in arts and science colleges including their syllabi and subjects.

3.1.5 Urban Economy

The existence of infrastructure facilities such as sea port, trunk roads and broad guage railway line have resulted in the development of Calicut as the most important collection and distribution centre in the Malabar Region. The produces of the Wynad district, which is famous for Cash crops and timber is brought first to Calicut and then transported to other parts of the country. Similarly a large quantum of consumer goods brought by rail from other states is unloaded at Calicut from where it is redistributed to the wynad region by road. Thus Calicut still continues to be the unchallenged trade centre in the Malabar region, though several smaller urban centres in the region are growing rapidly.

3.1.6 Tourism

Mananchira square is the heartland of the city. Dream city project area is an attraction for domestic tourists. The area is a mangrove land and is of interest to ornithologists as well. Calicut beach is one of the longest in Malabar area of Kerala state. Krishna Menon Museum is located in East hill. Calicut and nearby Vatakara are centres of Kalarippayattu, the martial art. Kappad beach were Vasco da Gama landed and Velliyankallu, the majestic rock in the sea are located near the city. The port of Beypore is six kilometers south of the city and it is renowned for Urus. Calicut has number of historically important temples and mosques. The Miskal Mosque, constructed by Naguda Miskal an Arab merchant in 16th century is one of the biggest wooden structure in South India. The other historically important mosques are Kuttichira Valiya Juma Palli, and Muchunthi Palli. The zone of Kuttichira still retains certain Arab traits.

The ancient temples like Tali Mahadeva Kshethram, Thiru Vilayanadu Devi Kshethram are part of the Zamorin's history. Varakkal and Puthur temples are also ancient. Scholarly union of Revathi Patta Thanam on vedic text is still being convened in Tali temple.

The city has a Jain temple and Parsi temple. Calicut city has number of Christian churches as well.

3.2 Profile of The Sample Households

A detailed analysis of the socio-economic characteristics of the sample households, is presented in this section.

3.2.1 Zone- Wise Distribution Of The Sample

Table No.3.1 shows that 34.06 per cent of the sample selected belong to Zone I. The highest number of sample is drawn from Zone II. (41.30 per cent). This is because the largest number of beneficiaries of the piped water distribution system belong to Zone II. The sample drawn from Zone III and Zone IV is 10.87 per cent and 13.77 per cent respectively.

Table No.3.1

Zone-Wise Distribution of The Sample

Zone	Frequency	Percentage
I	141	34.06
II	171	41.30
III	45	10.87
IV	57	13.77
Total	414	100

Source : Field Survey Data

3.2.2 Age Wise Profile Of The Sample

Table No.3.2 shows that 2.66 per cent of the samples selected belong to those below 30 year of age group which is the smallest segment among the three age group considered. Under the 30-60 year category, 85.02 per cent of the sample falls. This is the largest of the three groups. Finally 12.32 per cent of the samples belong to the 60-year above category.

Table No.3.2

Age wise Profile of The Sample

Age composition in years	Frequency	Percentage
Below 30	11	2.66
30-60	352	85.02
Above 60	51	12.32
Total	414	100.00

Source : Field Survey Data

3.2.3 Sex-Wise Composition Of The Sample

Table No.3.3 indicates that the samples consists of 92.51 per cent males and the rest (7.49 per cent) females

Table No.3.3.

Sex-Wise Composition of The Sample

Sex composition	Frequency	Percentage
Male	383	92.51
Female	31	7.49
Total	414	100.00

Source : Field Survey Data

3.2.4 Religious Composition Of The Respondent

The major religious group of the city are Hindus, Muslims and Christians. Of them the Hindus dominate the other groups. In the sample (323 out of 414) are Hindus. The division of the Hindus into forward and backward brings 24.88 per cent of the sample under the first category and 53.14 per cent under the second. Hindu backward includes schedule caste members also. 12.32 per cent of the sample households are of Muslims. Another 9.66 per cent of the households are of Christians.

No coherent pattern of the composition is seen among the samples collected from different zones. Table No.3.4 reveals the Religion / Community composition of the Sample

Table No.3.4.

Religious Composition of The Respondents

Religion / Community	Frequency	Percentage
Hindu forward	103	24.88
Hindu Backward	220	53.14
Muslims	51	12.32
Christians	40	9.66
Total	414	100.00

Source : Field Survey Data

3.2.5 Distribution Of The Sample Based On Educational Status Of The Households

Calicut city is not as blessed as the other cities of Kerala in educational attainments. However, in the field of professional education Calicut is equal, if not higher than the two other cities. It has the unique status of having the National Institute of Technology and Indian Institute of Management at its suburb.

A cursory analysis is made on the service of the educational institutions to the city population by discussing the educational attainment of the sample. This will help to understand how the educational status of the sample influences their perception on the water demand and availability in the city. Educational Status (the highest level in the House) of the Household is considered here by classifying the level of education into a) Primary b) Secondary c) Graduation d) Post graduation and Professionals. This classification is done for venience of analysis. It is seen that 24.15 per cent of the sample have got nary education as the highest level in the family, 19.57 per cent Secondary cation, and 41.3 per cent graduation. Percentage of households having Post luation and Professional degree is 14.49. Table No.3.5 reveals the Distribution he Sample Based on Educational Status (highest level) of the Household

Table No.3.5

)istribution of The Sample Based on Educational Status of the Household (Highest level in the House)

Level of Education	Frequency	Percentage
Up to Primary	100	24.15
Up to Secondary	81	19.57
Graduate	173	41.79
Postgraduate and Professionals	60	14.49
Total	414	100.00

ırce : Field Survey Data

.6 Distribution Of The Sample Based On Occupation

An enquiry into the occupational structure of the sample revealed t the highest portion 40.82 per cent constitute salaried class. 31.64 per cent of sample belongs to others category. This include Coolies, Maizons, Daily ıge earners, Trolly pullers, Casual Workers, Fish venders, Petty brokers, ›rkshop assistants etc. Business people constitute 27.54 per cent of the sample e. The analysis shows that occupational diversities of Calicut Population are ll incorporated into the sample.

Table No.3.6.

Distribution of The Sample Based on Occupation

Occupational Class	Frequency	Percentage
Business	114	27.54
Salaried Class	169	40.82
Others	131	31.64
Total	414	100.00

Source : Field Survey Data

NB. Others include Coolies, Maizons, Daily Wage earners, Trolly pullers, Casual Workers, Fish venders, Petty brokers, Workshop assistants etc.

3.2.7 Distribution Of The Sample Based On Income Catagorisation

Household income is a strong background variable determining water demand and for the analysis of water availability problem faced by different category of consumers. For conveniences of analysis, on the basis of average monthly income, households are divided into three income classes. Higher income class constitutes households having a monthly average income above Rs.10000/-. Where as middle-income class are those having an income range between Rs.2501 - Rs.10000/-. Households having an average monthly income up to Rs.2500/- are categorized as lower income class.

Table No.3.7 provides an analysis of the sample households based on income categorization. 44.69 per cent of the respondents fall in the high-income class, where as 30.19 per cent of the respondents belong to the category of lower income group and 25.12 per cent falls under middle-income category. The analysis of the sample reveals that the three income groups are well incorporated in the sample.

Table No.3.7

Distribution of The Sample Based on Income Categorization

Income based categorization of household.	Frequency	Percentage
Higher Income class	185	44.69
Middle Income class	104	25.12
Lower Income class	125	30.19
Total	414	100.00

Source : Field Survey Data

3.2.8 Distribution Of The Households, Based On Their Source Of Water

The beneficiaries of the piped water distribution system consist of the two types of consumers. a) Households having metered water connections and b) Households depending on Public Stand Posts, through which water is supplied free of cost. Table No.3.8 gives an analysis of the sample households based on these sources of water. 69.81 per cent of the sample households are from the category of households having metered connection and 30.19 per cent belongs to the category of households depending on Public Stand Posts.

Table No.3.8

Distribution of the Households Based on Their Source of Water

Type of Water source	Frequency	Percentage
Households having metered Water connection	289	69.81
Households depending on Public Stand Posts	125	30.19
Total	414	100.00

Source : Field Survey Data

3.2.9 Locality Wise Distribution Of The Respondents

Nature of the locality is an important background variable needed for analyzing the availability problem of water. The city of Calicut consist of Elevated and plain locations having difference in water availability. Table No.3.9. Shows the distribution of the sample based on nature of locality. 50.97 per cent of samples are drawn from plain places. Analysis of the sample shows that more or less equal weightage is given for both the places while constituting the sample frame.

Table No.3.9

Locality Wise Distribution of The Respondents

Nature of Locality	Frequency	Percentage
Elevated	211	50.97
Plain	203	49.03
Total	414	100.00

Source : Field Survey Data

3.2.10 Composition Of The Sample Based On Type Of House

Type of house is an important background variable determining the water use practice of households. It has a direct link with the demand for water. Table No.3.10. Shows the distribution of the sample based on the type of structure (House) the household occupy. 56.76 per cent of the sample is residing in pucca houses, where as 19.81 per cent was found occupying semi pucca houses and 23.43 per cent in Katcha houses. (The details of the classification of houses is given in introductory Chapter in the section Sample Design)

Table No.3.10

Composition of The Sample Based on Type of House

Type of House	Frequency	Percentage
Pucca	235	56.76
Semi pucca	82	19.81
Katcha	97	23.43
Total	414	100.00

Source : Field Survey Data

3.1.11 Distribution Of The Sample Based On Floor Area Of House

Table No.3.11 indicates the distribution of the sample based on the size of the house. Size of the house has an indirect link with the demand for water of the households. Analysis in the table shows that 25.85 per cent of the sample constitutes households having houses with a size up to 250 square feet. Households coming in the range of 250 – 500 square feet house size constitute

17.87 per cent of the sample size. 26.33 per cent of the sample households fall in the category of houses having a size range of 500-1000 square feet. Table No.3.11. reveals that samples are more or less uniformly drawn from the other two house size class (That is 1000-1500 square feet and 1500-3000 square feet class).

Table No. 3.11

Distribution Of The Sample Based On Floor Area Of House

Floor area in square feet	Frequency	Percentage
100 - 250 sq feet	107	25.85
250 – 500 sq. feet	74	17.87
500 – 1000 sq. feet	109	26.33
1000 – 1500 sq. feet	58	14.01
1500 – 3000 sq. feet	66	15.94
Total	414	100.00

Source : Field Survey Data

3.2.12 Distribution Of The Sample Based On Water Storage Facility

Table No.3.12 shows the distribution of the sample based on the type of water storage facility available to households. Large accumulation of water in tank and sump has a direct impact on water use pattern of consumers. Analysis of the sample shows that 0.48 per cent of the sample beneficiaries possess overhead tank to store water. 69.32 per cent have both sump and overhead tank facility to store water. Sample households having sump only constitute zero per cent. This is so because without overhead tank, sump alone cannot do the purpose. 30.19 per cent of the sample households have no water storage facility. They have neither sump nor overhead tank to store water. Their number is 125 and they constitute the bulk consumers depending on P.S.P.

Table No.3.12

Distribution of The Sample Based on Water Storage Facility

Type of water storage facility	Frequency	Percentage
Over Head Tank only	2	0.48
Sump only	0	0.00
Both (Tank and Sump)	287	69.32
No Tank and Sump	125	30.19
Total	414	100.00

Source : Field Survey Data

3.2.13 Distribution Of The Sample Based On The Type Of Flushing System In The Toilet

The type of the flushing system in the toilet is an important background variable determining the water demand of households. In the Table No.3.13, the distribution of the sample based on the type of flushing system in the toilet, shows that 69.81 per cent of the sample was found with flush system in the toilet, where as 30.19 per cent was found without flush system. All the samples drawn from katcha houses were found without flush system

Table No.3.13

Distribution of The Sample Based on The Type of Flushing System in The Toilet

Type of Flushing System	Frequency	Percentage
Toilet with flushing system	289	69.81
Toilet without flushing system	125	30.19
Total	414	100.00

Source : Field Survey Data

3.2.14 Distribution Of The Households Based On The Family Size

Table No.3.14 provides an analysis of the sample based on the size of family. Largest portion of the sample (53.14 per cent) falls in the category of households having 4 members. 13.04 per cent samples have 3 members in the house, where as 6.04 per cent falls in the category of households having two members. A single member household is zero in the sample design. 12.56 per cent have more than 5 members in the household. Usually the standard norms adopted for defining urban households are five members.

Table No.3.14

Distribution of the Households Based on The Family Size

Family Size	Frequency	Percentage
1	0	0.00
2	25	6.04
3	54	13.04
4	220	53.14
5	63	15.22
Above 5	32	12.56
Total	414	100.00

Source : Field Survey Data

3.2.15 Distribution Of Samples Based On Index Of Household Durables

Household durables, the household possess is a better and objective index of measuring the socio-economic status of households. In Table No.3.15. Index of household durables are ranged into four classes. Perusal of data shows that 41.31 percentage of households possess only necessary household durables. 5.07 percentage of households are having larger variety of luxurious household durables. 53.62 percentage of sample households posses a variety of semi-luxury household durables.

Table No.3.15

Distribution Of Sample Based On Index Of Household Durables

Range of index of household durables (Points)	Frequency	Percentage
1 – 6	171	41.31
6 – 12	162	39.13
12 – 18	60	14.49
Above 18	21	5.07
Total	414	100.00

Source : Field Survey Data

3.3 Profile Of The Sample Beneficiaries Of Mini Water Supply Scheme

3.3.1 Project wise Distribution of the Sample

Table No.3.16 shows the distribution of the 60 samples taken from six mini water supply schemes. Ten beneficiaries were taken as sample from each project.

Table No.3.16

Project Wise Distribution of The Sample

Sl.No.	Project Code	Table number of Households Benefitted	No. of Sample Beneficiaries selected
1	05	120	10
2	07	150	10
3	02	120	10
4	03	120	10
5	08	40	10
6	04	90	10
Total		640	60

Source : Field Survey Data

3.3.2 Age Wise Profile Of The Sample

Table No.3.17 shows that 13.33 per cent of the sample selected belong to those below 30 year age group, which is the smallest segment among the three age groups considered. Under the 30 – 60 year age category, 68.34 per cent of the sample falls. This is the largest of the three groups. Finally 18.33 per cent of the samples belong to 60 year above category.

Table No.3.17

Age Wise Profile of The Sample

Age composition in years	Frequency	Percentage
Below 30	8	13.33
30 – 60	41	68.34
Above 60	11	18.33
Total	60	100.00

Source : Field Survey Data

3.3.3 Sex-Wise Composition Of The Sample

Table No.3.18 indicate that the samples consist of 66.67 per cent males and 33.33 per cent females.

Table No.3.18

Sex-wise Composition of The Sample

Sex composition	Frequency	Percentage
Male	40	66.67
Female	20	33.33
Total	60	100.00

Source : Field Survey Data

3.3.4 Religious Composition Of The Respondents

Table No.3.19 shows that 42 out of 60 samples selected are Hindus. The division of the Hindus into forward and backward brings 13.33 per cent of the sample under the first category and 56.67 per cent under the second. Hindu backward includes schedule caste members also. 20 per cent of the sample households are of Muslims. Another 10 per cent of the households are of Christians. No coherent pattern of the composition is seen among the samples collected from different Mini water Supply Schemes. Table 3.19 reveals the religion / community composition of the sample.

Table No.3.19

Religious Composition of The Respondents

Religion / Community	Frequency	Percentage
Hindu Forward	8	13.33
Hindu Backward	34	56.67
Muslims	12	20.00
Christians	6	10.00
Total	60	100.00

Source : Field Survey Data

3.3.5 Distribution Of The Sample Based On Educational Status Of The Household

Educational status (the highest level in the house) of the household is considered here, by classifying the level of education into a) Primary b) Secondary c) Graduation d) Post graduation and Professionals. This classification is done for convenience of analysis. It is seen that 38.33 per cent of the sample have got primary education as the highest level in the family, 46.67 per cent Secondary education and 11.67 per cent graduation. Percentage of households having Post graduation and professional degree as the highest level is 3.33 per cent. Table No. 3.20.reveal the distribution of the sample based on educational status (highest level) of the head of the households.

Table No.3.20

Distribution Of The Sample Based On Educational Status Of The Household (Highest Level In The House)

Level of Education	Frequency	Percentage
Up to Primary	23	38.33
Up to Secondary	28	46.67
Graduates	7	11.67
Post Graduate and Professionals	2	3.33
Total	60	100.00

Source : Field Survey Data

3.3.6 Composition Of The Sample Based On Occupation

An enquiry into the occupational structure of the sample revealed that the highest portion 73.33 per cent contribute, others category. This include Coolies, Maizons, Daily Wage earners, Trolly pullers, Casual workers, fist venders, Workshop assistants etc. Salaried persons constitute 9 per cent where as business people constitute 11.67 per cent of the sample size.

Table No.3.21

Composition of The Sample Based on Occupation

Occupational Class	Frequency	Percentage
Business	7	11.67
Salaried Class	9	15.00
Others	44	73.33
Total	60	100.00

Source : Field Survey Data

3.3.7 Distribution Of The Sample Based On Income Categoriszation

Household income is a strong background variable needed for analyzing the water availability problem faced by different economic state in the society. For convenience of analysis, on the basis of average monthly household income, households are divided into three income classes. Higher income class constitute households having a monthly average income above Rs.10000/-. Where as middle-income class are those having an income range between Rs.2501 – Rs.10000/-. Households having an average monthly income up to Rs.2500/- are categorized as lower income class. Table No.3.22 gives an analysis of the sample households based on income categorization. 70 per cent of the respondents fall in the lower income group, where as 26.67 per cent fall in the middle income group. Higher income group constitute only 3.33 per cent of the sample. The analysis of the sample shows that majority of the beneficiaries selected belongs to lower income group.

Table No.3.22

Distribution Of The Sample Based On Income Categorisation

Income based categorization	Frequency	Percentage
Lower income class	42	70.00
Middle income class	16	26.67
Higher income class	02	3.33
Total	60	100.00

Source : Field Survey Data

3.3.8 Distribution Of The Households Based On Their Source Of Water

Out of the six mini water supply schemes surveyed, only in one project there were metered consumers. In all the other projects, water is supplied only through Public Stand Post. Table No.3.23 gives an analysis of the sample households based on their source of water. 90 per cent of the sample households are drawn from the category of households depending on public stand posts and 10 per cent for the sample households are drawn from the category of households having metered connection.

Table No.3.23

Distribution of The Households Based on Their Source of Water

Type of Water Source	Frequency	Percentage
Households having metered Water connection	6	10
Households depending on Public Stand Post	54	90
Total	60	100.00

Source : Field Survey Data

3.3.9 Distribution Of Households Based On Type Of House

Table No.3.24 shows the distribution of the sample based on the type of structure (house) the households occupy. 63.33 per cent of the sample is residing in Katcha houses, where as 33.33 per cent was found occuping semi pucca houses and 3.33 per cent pucca houses. (The details of the classification of houses is given in introductory chapter in the section Sample Design.)

Table No.3.24.

Distribution of Households Based on Type of House

Type of House	Frequency	Percentage
Pucca	2	3.33
Semi Pucca	20	33.33
Katcha	38	63.34
Total	60	100.00

Source : Field Survey Data

3.3.10 Distribution Of The Sample Based On Floor Area Of House

Table No.3.25 indicates the distribution of the sample based on the floor area of the house. Analysis of the table shows that 63.33 per cent of the sample constitute households having houses with a size up to 250 sq.feet. Households in the range of 251 – 500 sq. feet house size constitute 33.33 per cent of the sample size. Where as households in the range of 501 – 1000 sq. feet and 1501 – 3000 sq. feet constitute 1.67 sq. feet.

Table No.3.25

Distribution of The Sample Based on Floor Area Of House

Floor Area in Sq. feet	Frequency	Percentage
100 - 250 sq. feet	38	63.33
250 – 500 sq. feet	20	33.33
500 1000 sq. feet	1	1.67
1000 – 1500 sq. feet	0	0.00
1500 – 3000 sq. feet	1	1.67
Total	60	100.00

Source : Field Survey Data

Almost all Mini Water Supply Schemes Commissioned are located in Water scarce regions of the city. Hence the six projects considered for analysis are also from these places. People in these areas have been experiencing acute water shortage for the last several years. The centralized supply system has failed to ensure reasonable supply to household residing in these areas. All Mini Water Supply Schemes are based on traditional water source like pond, well etc.

CHAPTER IV

CALICUT WATER SUPPLY SYSTEM – A DETAILED DESCRIPTION

CHAPTER IV

CALICUT WATER SUPPLY SYSTEM – A DETAILED DESCRIPTION

A detailed analysis of the present water supply system in Calicut city in terms of source, augmentation, transmission and distribution is presented in this chapter. A critical evaluation of the present system in terms of availability and distributional problems, will give a backdrop for analysis of water availability problem of Calicut city in the succeeding chapters.

4.1. History and Development of Water Supply in Calicut City

Calicut city with 39 municipal wards extends over an area of 82.67 sq.kms. and has a population of 4,36,527 (Census 2001). Calicut is one of the five municipal corporations in Kerala state. Calicut city experiences acute water shortage. The present supply of water in Calicut city is on alternative days. The area of Calicut city can generally be classified as residential, except a few commercial agglomerations in the heart of the city and industrial development in the southern part. Regarding the land use pattern, it is estimated that 75 per cent of the city area is used for residential purpose.

Calicut Corporation had been a Municipality till 1960. The earliest piped water supply scheme was introduced in Calicut city by the municipality in

1953, using poonurpuzha river as a source. The scheme comprised of an infiltration well sunk in the riverbed, a pumping station and a treatment plant at Poolakkadav. Water was purified using lime and alum and distributed after sedimentation and chlorination. The scheme designed for 4.5 Mld (Million liters per day) was later on abandoned as the siphon system of infiltration wells failed due to inadequate summer flow in the river.

Owing to the availability of water from a large number of tanks and open wells in the Municipal area, the need for piped water was not very much felt till the year 1960. Until 1960 the demand for house connection was not at all high and most of the domestic consumers took water supply connection as stand-by arrangement to their well water. Public tanks and wells were maintained in good condition and the local bodies and local people were very conscious to clean these wells and surroundings and pollution problems were practically nil.

In the subsequent years with increase in population and development of the municipality into corporation area, the demand for potable water also increased. Considering problems of water shortages, a treatment plant of 2.25 Mld capacity, using Poonurpuzha river as the source, was constructed, at Moozhikkal in 1965. The scheme was implemented exclusively for Medical College Campus, which was facing water shortage.

During 1960 investigations were conducted for a major water supply scheme with Chaliyar as source. Based on these investigations, a full-fledged water supply scheme to supply 54 Mld of filtered water to the city was developed at Koolimadu on river Chaliyar. The scheme was prepared in two phases of 36 Mld and 18Mld. First phase of 36 Mld inclusive of intake works, water treatment plant, transmission and distribution network, intermediate pumping station at Kuttikattur and service reservoirs was completed in 1971. The second phase of 18Mld capacity comprising of treatment plant and extension of the Kuttikattur pumping station is in progress.

After the Koolimadu scheme in 1971, the supply conditions in the city was further improved by implementing an additional 4.5 Mld scheme at Moozhikkal in 1985 using the Poonurpuzha river as a source. With this scheme, one service reservoir at Balamandiram and the connecting transmission main were introduced, to supply water to the citizens.

At present a quantity of 54 Mld from Koolimadu, 6.75 Mld from Moozikkal and 4.5 Mld from Poolakadavu are available. The total quantity of water made available is 65.25 Mld. Kerala Water Authority (KWA) is responsible for the operation and maintenance of present water works. (Figure No.4.1 indicates the location of present water source and water works).

Figure No. 4.1

Location of Present Water Source and Water Works in Calicut City

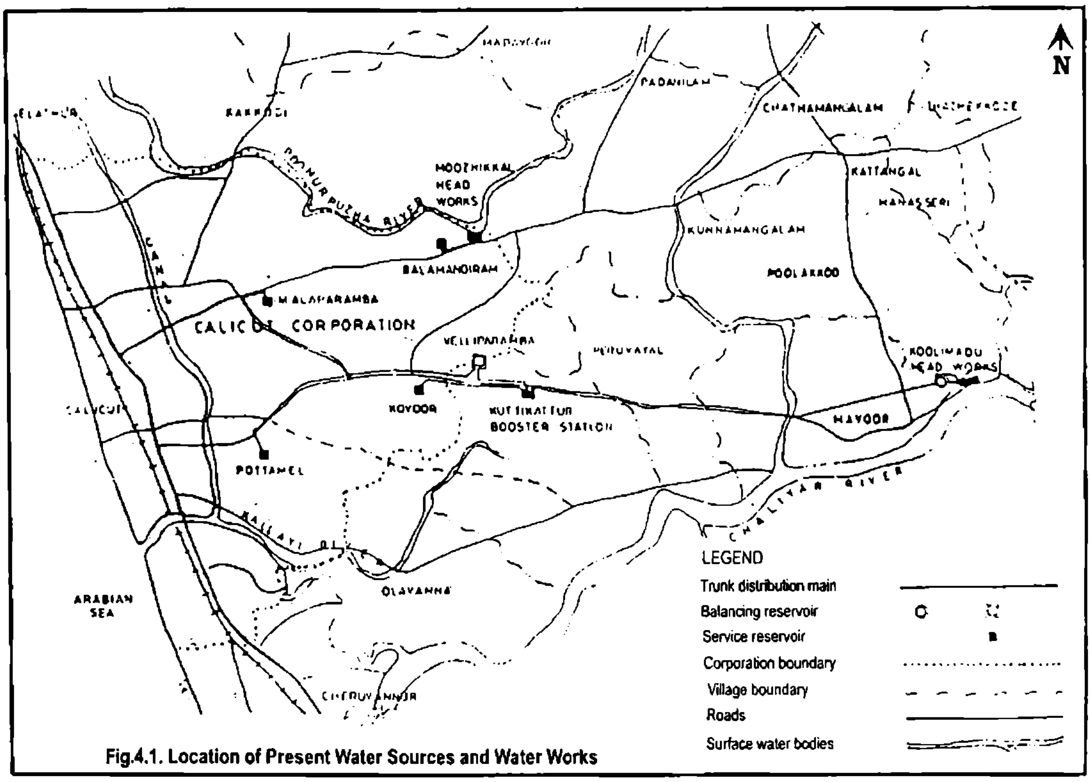


Fig.4.1. Location of Present Water Sources and Water Works

4.2 Component of the existing Water Supply System

A critical assessment of the existing piped water supply system in the city of Calicut necessitates a detailed analysis of the various components of the system in terms of source, Treatment, Transmission, Pumping system, service reservoirs and finally the distribution system.

4.2.1 Source of Water

The major source of water for Calicut city are Chaliyar and Poonur puzha. The river Chaliyar is one of the major rivers in the state of Kerala and contributes a major share of water supply to Calicut city. The quality of raw water of both the rivers does not exhibit much variation throughout the year except when the salinity intrusion takes place in Chaliyar river during the summer period. In recent years salinity in Chaliyar river has been controlled by constructing a temporary bund two km. downstream of Koolimadu water works.

4.2.2 Water Treatment System

Raw water from Poonur puzha is augmented at Moozhikkal about eleven km. to the east of Calicut city. Water is drawn through two separate intake works and pumped to the water treatment plants having installed capacities of 2.25 Mld and 4.5 Mld located adjacent to each other. Raw water is treated in both treatment plants with conventional methods like aeration, coagulation, flocculation, sedimentation, filtration and disinfection. Treated water from both water treatment plants is collected in separate clean water sumps and pumped for distribution. The total designed capacity of water treatment plants at Moozhikkal is 6.75 Mld. However, both treatment plants are under utilized and about 5 Mld water is being treated presently. Both plants need major rehabilitation works. However authorities argue that even if treatment plants are rehabilitated, both the plants must be shut down during the summer, when poonurpuzha gets dry.

Water from Chaliyar river is collected in the raw water sump and pumped to the treatment plant at Koolimadu, about twenty-five kms. to the east of Calicut city. The water drawn through separate intake works is treated with conventional methods. The installed capacity of the Water Treatment Plant at Koolimadu is 36 Mld. Presently about 30 Mld water is pumped to the treatment plant. This plant also requires rehabilitation works to restore the performance and to make full capacity utilization. Treated water is stored in clean water sump having a capacity of 1.8 ml and pumped to an overhead tank, constructed about 350m. away from the plant site. The clean water sump for the present ensures one-hour storage, however the capacity needs further augmentation, when water production increases.

Laboratory facilities for conducting the tests like turbidity, residual chlorine etc., are available at both the treatment plants. But very often samples are sent to the Regional laboratory of Kerala Water Authority at Calicut, for other chemical and bacteriological tests. From investigation, it is realized that once in a month, raw and treated water samples are tested. Treatment plants at Koolimadu and Mozhikkal are operated for about only 20 hours a day due to low voltage problem. This has substantially affected the supply levels in the city.

4.2.3 Transmission system

Pipes used in the transmission system are mainly of premo and cast iron. The total length of the transmission main is about 31 Kms. Treated water from Moozhikkal is directly pumped to the Medical College Campus and Balamandiram service reservoirs through two separate mains. Treated water from Koolimadu overhead reservoir is conveyed to the Kuttikattor booster station by gravitational push. From the booster station, it is pumped to Kovoor and Velliparamba resorvoir through separate pumping mains. Velliparamba reservoir acts as a balancing reservoir and it feeds Pottammal and Malaparamba service reservoirs by gravity through premo pipes. Analysis of the various study reports and investigation from Water Authority officials reveals that incidences of frequent bursting of premo pipes have occurred in various stretches causing wastage of water and interruptions in the normal supply. More frequent bursts had occurred between Koolimadu and Kuttikattur booster stations. More over this situation leads to leakages in supply system at many places. However, in recent years, Kerala Water Authority has under taken, a scheme to replace premo pipes with cast iron pipes in damage prone stretches. However, paucity of fund is a stumbling block in the implementation of the proposal.

4.2.4 Pumping System

In the present supply system, there are three raw water and four clean water pumping stations. Raw water pumping stations are at Koolimadu and Moozhikkal complexes. At Moozhikkal raw water from Poonur puzha river is collected in two separate intake wells and then pumped to the treatment plants using vertical turbin pumps. At Koolimadu, there are two intake works with pump houses constructed in 1970. Presently one intake well with a pump house is utilized. Raw water from Chaliyar river is collected in the intake well and then pumped to Treatment Plant using vertical turbin pumps. Raw water pumps at both the water works are operated only for twenty hours a day due to low voltage even though voltage booster have been installed at Koolimadu, still the voltage is not sufficient to run the pumps. Clean water pumping stations are in Koolimadu, Moozhikkal and Kuttikattur complexes.

4.2.5 Service Reservoirs

Treated water from Moozhikkal and Koolimadu water works is distributed in the city through four-ground service reservoirs located at Malaparamba, Pottamel, Kovoor and Balamandiram. Calicut Medical College campus receives its supply from a separate reservoir located within the medical college campus. All reservoirs have been constructed in the year 1970 except Balamandiram reservoir, which is constructed in 1985. The present storage capacity of the service reservoirs is 10.8 Mld which is about 10 per cent of the 1991 filtered water demand of the city (107.0 Mld). Hence the storage capacity is absolutely inadequate. Malaparamba and Pottammel service reservoirs receive water supply on alternative days from Velliparamba balancing reservoir. Kovoor gets its supply from Kuttikattur Booster station and Balamandiram is fed from Moozhikkal. The supply to all these reservoirs is for about 20 hours a day.

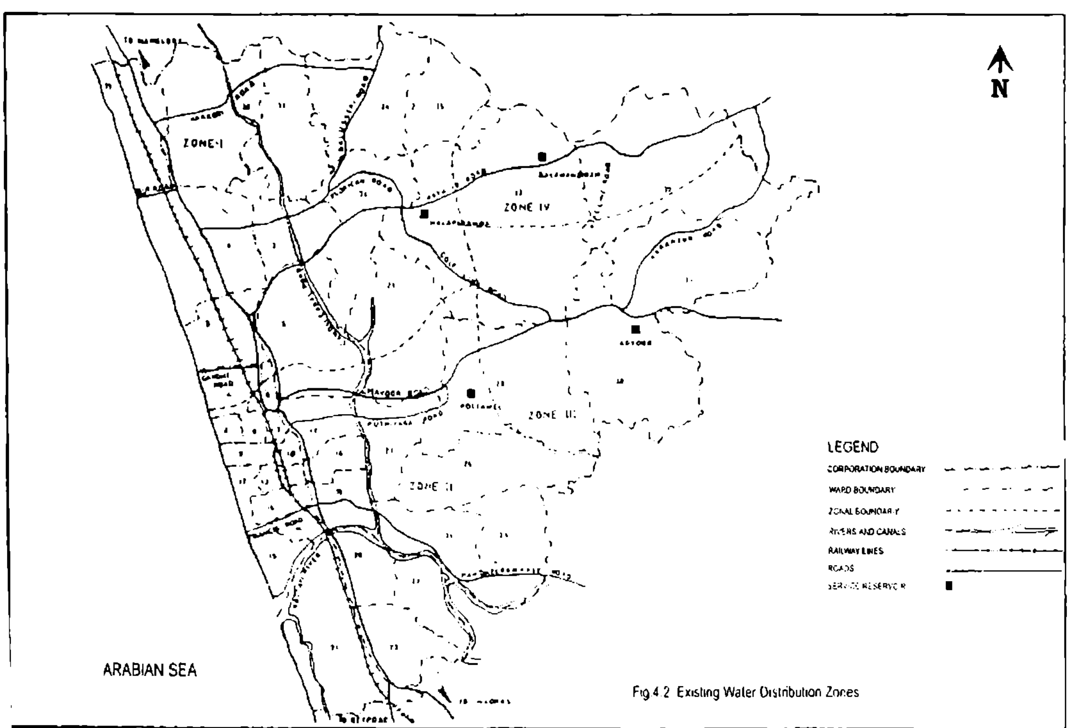
4.2.6 Piped Water Distribution System

Distribution system is the most important component of any water supply system. An analysis of the distribution system gives an insight into the functioning of the system, in terms of water availability and deficiencies in the distribution network.

Presently the population of Calicut city is served through four independent water distribution zones. Distribution Zones are designed based on the system design approach and design criteria. The command area of the existing water distribution Zones is indicated in Figure No.4.2.

Figure No.4.2

Existing Water Distribution Zones In Calicut City



The area and estimated population (1991) served by the Zones is given below.

Table No. 4.1

Area and Population Served by Water Distribution Zones

Zone	Area (Ha)	Estimated Population (In '000) 1991
Zone I (Malaparamba)	2876	146
Zone II. (Pottammel)	2653	215
Zone III. (Kovoor)	1725	42
Zone IV. (Balamandiram)	1013	21

Source: Compiled from KWA office records and published reports, Regional office Calicut

It is seen from the table that Zone I (Malaparamba) and Zone II (Pottammel) are the largest water distribution zones and serve near about 85 per cent of the city's population. Zone III (Kovoor) and Zone IV (Balamandiram) are small compared to Zone I and Zone II and serve only about 15 per cent of the total population of the city.

The command area of Zone I (Malaparamba) covers half of the northern part of the city. The farthest area covered are West hill, Puthiyandadi and Kunduparamba, which are about 5 kms. away from the reservoir. Due to such long travel of distribution mains and inadequate supply, these areas are affected badly. Like wise the command area of the II Zone (Pottamel) is thickly populated and commercialized. The zone covers about 50 per cent of the population. Like

Zone I, the farthest area covered is about 5-6 Kms. away from the reservoir. Ground level variations are more in this zone. Some of the farthest area such as the area along the coast between Kallai river and Mayor Bhavan and the area beyond Kallai river are experiencing water shortage. Zone III and Zone IV have small command areas. The supply conditions in these Zones are satisfactory compared to Zone I and Zone II. A full-fledged local distribution system for Calicut city was first laid between 1964 and 1974. The total length of the local distribution main is about 450 km. But the size of pipeline vary from 63mm to 1000mm. Cast iron pipes cover over 65 per cent of the total length.

The existing local distribution system is more than 25 years old. Present supply to the various zones is intermittent and varies considerably over a day. In Zone I and Zone II the supply is given on alternative days. Undulating geography also exerts its influence in the distribution system. Except at public stand posts, the distribution system is metered. There are about 30648 service connections, which include 28730 house connections and 1918 non-domestic connections. Apart from this the supply system consist of 2725 public stand posts, through which water is supplied to low-income settlements and slum population.

4.3 Drinking Water Demand and Supply Projections

The demographic data reveal that, during the decade 1981-91, city's growth rate dropped significantly from 18 per cent to 6.36 per cent. The city's population is 4,36,527 as per 2001 census data. Population projection for the Calicut Corporation was done by Kerala Water Authority by using shift and share method and graphical trend method. Population projections prepared by Kerala Water Authority, by using this method give results that are compatible with the past trend. According to shift and share method, city's population in the year 2006 will be 4,67,705. In 2011, it will be 4,88,858 and in the year 2021, it will cross 5,00,000 mark and is estimated to be 5,14,768.

A study conducted by the Kerala Urban Development Project (KUDP) shows that pattern of domestic water consumption in Calicut city varies from 140 liters per capita daily (lpcd) to 225 lpcd depending upon the type of house. The houses served by public stand posts are assumed to consume 80 lpcd. Keeping these factors in view, the KWA has calculated that an increase of 5 per cent per decade is necessary to cater to the improved living conditions.

The estimation of the consumption by non-domestic category (including hotels, schools, medical institutions, industrial units and other establishments) is based on the norms recommended by I.S.1172. After considering the consumption response, its increase is projected at 10 per cent per decade.

The Unaccounted For Water (UFW) includes distribution system losses, fire fighting requirements and losses at Water Treatment Plants (WTP). As the city's system is more than 25 years old (and in some parts it is more than 40 years old), the Unaccounted For Water (UFW) is taken at 15 per cent. The losses at treatment plants and fire fighting are added separately. These factors are duly considered while preparing the water demand projections.

Water demand is depended on various factors like type of housing, extent of Plumbing facilities, supply hours, residual pressure in the distribution system and socio – economic status of the consumers. The per capita consumption adopted for the existing scheme was 115 liters.

Considering the above mentioned factors, the Kerala Urban Development Project (KUDP), in a study projected the total water demand of Calicut city including domestic and non – domestic as 114.3 Mld. in 2001, 120.8 Mld in 2006, 129.1 Mld in 2011 and 143.3 Mld in 2021. Table No.4.2. gives a comparative view of future population growth and emerging water demand projections.

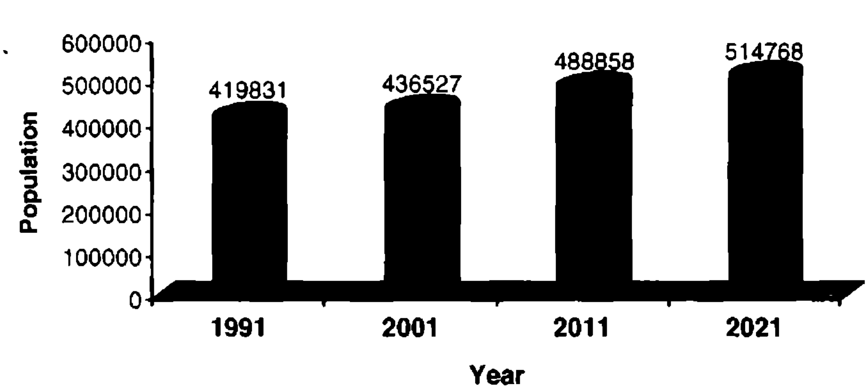
Table No.4.2
Population Growth and Water Demand Projections in Calicut City
(Years : 2001-2021)

Year	Population projections by KWA	Water Demand projections (KUDP) In Mld.
2001	4,36,527	114.30
2006	4,67,705	120.80
2011	4,88,858	129.10
2021	5,14,768	143.30

Note: The water demand figures include Unaccounted For Water (UFW) but excludes Water Treatment Plant losses (WTP)
Source: Compiled from KUDP –Project Report and KWA office records, Regional office, Calicut

Table No.4.2 clearly indicates the growing demand for piped water arising out of population growth and urbanization in the coming decades in Calicut city. (Figure No.4.3 indicate the population growth projection for Calicut city.

Fig.4.3. Population Projection by Graphical Method for Calicut city



4.4 Water Demand and Availability – Future Scenario

The present production capacity of Moozhikkal and Koolimadu Water works is 65.25 Mld. If no major scheme of augmentation of fresh water urce is implemented in the coming years, the installed capacity will remain as ɜ total filtered water supply available to the city population for the coming years ɜo.

About 15 per cent of total production capacity is considered as naccounted For Water (UFW). The UFW includes the leakages in the system, astage at street tap, unmetered consumption such as fire fighting, street washing ıd losses at Water Treatment Plants. Total production capacity less, the UFW ves the net supply available to the consumers through metered connections and ıblic stand posts. This net supply is around 55 Mld only. Table No.4.3. gives an ısight into the demand supply position of piped water in Calicut city in future.

Table No.4.3.
Water Demand and Supply Position – Future Scenario.

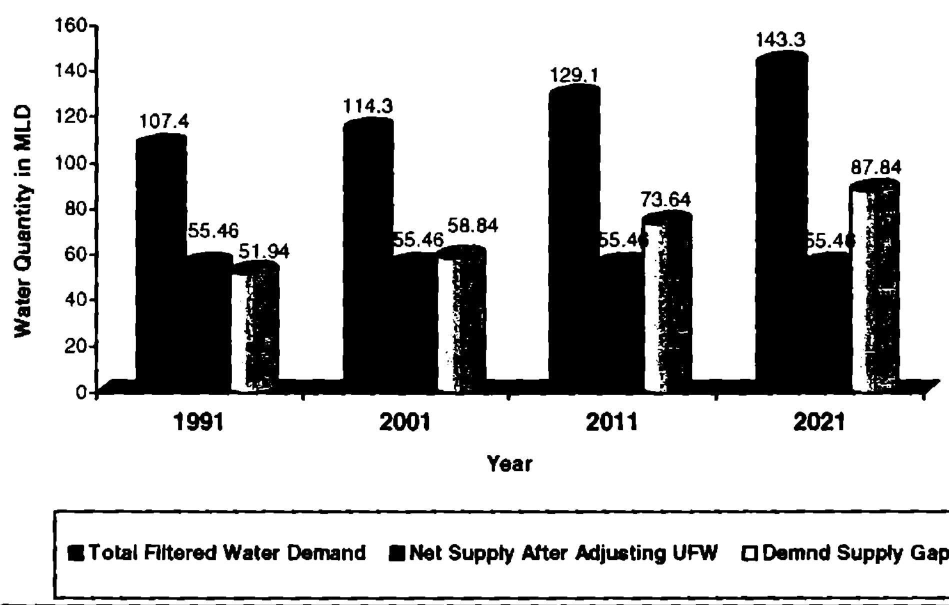
Year 1	Total filtered water demand (MLD) 2	Actual capacity (MLD) * 3	Net supply after adjusting UFW. (MLD) 4	Supply - Demand – gap (4 – 2)
1991	107.40	65.25	55.46	-51.94
2001	114.30	65.25	55.46	-58.84
2011	129.10	65.25	55.46	-73.64
2021	143.30	65.25	55.46	-87.84

- Supply capacity limited by Treatment Plant capacity at Moozhikkal and Koolimadu.

ource: Compiled from KUDF Project Report and KWA office records, Regional Office, Calicut..

Table No.4.3. clearly shows the growing gap between demand and supply of piped water disribution. It is evident from the table that not even 50 per cent of the present water demand is met with the existing supply system and the gap progressively widens. (Figure No.4.4. indicate water demand and supply projection for Calicut city.)

Fig.4.4. Water Demand and Supply Projection for Calicut City



4.5 Drinking Water Problems In The City Of Calicut

Critical analysis of the existing water supply system provides a better understanding of the various dimensions of drinking water problems in Calicut city in terms of shortage in supply, distributional problems and resource crunch in running the system.

.1 Shortage in Supply

The present supply of piped water in the city of Calicut is just ficient to met fifty per cent of the requirements in the city. The city receives y 55 Mld. of treated water (excluding losses) as against the projected demand 114.3 Mld in 2001. Out of a production of 65.25 Mld, approximately fifteen cent is lost in the treatment and distribution system due to electricity failure, tage drop, pipe breakage and theft. Hence the city is receiving only 55 Mld. of ited water for use. This production is stored up in three tanks for onward tribution to the consumers. The present storage capacity is only $1/3^{rd}$ of the duction capacity. The present practice is to fill each tank twice a day and open for supply.

The existing projects were executed without anticipating the future eds of the city. The running projects are insufficient to meet the steadily reasing drinking water demand. Since projects are not properly planned and ecuted considering future demand, Water scarcity increases yearly.

;.2 Water Quality of Other Sources of Supply

Part of the gap in filtered water demand and present supply in the y is met by private and public dug wells and ponds. In ancient times the city s blessed with a large number of ponds, which were primary source of water.

In the wake of rapid urbanisation and consequent construction of esidential Colonies and shopping complexes, almost majority of these ponds are illed up. Ponds gave way to multistoried buildings, residential apartments and uper specialty hospitals. Private ponds were filled on a massive scale, during the ast three decades. Many ponds, which previously served as potential source of vater supply like Chakkorathkulam, Kandamkulam, Anakkulam etc., was filled up y Calicut Corporation Authorities to construct multistoried shopping complex. his indiscriminate filling of ponds and tanks in and around the city, substantially educed the availability of alternative source of drinking water. If these sources vere retained, now it would have been possible to convert them into Mini Water upply Schemes catering to small group of households in various locations in the ity.

The mushroom land in and around Mavoor Road helped to store up ain water during rainy seasons, enhancing the surface water potential of the city rea. But the indiscriminate filling up of this mushroom land for construction of nultistoried shopping complex and super specialty hospitals, contributed to the lepletion of surface water availability and contamination of both surface water nd ground water.

During the time of drought 1983, the ground water department, ›vernment of Kerala, digged a lot of tube wells in Calicut city. More than 400 be wells were digged over the years. However, at present more than fifty per ›nt is not functioning properly. When many of the rings underwent repair, the ound water department stopped digging wells. Moreover there is no proper aintenance of these digged wells. There is no agency and permanent rangement to repair the tube wells, which are not functioning. This also ›ntribute to reducing the surface water availability.

The study conducted by Kerala Water Authority (KWA), Calicut ivision about the water quality of in-house wells within the Corporation area ›veals that the water of nearly 82 per cent of them are bacteriologically not safe ›r drinking. About 70 per cent of them are chemically unfit for consumption. he main quality problems identified in the study are low pH, Chlorides, excess on, total hardness etc. The laboratory analysis, in the Lions EXPO 2000 ‹hibition conducted in November 2000 in Calicut city, justifies the findings of ıe KWA. The water quality studies of selected water sources like ponds, wells tc of Calicut city conducted by P. S. Harikumar and V. Madhavan, scientists, 'WRDM Calicut in 1977, indicated that the major drinking water quality roblems are due to excess of iron, salinity intrusion in costal regions and micro iological contamination.

Proximity of septic tanks and soak pits to the well attached to independent houses and residential housing colonies, has contributed to the contamination of well water. As a result people are forced to depend more on the pipe water supply system. According to World Health Organization Standards there should be a minimum of 15m distance between the well and septic tank to prevent organic pollution. However in many housing colonies and independent houses, this principle is not at all followed and many residents of the city are not bothered to adhere to this principle either due to lack of awareness or non availability of adequate space. As a result majority of the wells attached to houses are contaminated beyond use. This has increased the demand for public water supply, leading to widening of the demand –supply gap in the system.

4.5.3 Ground Water Pollution

The type of soil in the city is loamy. The topsoil and the subsoil are highly pervious and facilitate good drainage. The Calicut Corporation lacks a full-ledged sewerage system. The minimum average water table below ground level i 0.5m in the coastal belt. Because of all these factors, ground water gets easily olluted from outside excreta disposal system.

4.5.4 Up-Keeping Of The System And Distributional Problems

Technical problems in the water distribution net works, electricity problems (both voltage variation and power failure), frequent bursting of the transmission mains and distribution pipes are the major causes for disrupting water supply in Calicut city. Once supply is disrupted it will take more than two days to regain the supply.

The Water Treatment Plant at Moozhikkal and Koolimadu are under utilized. The Water Treatment Plant at Moozhikkal need major rehabilitation works to achieve full capacity utilization. Electricity problems, mechanical failure, pipe wreckage due to heavy pressure etc prevent the full capacity utilization of plants. Treatment Plants at Moozhikkal and Koolimadu are operated for about only 20 hours a day due to low voltage prevailing in the area during the evening time. This has substantially affected supply level in the city. Moreover high wear and tear observed in the mechanical parts and instrumentation in the treatment plant at Koolimadu is a major reason affecting full capacity utilization.

Pressure in the distribution system as per KWA records varies from 21 mwc to below 1 mwc. The pressure in most part of the system are on the lower side. This is mainly due to larger command area of the distribution Zones.

Since periodical maintenance is not done properly, a major portion of water is wasted either as transmission loss or leakage in the line of distribution. Water distribution pipes in the city war first laid between 1961 and 1974. A part of the system laid in 1953, was integrated into it. The life span of the system is expired. As a result its carrying capacity is considerably reduced and the incident of pipe burst are frequent. The bursting of premo pipes laid thirty years ago is a major problem affecting the distribution system. Due to widening of roads most of the mains are in the middle of the road, which makes the repair work very difficult. Lack of replacement of these worn out pipelines, leads to large distribution loss of water. In many places water distribution lines are passing through wastewater drainage. The wear and tear in the distribution line creates holes making it easy for the wastewater, first to get into the distributaries, and then into the distribution main, leading to contaminating the entire potable water. To solve this problem the worn out pipeline should be replaced urgently. This needs huge investment, which is beyond the present financial capacity of the water authority. The GI pipes laid in the costal areas are corroded due to salinity and drinking water is leaking frequently in these areas. Number of house connections with G I pipes are also not in a good state, which require urgent replacement. The closed down Government quarters and buildings is another source of wastage of water. The pipes and taps there in will be leaking for months unnoticed. There is no inspection wing in KWA to look into the problem and to detect and plug leakage and wastage. The pipes in the comfort stations and public Stand posts account for unaccounted and indiscriminate use of water, which badly affects the distribution network.

4.5.5 Intermittent Supply

A study of the distribution systems behaviors shows that the water pressure at various locations is not adequate. Due to supply and demand gap, available water is not distributed equally among the different Zones and a large portion of the city area receives the supply on alternative days. Demand satisfaction is approximately fifty per cent of the present demand. Intermittent supply also lead to infiltration of pollutants from rusted points to the treated water. Intermittent supply also leads to 'hoarding syndrom' among the consumers. In Calicut city more than 100 establishments which includes hostels, multistoried apartments, lodges etc are storing water illegally. Apart from this both independent house and houses in colonies construct large sumps for storing pipe water. Consumers tend to store water largely in excess of their needs, which goes waste. This hoarding syndrom also lead to excess draining of water from mains at lower levels there by affecting availability of water in elevated areas and far away places from distribution Zones.

In short, available water is not distributed equally amongst the consumers and a large portion of the city area receives supply on alternative days. Even if water is received on alternative days supply was restricted for a few hours.

ıce under the present system of delivery, because of limited supply, ributional problems and larger command areas the following localities erience acute water shortage. a) Elevated places in Moozhikkal area, laparamba, Florican Hill Road b) West Hill, Puthyangadi area c) localities in around Vengerikadu, Tanneerpandal area, Maloor Kunnu and Koorakunnu d) il Station area, part of Kotooli and Chempra Chulliode area e) Elevated places Kokkozhikode, Thenam Kunnu, Tali kunnu and Pokkunnu areas f) Part of vindapuram area, Kodamolikunnu, Ponnamkottu kunnu areas, g) and the far ıy places from the distribution Zones like Meenchanda, Tiruvannur area. The cussions with the peoples representatives of Calicut Corporation also confirms t the above localities experience acute shortage on all seasons.

.6 Water Tariff and Resource Crunch

Public water supply scheme in Calicut city needs urgent abilitation. Revamping the distribution system by replacing worn out pipelines, dings new augmentation source, modernization of Water Treatment Plants to g leakage and loss are some of the rehabilitation measures needed urgently to dernize the existing system and to enable full capacity utilization. This uires huge investment, which is beyond the reach of the authorities. KWA, licut division has only the accounts of liabilities. The operation and intenance expenses per month are on a steady increase, where as monthly

:venue yield is shrinking. This economic crisis of water authority further ggravates the existing water supply problem.

The monthly revenue collection is not even sufficient to meet the ecurring expenditures of electricity bill, salary and allowances of employees and ost of chemical purchase. The present tariff rate, even though is slightly romising is not at all able to generate additional resources to meet maintenance ost and to attain economy in water use (Table No.4.4)

Table No. 4.4

Existing Water Tariff Structure

)uantity in Kilo liter Kl = 1000 liters	Tariff rate per kiloliters. in Rupees
.ess than 10 Kl	Rs.20/- + Rs.2/- service charge = Rs.22/-
0 kl to 30 kl	Rs.22/- +@Rs.3/- per kl in excess of 10 kl
0 kl to 50 kl	Rs.82/- +@Rs.5/- per kl in excess of 30 kl
bove 50 kl	Rs.182/- +@Rs.7.35/- per kl in excess of 50 kl

ource:Complied from KWA office records, Divisional office. Calicut.

The Kerala Water Authority is the sole authorised agency for the roduction, transmission, treatment and distribution of water in the state. Water upplied through public taps or street foundations are unmetered and no water harge is levied on it. Metered connection are given to households and the water upplied to them is charged. The rate is slightly progressive and is fixed for water per 1000 liters. Optimization of use can be attained by imposing a stepped tariff structure for consumers, from the point of view of discouraging excessive consumption and preventing water misuse for gardening, construction purpose, animal bathing, and toilet flushing and cleaning. At the same time tariff rate should generate at least a revenue to meet the operation and maintenance cost. The present tariff structure is not able to yield sufficient revenue to meet operation and maintenance cost and to prevent misuse of water and to attain economy in use. Presently the cost of production and distribution of water is around Rs.7/- per kl. And the ordinary consumer (60 per cent of the total consumers) is paying at the rate of Rs.2/- per kl. The monthly electricity charge for running Calicut City Water Supply Scheme is Rs.30 lakhs, where as the monthly average revenue collection is only 25 lakhs. This shows that the revenue collection realized is not even adequate to pay the electricity charges. Due to this, KWA finds it difficult to maintain the water supply scheme to the expectations. Interestingly, about Rs.16/ crores are due from institutions like Medical college, Government hospitals, Calicut corporation etc., Hence resource crunch is a major factor affecting the present water supply system in the Calicut city.

Thus the analysis of the present water supply system in Calicut city unveils the major problems of the system. The main problems are defective distribution system, insufficiency of the treated water, reduction in efficiency of the system, geographical features of the city, insufficient power supply, over and ve the insufficient funds available. The most urgent need is to utilize the king water in a sustainable manner. Rehabilitation of the existing Calicut :er supply scheme is another crying need for an effective utilization of the ;ent installed capacity. To recap, the analysis unequivocally proves that the ;ent piped water supply system is grossly inadequate and insufficient to ensure asonable level of supply to the citizens of Calicut.

CHAPTER V

PERCEPTION ON THE WATER SUPPLY SYSTEM

CHAPTER V

PERCEPTION ON THE WATER SUPPLY SYSTEM

The efficiency of the water supply system based on the perception of the beneficiaries of the system, is analysed in this chapter. The field survey data is analysed, to ascertain, the water availability problem faced by different categories of consumers within the Calicut city. A detailed analysis of the water use pattern, quality aspect and management problem as perceived by the beneficiaries of the system is also presented in this chapter..

For convenience of analysis and presentation, the summary of the chapter is organized in two sections. Section A – contains an analysis of the water availability problem faced by consumers residing in pucca, semi pucca and katcha houses, from the public delivery system of water. For the purpose of analysis tabular presentation of the per capita water consumption per day (lpcd) computed from field survey data and appropriate statistical tool like 'Z' test is applied. Inequality in water availability within the category is projected in a Lorenz curve. In section B, water use pattern of different category of consumers based on household consumption data, obtained from field survey is presented. A detailed analysis of the management and quality problem perceptions by beneficiaries of the supply system is also presented in this section..

.1 SECTION - A

The water availability problem is analysed on the basis of data btained from the household survey carried out in the city of Calicut. A total of 14 sample households residing in Pucca, Semi pucca and Katcha houses were urveyed to obtain water consumption data. The classification of the construction f dwelling units and the type of it has been in line with the National Sample urvey (NSS) classification. [A detailed description of the characteristics of the welling units is given in the section – Sampling Design and Data Collection in ntroductory Chapter.]

The per capita water consumption per day (lpcd) is tabulated from he household water consumption figures per day obtained from the field survey. The per capita consumption (lpcd) obtained from the field survey does not epresent a satisfactory level of consumption, as the city is experiencing water hortages and also acute variations in availability among different types of consumers. Therefore in this analysis, the per capita water requirement per day lpcd) in liters representing a satisfactory level of consumption is computed as per standard norms in operation. The quantity of domestic water consumption per capita per day (lpcd) will vary according to the living condition of consumers in any city. As per I.S. Code: 1172-1993 (ie. I.S. Code on Basic Requirements of Water Supply, Drainage and Sanitation 1993) the minimum domestic consumption for a town or a city with houses having full flushing system in toilet should be taken at 200 lpcd; although it can be reduced to 135 lpcd for economically weaker section and Low Income Group (L.I.G). colonies, depending upon prevailing conditions. The I.S. Code in fact lays down a limit on domestic water consumption between 135-200 lpcd under ordinary circumstances with flushing system. However the standard norms for consumers depending on public stand post is 80 lpcd.

In line with the above requirement norms and the findings of the study conducted by Kerala Urban Development Project (KUDP) on water supply improvement in Calicut City Region in 1993, the following standard norm in lpcd is taken to represent the admissible consumption per person per day for three types of consumers considered in the study, to analyse and ascertain water availability problem, if any, existing among them. The three type of consumers considered in the study are a) consumers residing in Pucca houses with full flushing system in the toilets; b) consumers residing in Semi-Pucca houses with flushing system in the toilets and c) consumers residing in Katcha houses without flushing system in the toilets and depending fully on water supply through public stand posts. Table No.5.1 gives the admissible consumption as per standard norms in liter per capita daily (lpcd) for the above three category of consumers.

Table No.5.1

Admissible Consumption As Per Standard Norms For Three Categories Of Consumers

House category	Admissible consumption As Per Standard Norms (in lpcd)
Pucca	200
Semi pucca	135
Katcha	80

Source: Compiled from I.S. Code:1172-1993 & KUDP Study Report, KWA, Calicut Region.

5.1.1 Average Per Capita Consumption - Zone Wise And House Category Wise

Table No.5.2

Average Per Capita Consumption In Zone – I

House category	Average Per Capita Water Consumption (in lpcd) per day.	Admissible Consumption as per standard norms (in lpcd)
1. Pucca	264.21	200
2. Semi Pucca	125.59	135
3. Katcha	58.54	80

Source : Field Survey Data.

Table No.5.3

Average Per Capita Consumption In Zone – II

House category	Average Per Capita Water Consumption (in lpcd) per day.	Admissible Consumption as per standard norms (in lpcd)
1. Pucca	230.46	200
2. Semi Pucca	109.34	135
3. Katcha	60.78	80

Source : Field Survey Data.

Table No.5.4

Average Per Capita Consumption In Zone – III

House category	Average Per Capita Water Consumption (in lpcd) per day.	Admissible consumption as per standard norms (in lpcd)
1. Pucca	287.84	200
2. Semi Pucca	110.06	135
3. Katcha	60.63	80

Source : Field Survey Data.

Table No.5.5

Average Per Capita Consumption In Zone – IV

House category	Average Per Capita Water Consumption (in lpcd) per day.	Admissible consumption as per standard norms (in lpcd)
1. Pucca	264.28	200
2. Semi Pucca	105.05	135
3. Katcha	60.89	80

Source : Field Survey Data.

Table No.5.6

Average Per Capita Consumption (All Zones)

House category	Average Per Capita Water Consumption (in lpcd) per day.	Admissible consumption as per standard norms (in lpcd)
1. Pucca	251.53	200
2. Semi Pucca	114.70	135
3. Katcha	60.13	80

Source : Field Survey Data.

An analysis of the average per capita water consumption data reveals that in general (Table No.5.6) consumers residing in pucca houses are better benefited from public delivery system. Their average per capita consumption per day (lpcd) is much greater than the admissible lpcd consumption as per standard norms. That is, 251.53 lpcd against 200 lpcd, where as consumers residing in Semi pucca houses are getting less than what they deserve. That is, 114.70 lpcd against the lpcd norms of 135. As far as consumers residing in katcha houses, depending on public stand post are concerned, they are able to fetch only 60.13 lpcd on an average, against the admissible consumption norms of 80 lpcd. Thus it is evident that there is perceivable variation in water availability among the three categories of consumers.

The economically well-off households may be using efficient gadgets to ooze out the precious commodity at a higher rate than what is allowed to them. However, all households residing in Katcha houses belongs to the lower income stratum with an average monthly household income less than or equal to Rs.2500/- per month, staying in slum settlements or elevated and water scarce areas. They have no water storage facility and they wholly depend on public stand post for their water requirement. Hence they receive less than the admissible consumption as per standard norms. They are alienated from the pubic delivery system because of low income, low social status and lack of built-in water storage facilities.

A cross analysis of the Zone-wise consumption data as given in Tables 5.2, 5.3, 5.4 and 5.5 shows that there is perceivable variation in water availability among consumers residing in pucca houses. In terms of lpcd, the consumption data is 264.21, 230.46, 287.84 and 264.28 in Zone 1,2,3 and 4 respectively. This can be attributed to income variation, difference in floor area and other built in specifications within the house, nature of locality (elevated or plain) and difference in command area of Zones and difference in the distribution of consumers among Zones. Pucca category consumers in Zone 2nd receives lower lpcd, because Zone 2nd accommodates largest numbers of consumers (101 out of 171 in the sample size) and possess larger command area. Except in Zone 1st, semi pucca consumers in all the other three Zones receives more or less equal quantity. However consumers residing in katcha houses in all Zones receives more or less equal quantity in terms of lpcd. The Zonal variation in lpcd is very negligible as far as katcha category is concerned, where as it is high in pucca type consumer category, followed by semi pucca category consumers.

The analysis adequately supports the hypothesis that the residents of Katcha house are getting lesser quantity of water than what they are entitled to.

l.2 Statistical Analysis of Water Availability Problem

The test of significance for the difference in average per capita nsumption per day (lpcd) obtained from field survey data and admissible nsumption (lpcd) as per standard norm is compared using 'Z' test. The details the analysis are given in Table No.5.7.

Table No.5.7

[abulated Data To Measure Water Availability Problem by using 'Z' Test.

House Category	lpcd obtained from field survey $\bar{X}$	lpcd as per standard norms μ_0	Standard deviation (s)	Number of consumers (n)	Z Observed value	Z Table value
ıcca	251.53.	200	50.29	235	15.7076	1.645
ːmi pucca	114.70	135	30.87	82	-5.5947	-1.645
ıtcha	60.13	80	7.93	97	-24.678	-1.645

ıurce : Field Survey Data.

a) Pucca House Category:

Here the Null hypothesis is average per capita water consumption ːr day (lpcd) is 200, against the alternative, it is greater than 200. That is

$H_0 : \mu = 200$ against

$H_1 : \mu > 200$

ıe calculated value of Z = 15.7076 which is > 1.645

Here the calculated value of Z is less than table value at 5 per cent l. Therefore H_0 is rejected. Hence it can be concluded that the average per ta water consumption of consumers residing in katcha houses is significantly than admissible consumption as per standard norms.

3 Variation With In The Categories

To find out the variability in water availability among consumers in same category, coefficient of variation is estimated for the three categories of umers. The details of the analysis are given in Table No.5.8

Table 5.8.

Pattern of Distribution of Water

use Category	lpcd obtained from field survey $\bar{X}$	Standard Deviation S	Coefficient of Variation CV
ca	251.53	50.29	19.993
i pucca	114.70	30.87	26.913
cha	60.13	7.93	13.188

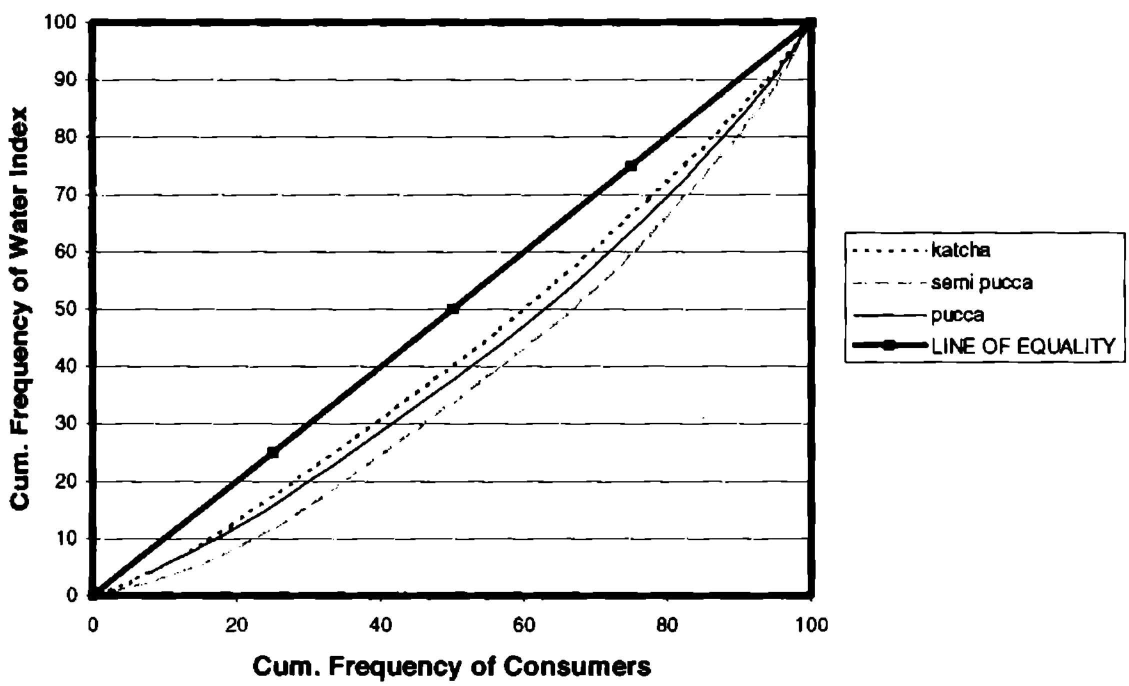
rce : Field Survey Data.

Table No.5.8 shows that variation in the water availability is the est among consumers residing in semi-pucca houses. The per capita water lability per day (lpcd) among these types of consumers varies from 105.05 (in e IV) to 125.59 (in Zone 1) with an admissible lpcd of 135 (Table Nos. 5.2, 5.4 and 5.5). This variation in availability can be attributed to difference in sehold income level and its composite effect on built in facilities in the house and consumer durables the household possess. In the case of consumers residing in pucca house, the variation is less than that of consumers in semi pucca houses. This can be attributed to difference in built in water storage facility. Since all consumers under this category possess built in water storage facility (sump and overhead tanks) the variation in availability of water is comparatively lesser than consumers in semi pucca house category. However, as far as katcha house category consumers are concerned, the variation in water availability is very low compared to the other two types of consumers. A cross analysis of the consumption data given in Table Nos. 5.2, 5.3, 5.4 and 5.5 shows that the average per capita water consumption (lpcd) of consumers in Katcha house category varies between 58.54 (in Zone I) to 60.89 (in Zone IV). All the consumers under this category belong to the lower income group (average household monthly income less than or equal to Rs.2500/-) and possess no built in water storage facility. They fully depend on pubic stand posts. Hence it can be conclusively stated that all the consumers in katcha house category experiences water shortage problem uniformly and they are badly affected by the public distribution system.

Lorenz curves were drawn for the three sets of data as shown in illustrations. As seen in the illustration katcha curve is closer to the equalitarian line revealing lesser inequality in the distribution within the category (Figure No.5.1).

Figure No.5.1

Lorenz Curve



5.2 SECTION - B

5.2.1 Percèption On Water Shortage

Water shortage is a perennial problem in Calicut city, in spite of the many measures taken by the authorities to alleviate it. During summer the problem gets aggravated as the pumping form the lean flow in the rivers is a herculean task. As we know, the demand for piped water increases during this season, as people require more water to get rid of the scorching sun. Further it is the season when, natural springs get receeded and more people switch over to public supply system for their water requirement. The public supply in most areas in the city is on alternative days that too restricted for a few hours in a day. As a result people experience acute shortage of water. Table No.5.9 gives an insight into the beneficiaries' perception to the shortage problems.

Table No.5.9

Beneficiaries Perception On Water Shortage Problem. Zone-Wise

Zone	Never Experienced Water Shortage	Occasionally Experienced Water Shortage	Frequently Experienced Water Shortage	Total
Zone I	3 (2.13)	116 (82.27)	22 (15.60)	141 (100.00)
Zone II	10 (5.85)	87 (50.88)	74 (43.27)	171 (100.00)
Zone III	5 (11.11)	32 (71.11)	8 (17.78)	45 (100.00)
Zone IV	12 (21.05)	33 (57.89	12 (21.05)	57 (100.00)
Total	30 (7.25)	268 (64.73)	116 (28.02)	414 (100.00)

Source : Field Survey Data.
(Cell frequencies in percentage are given in brackets.)
Chi – Square Value is 58.58. df = 6 Table value at 1% level = 16.812
The association is significant)

Zone-wise analysis of data given in Table No.5.9. shows that 64.73 per cent of the respondents experience water shortage occasionally, where as 28.02 per cent is found to be experiencing water shortage frequently. Only 7.25 per cent reported that they never experienced any water shortage.

Table No.5.9 reveals that Zone II is more affected by the supply failure. 43.27 percentage of the respondents are victims of frequent supply failures. In Zone I and Zone III, the failure is by and large occasional. 82.27 percentage of Zone I and 71.11 percentage of Zone III experience the problem occasionally. In this matter Zone IV is in a better position. 21.05 percentage of the respondents belonging to this Zone stated that they have steady supply of water. On a consolidation of the results it is to be highlighted that respondents in Zone II is experiencing acute water shortage problem. Only 2.13 percentage of respondents in this Zone stated that they have steady supply of water. This may be due to the fact that Zone II accommodates the largest number of consumers in the delivery system. Consolidated results further shows that only 7.25 per cent of respondents stated that they have steady supply of water.

Table No.5.10

Income Status And Perception On Water Shortage

Income Status	Never Experienced Water Shortage	Occasionally Experienced Water Shortage	Frequently Experienced Water Shortage	Total
Higher	24 (12.97)	140 (75.68)	21 (11.35)	185 (100.00)
Middle	6 (5.77)	71 (68.27)	27 (25.96)	104 (100.00)
Lower	0 (0.00)	57 (45.60)	68 (54.40)	125 (100.00)
Total	30 (7.25)	268 (64.73)	116 (28.02)	414 (100.00)

Source : Field Survey Data.
(Cell frequencies in percentage are given in brackets.)
Chi – Square Value is 77.98. df = 4 Table value at 1% level = 13.277
The association is significant)

Analysis of data based on income status shows that majority of respondents in higher income and middle-income groups experience water shortage occasionally (75.68 per cent and 68.27 per cent respectively) where as the problem is acute among consumers in lower income group. Majority of the group (54.40per cent) face the problem frequently and the rest (45.60per cent) occasionally. It it interesting to note that none of them is getting steady water supply

Table No.5.11

Perception on Shortage Problem – Locality Based

Nature of locality	Never Experienced Water Shortage	Occasionally Experienced Water Shortage	Frequently Experienced Water Shortage	Total
Elevated	1 (0.47)	95 (45.02)	115 (54.50)	211 (100.00)
Plain	29 (14.29)	173 (85.22)	1 (0.49)	203 (100.00)
Total	30 (7.25)	268 (64.73)	116 (28.02)	414 (100.00)

Source : Field Survey Data.
(Cell frequencies in percentage are given in brackets.)
Chi – Square Value is 160.77. df = 2 Table value at 1% level = 9.210
The association is significant)

Locality wise analysis of the shortage problem is given in Table No.5.11. The figures in the table clearly shows that consumers in elevated areas experience shortage to the maximum (ie, 99.50 per cent) when compared to consumers in the plains (i.e. 85.22 per cent). This is due to the undulated geographical nature of the city.

5.2.2 Perception On Water Use Pattern

Each city has certain unique characteristics and hence each city has its own rate of demand and water utilization pattern. Keralities have a tendency to build big houses as a status symbol. This trend has been increasing rapidly over the years. People in this city also build palatial houses for the residential purposes of two or three persons. Such houses require large quantity of water. Such households built large storage sump.

Calicut city is experiencing water shortage frequently. The cost of treated water supplied by KWA is Rs.7/- per 1000 liters; where as more than 60 per cent of the consumers are paying at the rate of Rs.2/- per 1000 liters. Treated water is a precious commodity. It should be used only for domestic purpose. Unfortunately people use this scarce treated water even for other purpose like gardening, cleaning vehicles, cleaning animals and cleaning open terrace, since it is the cheaply traded public good. Using it for these purpose, by the higher income consumers may lead to the denial of this scarce and essential commodity to people in lower income stratum of society. Hence treated water used for such purpose can be considered as 'misuse of water'

The water use pattern of consumers given in Table No.5.12 gives an idea about the purpose for which treated water is used. In the present study, by 'domestic use', means treated water used for drinking, cooking, bathing, washing, ınd sanitation purposes. Where as 'other purpose' means water used for ;ardening, cleaning of vehicles, cleaning animals etc.

Table No.5.12

Type of House and Quantity of Water Used For Various Purposes

Type of House	Domestic Use Quantity In Lliters/Day	Other purpose Quantity In Lliters/Day	Average Household water consumption Quantity In Lliters/Day
Pucca	906.68 (87.45)	130.12 (12.55)	1036.80 (100.00)
Semi-Pucca	539.45 (100.00)	0 (0.00)	539.45 (100.00)
Katcha	255.80 (100.00)	0 (0.00)	255.80 (100.00)

Source : Field Survey Data.
(Cell frequencies in percentage are given in brackets.)

Perusal of data in Table No.5.12 reveals that consumers residing in pucca houses utilize 12.45 per cent of their average daily consumption for other purposes like gardening, cleaning vehicles, cleaning animals etc. Where as consumers in semi pucca and katcha house utilize filtered water for their domestic needs only.

An analysis of consumption pattern based on income category given in Table No.5.13.shows that consumers belonging to higher income and middle-income group use filtered water for other purposes, where as consumers in lower income group uses it only for their domestic needs.

Table No.5.13

Income and Water Use Pattern

Income category	Domestic Use/ Quantity In Lliters/Day	Other purpose/ Quantity In Lliters/Day	Average Household water consumption Quantity In Lliters/Day
Higher Income	898.97 (86.84)	136.20 (13.16)	1035.17 (100.00)
Middle Income	714.15 (95.08)	36.99 (4.92)	751.14 (100.00)
Lower Income	282.82 (100.00)	0 (0.00)	282.84 (100.00)

Source : Field Survey Data.
(Cell frequencies in percentage are given in brackets.)

Table No.5.13 shows that consumers in higher income group utilize 13.16 per cent of their household consumption for non-domestic purpose. The corresponding figure in respect of the middle-income group is 4.92. Where as consumers in lower income group uses filtered water only for their domestic needs. Higher income group consumers have larger built in water storage facility compared to consumers in Middle-income group. This enables them to store larger quantities of filtered water in sumps. This stored water is used for gardening, vehicle cleaning, terrace washing etc. This large scale storing reduces the availability of water for low-income group consumers, who have no built in storage facility attached to houses. Out of the little water they receive, they store up something in buckets, pots etc to meet their domestic needs, when contingencies arise.

A Zonal analysis of data on water consumption pattern of households is given in Table No.5.14.

Table No.5.14

Water Use Pattern of Households: Zone-Wise

Zones	Number of Households using filtered water for Domestic purpose only	Number of Households using filtered water for Domestic and other purpose	Total Respondents
1	58 (41.13)	83 (58.87)	141 (100.00)
2	70 (40.94)	101 (59.06)	171 (100.00)
3	27 (60.00)	18 (40.00)	45 (100.00)
4	26 (45.61)	31 (54.39)	57 (100.00)
Total	181 (43.72)	233 (56.28)	414 (100.00)

Source : Field Survey Data.
(Cell frequencies in percentage are given in brackets.)

Out of the 414 respondents, 181 (ie, 43.72 per cent) are found using treated water for domestic purpose only. Where as majority, that is, 233 out of 414 (56.28 per cent) utilizes it for domestic as well as other purpose. This ıercentage of consumers is the highest in Zone I (58.87 per cent) and Zone II 59.06 per cent) and lowest in Zone III (40.00 per cent)

Largest number of consumer households comes in Zone I and Zone I. Due to intermittent supply, availability problem is acute in these two zones. To overcome the availability problems, consumers in the higher and middle-income group, resort to large scale storing of filtered water in sumps attached to their house. When water comes on the next day, the already stored water is used for non-domestic purpose like terrace washing, gardening, vehicle cleaning etc. This reduces the water availability for consumers in lower income groups.

The intermittent supply and irregularly in availability leads to a 'hoarding syndrome' among consumers. As a result consumers tend to store up water in excess of their domestic needs, and the same is used for non-domestic purpose as stated above. This 'hoarding syndrome' by higher income consumers, exert a direct influence on water availability and use pattern by households.

Data on storage facility shows that out of 414 respondents 287 are found to have both underground sump and overhead tank facilities. The capacity of the sumps varies from 2000 liters to even 35000 liters and that of overhead tank from 200 liters to 2000 liters. Where as 125 respondents doesn't possess any built in storage capacity in the form of sump and over head tank. [Details on nature of storage capacity is given in Chapter III - Table No.3.12.]

In an attempt to identify the reason behind the hoarding syndrome shown by the households they were asked, why you are storing water in excess of your actual requirement? Many reasons were cited by the respondents., which may be ultimately amalgamated into one, namely unpredictability of availability of water in the system. To overcome the availability problem, water is to be stored as much as possible. Water kept unutilized for many days will become unfit for domestic use and it is to be diverted for non-domestic use or discarded. In this way a large quantity of precious water is lost. This research concludes that only through constant supply of water this mishaps can be avoided.

5.2.3 Perception On Water Quality

In many of the urban centers of the state of Kerala, the level of water supply is below the standard requirements both in quality and quantity. This is a paradox in spite of the spectacular progress the state has achieved in the field of literacy, family planning and public health. The need for protecting water supply has increased since the quality of water is adversely affected in many parts of the state especially in the costal areas owing to salinity, brackishness, bad odour etc.

The water supply system in the city of Calicut is not an exception to this phenomenon. Qualitative problems are an important aspect of water supply system in Calicut city. Majority of houses in the city are not designed properly, and they do not have proper drainage system. Even if houses have a proper drainage, it is stagnant on the roads. The city lacks a full-fledged sewerage system. Ground water is easily polluted from outside excreta disposal. The raw water source for public supply is not properly protected from contamination arising from waste disposal. Disrupted supply leads to infiltration of contaminants from rusted points in the pipe system, polluting the treated water. Brackishness, bad odour, excess chlorination etc are some of the quality problems of the supply.

Table No. 5.15

Quality Problems Of The Water

Zone	Bad odour	Turbidity	Chlorine smell	Total
Zone I	15 (10.64)	29 (20.57)	97 (68.79)	141 (100.00)
Zone II	3 (01.75)	29 (16.96)	139 (81.29)	171 (100.00)
Zone III	5 (11.11)	10 (22.22)	30 (66.67)	45 (100.00)
Zone IV	10 (17.54)	19 (33.33)	28 (49.12)	57 (100.00)
Total	33 (07.97)	87 (21.01)	294 (71.02)	414 (100.00)

Source : Field Survey Data.
(Cell frequencies in percentage are given in brackets.)
Chi – Square Value is 28.76 df = 6 Table value at 1% level = 16.812
The association is significant)

A Zone-wise analysis of the major water quality problem faced by beneficiaries of the supply system is given in Table No.5.15. In Zone I, 68.79 per cent of the respondents reported to have excess chlorine smell. This percentage is 1.29 in Zone II, 66.67 per cent in Zone III and 49.12 in Zone IV. Turbidity is another major quality problem of the supply system. The percentage of consumers experiencing turbidity problem is lowest in Zone II (16.96) and highest in zone IV (33.33). In Zone I and III this percentage is 20.57 and 16.96 respectively. Where as the problem of Bad odour is the lowest in Zone II (1.75 per cent) and highest in Zone IV (17.54 per cent). In general 71.02 per cent of respondents reported to have the problem of Chlorine smell, and the problem of turbidity was experienced by 21.01. Only 7.97 per cent reported to have the problem of bad odour.

5.2.4 Perception on Water Purification

To overcome the qualitative problems, the consumers resort to different method to purify the water. An attempt is made to identify the different methods adopted by the consumers to purify the water. The consumers differed in their response. Table No.5.15. gives an insight in to the beneficiaries perception on the different methods adopted for purifying water.

Table No.5.16

Zone and Water Purification Methods

Zone	Boil only	Filter only	Filter and Boil	No Purification	Total
Zone I	80 (56.74)	12 (8.51)	27 (19.15)	22 (15.60)	141 (100.00)
Zone II	107 (62.57)	12 (7.02)	5 (2.92)	47 (27.49)	171 (100.00)
Zone III	32 (71.11)	2 (4.44)	7 (15.56)	04 (8.89)	45 (100.00)
Zone IV	28 (49.12)	1 (1.75)	20 (35.09)	8 (14.04)	57 (100.00)
Total	247 (59.66)	27 (6.52)	20 (14.25)	81 (19.57)	414 (100.00)

ource : Field Survey Data.
Cell frequencies in percentage are given in brackets.)
hi – Square Value is 51.01 df = 9 Table value at 1% level = 21.666
he association is significant)

Analysis of data shows that 19.57 per cent of the respondents is not ing any method to purify water. Where as majority (59.66 per cent) was using e method of boiling to purify water. The percentage of consumers using boil d filter method is 14.25, where as only 6.52 per cent were found using the filter ethod alone to purify water.

In Zone I, II and III majority were adopting the method of boiling to duce organic impurities. Where as in Zone IV this percentage is only 49.12. ut in Zone IV, 35.09 per cent were adopting the method of filter and boil to ırify water. In other three zones this percentage is below 20. However the ːrcentage of consumers using filter method alone is below 10 in all zones. The ıalysis of data shows that in general majority of the consumers are aware of the ıality problem and they adopt any one of the method given in Table No.5.16.

Table No.5.17

Income Status and Water Purification Methods adopted

ıcome Class	Boil only	Filter only	Filter and Boil	No Purification	Total
Higher	86 (46.49)	26 (14.05)	59 (31.89)	14 (7.57)	185 (100.00)
Middle	98 (94.23)	1 (0.96)	0 (0.00)	5 (4.81)	104 (100.00)
Lower	63 (50.40)	0 (0.00)	0 (0.00)	62 (49.60)	125 (100.00)
Total	247 (59.66)	27 (6.52)	20 (14.25)	81 (19.57)	414 (100.00)

ource : Field Survey Data.
Cell frequencies in percentage are given in brackets.)

Analysis of data in Table No.5.17 shows that among the higher ıcome group 46.49 per cent adopt the method of boiling and 31.89 per cent adopt lter and boil method to purify water. In Middle income group maximum ːspondents (94.23 per cent) practice the method of boiling only. Where as in ›wer income group 50.40 per cent practice the method of boiling only and 49.60 er cent do not adopt any method to purify water. The majority of consumers, 'ho is not adopting any method to purify water (49.60 per cent) belong to the ›wer income group. An income status wise analysis of data also shows that the ıigher income class alone practices the method of filtering and boiling to purify vater. Since filtering is an expensive activity, the middle and lower income class s not usually adopting this method The different purification methods adopted by he majority of beneficiaries indicates the awareness among consumers regarding he qualitative problem of pubic water supply.

5.2.5 Perception On Water Supply Management

Efficiency of water supply system means ensuring steady supply at he required qualitative and quantitative standards. In terms of these indices Calicut water supply system is quite inefficient. In this study in order to understand the beneficiaries perceptions on this matter an attempt was made to analyse the performance of the supply system.

Pipe breaking and supply disruption is a frequent phenomenon in the supply system in Calicut city. However, care is taken from the part of the authorities to ensure a stable supply of treated water. The worn out pipeline causing frequent breakage and its replacement is a major problem in the supply system. The revenue crunch is a limiting factor in carrying out the maintenance work. Coupled with this, the steadily upward rising demand and stagnant supply creates imbalance in distribution. Hence an up keeping of the system and it's efficient management is urgently needed to ensure a reasonable level of supply.

.2.6 Perception On Regularity of Supply

Here analysis of the extent of satisfaction the consumers receive 'om the present supply system is projected in Table No.5.18.

Table No.5.18.

Beneficiaries Perception on Regularity of Supply

Zone	Regular and continuous	Irregular	No response	Total
Zone I	13 (9.22)	96 (68.09)	32 (22.70)	141 (100.00)
Zone II	39 (22.81)	131 (76.61)	1 (0.58)	171 (100.00)
Zone III	2 (4.44)	36 (80.00)	7 (15.56)	45 (100.00)
Zone IV	8 (14.04)	31 (54.39)	18 (31.58)	57 (100.00)
Total	62 (14.98)	294 (71.02)	58 (14.00)	414 (100.00)

Source : Field Survey Data.
Cell frequencies in percentage are given in brackets.)
Chi – Square Value is 59.37. df = 6 Table value at 1% level = 16.812
The association is significant)

Analysis of data shows that 71.02 per cent of the respondents are of he opinion that the supply is grossly irregular. 14.98 per cent gets regular and continuous supply and 14.00 per cent do not respond to the question. Thus in all Zones majority of respondents have complaints of irregularity in water supply. Of hese the maximum number of respondents is in Zone III (80.00 per cent) and Zone II (76.61 per cent). A perusal of data in general shows that the present supply system is grossly irregular and majority of consumers are not at all satisfied with the supply system.

5.2.7 Perception On Sufficiency in supply

Table No.5.19 analyses the beneficiaries perception on quantity of the water supply.

Table No.5.19.

Beneficiaries Perception on Quantity of Supply

Zone	Sufficient	Not Sufficient	No Response	Total
Zone I	41 (29.08)	74 (52.48)	26 (18.44)	141 (100.00)
Zone II	55 (32.16)	115 (67.25)	1 (0.58)	171 (100.00)
Zone III	10 (22.22)	27 (60.00)	8 (17.78)	45 (100.00)
Zone IV	12 (21.05)	27 (47.37)	18 (31.58)	57 (100.00)
Total	118 (28.50)	243 (58.70)	53 (12.80)	414 (100.00)

Source : Field Survey Data.
(Cell frequencies in percentage are given in brackets.)
Chi – Square Value is 46.88. df = 6 Table value at 1% level = 16.812
The association is significant)

Table No.5.19 shows that majority of respondents (58.70 per cent) are not able to get sufficient a\quantity of water from the supply system. However 28.50 per cent of the respondents are of the opinion that they get sufficient quantity of treated water and 12.80 per cent of respondents evaded the question.

' all the Zones majority of respondents in Zone II (67.25 per cent), Zone III 0.00 per cent) and Zone I (52.48 per cent) have complaints of insufficiency of pply. A cross analysis of data shows that the problem is acute in Zone II, cause this Zone accommodates the largest number of consumers in the delivery stem. Hence in terms of sufficiency of supply, the system is far from neficiaries expectation.

2.8 Perception On Performance of the Supply System

Kerala Water Authority is in charge of the production, treatment and stribution of treated water in the city. Perception about the performance of the ipply system is analysed in Table No.5.20.

It is evident from the data that majority of respondents in Zone I '2.34 per cent) and Zone III (66.67 per cent) gave average rating regarding the erformance of the supply system. A fairly good number of respondents (56.14 er cent) in Zone IV are of the same opinion. However among dissatisfied ategory of respondents the maximum (38.01 per cent) is from Zone II and inimum (18.44 per cent) from Zone I. Zone II accommodates the largest number f consumers and disruption in water supply owing to pipe bursting is a frequent henomenon in this Zone. In Zone I the complaints of disruption in supply owing o pipe breaking in lesser. On a consolidation of results it is to be highlighted that nspite of complaints and problems experienced, the majority of respondents

(55.32 per cent) gave average rating to the performance of the supply system. The extremely satisfied category constitute only 6.04 per cent of the total respondents.

Table No.5.20.

Beneficiaries Perception on the Performance of the Supply System

Zone	Extremely satisfied	Good	Average	Not at all	Total
Zone I	4 (2.84)	9 (6.38)	102 (72.34)	26 (18.44)	141 (100.00)
Zone II	15 (8.77)	32 (18.71)	65 (38.01)	59 (34.50)	171 (100.00)
Zone III	5 (11.11)	0 (0.00)	30 (66.67)	10 (22.22)	45 (100.00)
Zone IV	1 (1.75)	7 (12.28)	32 (56.14)	17 (29.82)	57 (100.00)
Total	25 (6.04)	48 (11.59)	229 (55.32)	112 (27.05)	414 (100.00)

Source : Field Survey Data.
(Cell frequencies in percentage are given in brackets.)
Chi – Square Value is 49.80. df= 9 Table value at 1% level = 21.666
The association is significant)

5.2.9 Perception On Restoring Disrupted Water Supply

Water supply is often disrupted due to breaking of pipeline. The respondents were asked about the disruption in piped water supply. Out of the 414 respondents 364 admitted that there is disruption in supply, where as 50 disagreed with this view. Among the 364 respondents, 360 were of the opinion that disruption is mainly due to frequent bursting of distribution pipelines, where as 4 respondents disagreed with the view. It is interesting to note that, out of the 360 respondents, 355 used to report the matter of pipe breakage and water supply disruption immediately to the authorities concerned.

To understand the efficiency of functioning of the water supply system a crucial question was asked to the respondents, "what is the usual reinstating time when the supply is disrupted?" The responses were structured as, within two days, within a week and according to the convenience of the authorities.

Table No.5.21.

Efficiency of Restoring Disrupted Water Supply

Zone	Within Two days	Within a Week	Convenience Of the Authorities	Total
Zone I	21 (22.11)	58 (61.05)	16 (16.84)	95 (100.00)
Zone II	3 (1.82)	117 (70.91)	45 (27.27)	165 (100.00)
Zone III	5 (16.13)	25 (80.65)	1 (3.23)	31 (100.00)
Zone IV	2 (5.56)	32 (88.89)	2 (5.56)	36 (100.00)
Total	31 (7.49)	232 (70.95)	64 (15.46)	327 (100.00)

Source : Field Survey Data.
(Cell frequencies in percentage are given in brackets.)
Chi – Square Value is 44.78. df = 6 Table value at 1% level = 16.812
The association is significant)

As revealed in Table No.5.21 an overwhelming majority (70.95per cent) stated that it took one week time to get the repair done and supply reinstated. The response of 15.46 per cent implies that they are at the mercy of the authorities in this matter. However 7.49 per cent informed that whenever they had a problem, within two days the authorities attended to it. When we consolidate these views it can be seen that the authorities are not paying appropriate heed to this matter. Taking one- week time to restore the supply of this life-supporting commodity, in no way, can be taken as a sign of efficiency. Regarding the impressions of the different Zones, it can be seen that the problem is much acute in Zone II and the least in Zone III. (27.27 per cent of Zone II respondents got repaired the pipes according to the convenience of the authorities. The corresponding figure in respect of Zone III is only 3.23 per cent).

It is to be inferred that in getting things right, the consumers of the city area are not supported by the authorities uniformly. The supply area of Zone II is very vast and hence complaints from there more. This might be one of the reasons, which delays the reinsting of the disrupted supply inordinately.

CHAPTER VI

DEMAND ANALYSIS OF PUBLIC WATER SUPPLY

CHAPTER VI

DEMAND ANALYSIS OF PUBLIC WATER SUPPLY

Public water supply, which constitutes a necessary part of the infrastructure, required to attain the goal of development, has to keep pace with the growth in public demand for water. The demand is likely to go up exponentially with economic development. The present chapter is devoted to a discussion on the determinants of demand and variations in its pattern. For convenience of analysis and presentation the summary of the chapter is organized as follows.

In section A, a brief analysis of the different approaches, for estimating household water demand is presented. The role of socio-economic variables in demand for pubically distributed water for residential household use is analysed in section B. The socio-economic determinants of water demand is analysed by using a) Tabular presentation and b) Empirical estimation by using Multiple Linear Regression Analysis.

6.1 Section - A

6.1.1 Water Demand Estimation – Different Approaches

Publicly distributed water is mainly used for residential or domestic purposes. The other uses of water consist of industrial and commercial establishments and service agencies such as hospitals and schools. Since only residential water uses comes under the study, we take household as the decision unit in the analysis of the residential demand for water. The decisions and responses of households regarding the use of publicly distributed water constitute the factors determining its demand and supply. Residential demand for water is defined as demand by households for drinking, cooking, bathing, washing of clothes, house cleaning, sanitation, gardening and other residential uses. There are different approaches for estimating water demand.

6.1.2 Requirement Approach to Water Demand

Water demand in a particular region is estimated on the basis of per capita requirement of the population in that region. Demand is estimated not only for the present but for a projected future period also. The demand estimates for the future are made, based on projected population increases and changes in per capita income. Water supply schemes are planned and installed on the basis of estimated demand for the present and the future. However the requirement approach does not take into consideration the possible changes in the pattern of demand in the area where water supply is being made. It assumes an unchanging relation with the size of population and the type of industrial development on the one side and the quantity of water on the other and considers demand as a given function only of population growth and type of urban development. Thus this approach suggest that water price and consumer disposable income do not affect water demand (Headly, Charles, 1963, p.441). This approach over looks the relationship between per capita demand and water rates and ignores the question of optimum per capita water use.

Hence it has encouraged "the carefree impression that water is practically free, and the frequently mistaken premise that additional supplies cost less than would measures of economy" (Landsburg, Hans H., 1965, p.126). Hence Foster and Beattie while analyzing urban residential demand for water in the United States pointed out that the estimation of urban water demand has progressed from a requirement concept to economic development models (Foster, Beattie, 1979, p.43).

6.1.3 Demand Curve Approach

The various economic factors which influence the demand for water are taken explicitly in this approach. The Economic factors would include price of water and income of the consumer. Various studies have proved the importance of economic variables in determining residential water demand and the interdependence between investment, planning, pricing policy and demand projections. Fourt (1958), Gottlieb (1963) are of this view. R.A.Batchelor pointed out in his demand model that water required by household will vary according to economic size as measured both by the number of occupants and their real wealth. Further, he put emphasis on the influence of the variations in household technology in the water demand. The technological change and the resulting introduction of water using appliances increase the level of water demand (Primeaux, Walter J. and Kenneth W Hollman, 1973, pp.189-198). Similarly various empirical studies have analysed the influence of price on the consumption pattern of water. Howe and Linaweaver estimated price elasticities of water in relation to types of uses. Like wise Billings and Agthe analysed price elasticities for water under increasing block rate pricing. Agtha and Billings made another study inorder to determine the price elasticity of demand for each income group.

The Kerala Water Authority, the only Legal Authority in Kerala follows the requirement approach to water demand in planning, installing and managing water supply systems. The project report of the proposed water supply system it prepares, estimates water demand in the region for which the scheme is proposed on the basis of per capita water use. The estimation of present and future demand is made on the requirement approach according to which the per capita per day use is multiplied by the total population of the region concerned. The growth of water demand is considered as the function of growth of population.

Demand for water for residential use is the function of both economic and non-economic variables. Many factors could affect the consumption of drinking water. Requirement approach to water demand in planning, Installing and managing public water supply system has its own limitation. Economically speaking it may not be helpful. The demand approach would seem to have a stronger claim for consideration. It explicitly takes into account the economic factors despite its conceptual limitation. Moreover in a non-egalitarian society this approach has its own weakness and limitations. But then non-economic variables are also weightily and may have to be given their due role in decision-making and estimation of costs and receipts of public water supply schemes. For a precise forecast of demand, it is better to have an understanding of the socio-economic variables influencing water demand of households.

6.2 Section - B

6.2.1 Socio-Economic Variables Influencing Demand For Water

Most of the studies on demand for public utilities have the conventional framework for the analysis. The demand for drinking water is not an exception to this. In the case of water also price determine the level of demand. However the argument does not hold good in an economy characterized by the state owned or managed pubic utility system.

In an economy when the state owns water utilities, the consideration of cost aspect are generally ignored, and hence the government meets the expenditure incurred to providing the service in the form of subsidies. In such economies the welfare of the people, socio-economic situation etc are given more importance. Hence an understanding of the factors influencing the demand for water of households would be essential for framing pricing policy and water supply augmentation and planning.

6.2.2 Data on Demand Analysis

The data for the purpose of demand analysis of the pattern of drinking water was made on the basis of a field survey conducted within the Calicut

Corporation Area. Out of the 414 samples collected from 4 independent Water Distribution Zones, for demand analysis, 289 households have metered water connection and 125 households were depending on public stand posts for water supply. Total households include households occuping pucca, semi-pucca and katcha houses. [A detailed description of the data source, sample household drawn etc is given in the Methodology part in the Introductory chapter. However for demand analysis the sample beneficiaries of Mini Water Supply is not considered now.]

6.2.3 Demand Analysis

Probably there are two ways of estimating demand for consumption of water which includes household composition effect. The first method is to incorporate the Household composition measured by Adult Equivalent Scales along with the Socio-Economic Variables in the same model. That is to say we treat all the variables as exogenous. The second method is to express the consumption function as a multiplicative model of Household size and Socio-Economic variables. Under this assumption the average household consumption per day is estimated as a function of Socio-Economic variables. For example

$$C = f\,(S, X)$$

Where 'C' is the household consumption, 'S' household size and 'X' for socio-economic variables.

In this research analysis the second method is followed.

.2.4 Field Survey Results – A Tabular Analysis

For the purpose of Tabular analysis household water consumption data ; taken as 'average household water consumption per day'. Average household 'ater consumption per day is analysed based on Zonal distribution system of water, ıdex of consumer durables the household possess, the type of dwelling units Pucca, Semi-Pucca and Katcha) and its characteristics like floor area of the house, umber of water taps, nature of flushing system in the toilets, garden attached to ouses etc, frequency of cloth washing and the size of household. Analysis of data xhibits that those who dwell in pucca and semi-pucca houses do have the average onsumption much higher than that of those staying in katcha houses. This can be .ttributed to difference in the characteristics of the house, difference in the social tatus of households measured in terms of index of household durables the ıousehold possess and income effect.

5.2.5 Field survey Results – A Tabular Presentation

Table No.6.1

Zone-Wise Average Household Water Consumption Per Day

Number of Zones	Consumption (in liters)
1	808.82
2	717.52
3	709.13
4	708.28

Source: Compiled from Field Survey Data.

Zonal analysis of consumption data given in Table No.6.1 doesn't shows any systematic and coherent pattern in household water consumption.

Table No. 6.2

House Type Wise Average Household Water Consumption Per Day

Type of House	Consumption (in liters)
Pucca	1036.79
Semi-Pucca	539.45
Katcha	255.80

Source : Compiled from Field Survey Data.

Analysis of consumption data given in Table No.6.2 shows that those who dwell in pucca and semi-pucca houses do have the average water consumption much higher than of those living in katcha houses.

Table No.6.3

Floor Area Wise Average Household Water Consumption Per Day

Range of floor area in square feet	Consumption per (in liters)
Up to 500	279.90
501 - 1000	766.26
1001 - 1500	939.65
1501 - 3000	1163.63

Source: Compiled from Field Survey Data.

In Table No.6.3 the floor area of the house is ranged in four classes. Analysis of data shows that households staying in houses with larger built in floor area do have average water consumption much higher than those staying in houses with lesser built in floor area.

Table No.6.4

Water Taps wise Average Household Water Consumption Per Day

Number of Taps (Range)	Consumption (In liters)
1 – 5	694.98
6 – 10	944.91
11 – 15	1047.42
16 – 20	1325.48

Source: Compiled from Field Survey Data.

For convenience of analysis the number of water taps are classified into four ranges. Data in Table 6.4 shows that number of water taps in a house exert a great influence on household water demand. The average water consumption of households staying in houses characterized by larger number of water taps is found much higher than those staying in houses characterized by lesser number of water taps.

Table No.6.5

Garden Wise Average Household Water Consumption Per Day

Nature of Garden	Consumption (in liters)
Houses without garden	398.27
Houses with garden	1041.55

Source : Compiled from Field Survey Data.

Table No.6.5 shows that garden is an important independent variable influencing water demand. Larger quantities of water is used for gardening and lawn watering. Houses built with garden is found consuming higher quantity of water compared to houses without any type of garden.

Table No.6.6

Flushing System Wise Average Household Water Consumption Per Day

Nature of flushing system in Toilets	Consumption (In liters)
Toilet without flushing system	282.81
Toilet with flushing system	962.23

Source : Compiled from Field Survey Data.

Various study reports shows that each flushing in a toilet consumes a minimum of 5 liters of water. Table No.6.6 shows that houses having toilets with full flushing system consumes much higher quantities of water than houses having toilets without modern flushing system.

Table No.6.7

Frequency of Cloth Washing and Average Household Water Consumption Per Day

Frequency of cloth washing	Consumption (In liters)
Daily Wash	881.16
Once in two days	414.00

Source: Compiled from Field Survey Data.

Table No.6.7 shows that households practicing daily washing of clothes consumes larger quantities of water than those practicing washing once in two days.

Table No.6.8

Range of Index of Household Durables and Average Household Water Consumption Per Day

Range of Index of Household Durables (points)	Consumption (In liters)
Up to 6 points	382.73
6 – 12	940.65
12 – 18	1028.91
Above 18	1369.94

Source: Compiled from Field Survey Data.

Household durables the households possess in a better and objective index of measuring the socio-economic status of households. In Table No.6.8 index of household durables are ranged into 4 classes. Analysis of data shows that households with larger variety of household durables consumes larger quantities of water, than households with minimum household durables.

Table No.6.9

Household Size Wise Average Household Water Consumption Per Day

Number of Family members	Consumption (In liters)
1	N.A.
2	478.90
3	602.00
4	711.83
5	849.65
Above 5	965.90

Source : Compiled from Field Survey Data.

Size of household is an important variable influencing water demand. As the number of members in a house increases, automatically the demand for water also goes up. Among the sample household surveyed, no household was found with a single member.

The tabular analysis of consumption data shows that household water consumption is influenced by:

a) The Zonal Water Distribution System
b) Type of House
c) Floor Area of the House
d) Number of Water Taps in the House
e) Garden attached to Houses
f) Type of Flushing System in the Toilets
g) Frequency of Cloth Wash
h) The index of Household Durables the household possess and
i) Household size.

6.2.6 Average Household Water Consumption - A Statistical Analysis

The effect of socio-economic variables on average household water consumption is analysed by using Multiple Linear Regression Method

6.2.6.1 Household Water Consumption - A Regression Analysis

In the regression analysis we consider the following multiple Regression Analysis.

' = f (S, Z, D, N, F, W, G) where.

; Household water consumption per day

Size of household

, Zone

) Index of household durables the household possesses

I Number of water taps in the house

Type of flushing system in the toilet, is dummy variable taking value 0 for Toilets without flushing system and 1 for toilets with flushing system in houses.

V Frequency of cloth wash, is dummy variable taking value 0 for cloth Washing on alternative days and 1 for daily wash.

i Garden attached to house, is dummy variable taking value 0 for houses without garden and 1 for houses with garden.

Therefore, the multiple regression model is,

$$= \beta_0 + \beta_1 S + \beta_2 Z + \beta_3 D + \beta_4 N + \beta_5 F + \beta_6 W + \beta_7 G.$$

Here we have to test the significance of the partial regression oefficient. That is,

$H_0 : \beta_i = 0, \ i = 1,2,3,4,5,6,7$

Test static,

$$Z = \frac{\hat{\beta}_i}{\sqrt{\sum e_i^2/(n-2)}/\sqrt{\sum x_i^2}}$$

$$\sum e_i^2 = \sum (C - \hat{C})^2$$

$$\sum x_i^2 = \sum (X_i - \overline{X})^2$$

Vhere X_i = The independent variables such as S, Z, D, N, F, W and G.

If probable value of Z is less than 0.05, reject H_0

Here the irrelevant variables are removed from the model and multiple regression model is formed with relevant variables.

From the stepwise regression, it is found that the variable Z is insignificant. Hence Z is removed from the regression model. So the regression model is

$$C = (\beta_0 + \beta_1 N + \beta_2 S + \beta_3 F + \beta_4 D + \beta_5 G + \beta_6 W)$$

The summarized results are given below.

Table No.6.10

Descriptive Statistics

	Mean	Standard Deviation	N
C	746.43	435.09	414
Z	2.04	1.00	414
S	4.22	1.18	414
D	7.63	5.89	414
N	6.55	6.17	414
F	0.70	0.46	414
W	0.66	0.47	414
G	0.56	0.50	414

Source : Compiled from Field Survey Data.

Table No.6.11

Model Summary [g]

l	R	R Square	Adjusted R square	Std. Error of the Estimate	Change statistics					Durbin-Watson
					R square change	F change	df1	df2	Sig. F change	
	.799[a]	.639	.638	261.70	.639	729.588	1	412	.000	
	.910[b]	.829	.828	180.38	.190	456.168	1	411	.000	
	.942[c]	.887	.886	146.60	.058	212.273	1	410	.000	
	.954[d]	.910	.909	131.51	.022	100.445	1	409	.000	
	.958[e]	.918	.917	125.50	.008	41.143	1	408	.000	
	.962[f]	.925	.924	119.69	.008	41.534	1	407	.000	1.733

a. Predictors (Constant), N
b. Predictors (Constant), N, S
c. Predictors (Constant), N, S, F
d. Predictors (Constant), N, S, F, D
e. Predictors (Constant), N, S, F, D, G
f. Predictors (Constant), N, S, F, D, G, W
g. Dependent variable: C

Source : Compiled from Field Survey Data.

Table No.6.12

Correlations

		C	Z	S	D	N	F	W	G
Pearson Correlation	C	1.000	-.082	.410	.793	.799	.723	.524	.737
	Z	-.082	1.000	.000	-.079	-.077	-.103	-.030	-.073
	S	.410	.000	1.000	-.050	-.031	-.041	.049	-.118
	D	.793	-.079	-.050	1.000	.871	.719	.471	.816
	N	.799	-.077	-.031	.871	1.000	.699	.433	.819
	F	.723	-.103	-.041	.719	.699	1.000	.482	.743
	W	.524	-.030	.049	.471	.433	.482	1.000	.411
	G	.737	-.073	-.118	.816	.819	.743	.411	1.000
Sig.(1-tailed)	C	.	.047	.000	.000	.000	.000	.000	.000
N	C	414	414	414	414	414	414	414	414

Source : Compiled from Field Survey Data.

Table No.6.13

ANOVA

Model		Sum of squares	df	Mean square	F	Sig.
1	Regression	49966568	1	49966568	729.588	.000[a]
	Residual	28216250	412	68486.043		
	Total	78182818	413			
2	Regression	64809533	2	32404767	995.893	.000[b]
	Residual	13373284	411	32538.405		
	Total	78182818	413			
3	Regression	69371503	3	23123834	1075.977	.000[c]
	Residual	8811315.1	410	21491.012		
	Total	78182818	413			
4	Regression	71108796	4	17777199	1027.828	.000[d]
	Residual	7074021.3	409	17295.896		
	Total	78182818	413			
5	Regression	71756801	5	14351360	911.195	.000[e]
	Residual	6426016.3	408	15750.040		
	Total	78182818	413			
6	Regression	72351846	6	12058641	841.689	.000[f]
	Residual	5830971.7	407	14326.712		
	Total	78182818	413			

a. Predictors (Constant), N
b. Predictors (Constant), N + S
c. Predictors (Constant), N + S + F
d. Predictors (Constant), N + S + F + D
e. Predictors (Constant), N + S + F + D + G
f. Predictors (Constant), N + S + F + D + G + W
g. Dependent variable C

Source : Compiled from Field Survey Data.

Table No.6.14(A)
Coefficients[a]

Model	Un standardized Coefficients		Standardized Coefficients			95% confidence interval for B	
	B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound
1 (Constant)	377.372	18.765		20.111	.000	340.486	414.259
N	56.360	2.087	.799	27.011	.000	52.258	60.461
2 (Constant)	-306.135	34.517		-8.869	.000	-373.987	-238.283
N	57.323	1.439	.813	39.837	.000	54.494	60.151
S	160.390	7.510	.436	21.358	.000	145.628	175.152
3 (Constant)	-430.545	29.323		-14.683	.000	-488.187	-372.903
N	40.701	1.634	.577	24.913	.000	37.490	43.913
S	162.777	6.105	.442	26.662	.000	150.775	174.778
F	319.702	21.943	.338	14.570	.000	276.567	362.837
4 (Constant)	-468.112	26.571		-17.617	.000	-520.345	-415.878
N	24.424	2.188	.346	11.165	.000	20.124	28.724
S	164.962	5.481	.448	30.095	.000	154.186	175.737
F	254.657	20.728	.269	12.286	.000	213.911	295.402
D	23.641	2.359	.320	10.022	.000	19.004	28.278
5(Constant)	-486.557	25.519		-19.067	.000	-536.722	-436.392
N	19.636	2.217	.279	8.857	.000	15.278	23.995
S	170.374	5.298	.463	32.156	.000	159.959	180.790
F	208.448	21.051	.220	9.902	.000	167.067	249.830
D	19.608	2.337	.266	8.390	.000	15.014	24.202
G	160.540	25.029	.183	6.414	.000	111.339	209.741
6 (Constant)	-502.069	24.457		-20.528	.000	-550.147	-453.991
N	19.478	2.115	.276	9.211	.000	15.321	23.635
S	167.760	5.069	.456	33.092	.000	157.794	177.726
F	178.141	20.620	.188	8.639	.000	137.605	218.677
D	17.527	2.252	.237	7.782	.000	13.100	21.955
G	165.625	23.884	.189	6.935	.000	118.673	212.576
W	93.666	14.534	.102	6.445	.000	65.095	122.237

a. dependent variable : C

Table No. 6.14 B
Coefficients[a]

Model	Correlation			Co linearity Statistics	
	Zero-order	Partial	Part	Tolerance	VIF
1 (Constant)					
N	.799	.799	.799	1.000	1.000
2 (Constant)					
N	.799	.891	.813	.999	1.001
S	.410	.725	.436	.999	1.001
3 (Constant)					
N	.799	.776	.413	.512	1.954
S	.410	.796	.442	.998	1.002
F	.723	.584	.242	.512	1.955
4 (Constant)					
N	.799	.483	.166	.230	4.353
S	.410	.830	.448	.997	1.003
F	.723	.519	.183	.461	2.167
D	.793	.444	.149	.217	4.616
5(Constant)					
N	.799	.402	.126	.204	4.909
S	.410	.847	.456	.971	1.029
F	.723	.440	.141	.407	2.455
D	.793	.384	.119	.201	4.976
G	.737	.303	.091	.247	4.056
6(Constant)					
N	.799	.415	.125	.204	4.910
S	.410	.854	.448	.965	1.036
F	.723	.394	.117	.386	2.590
D	.793	.360	.105	.197	5.081
G	.737	.325	.094	.246	4.061
W	.524	.304	.087	.729	1.371

a. Dependent variable : C

Table No.6.15
Excluded Variables[g]

Model		Beta In	t	Sig.	Partial Correlation	Co linearity Statistics		
						Tolerance	VIF	Minimum Tolerance
1	Z	-.021[a]	-.713	.476	-.035	.994	1.006	.994
	S	.436[a]	21.358	.000	.725	.999	1.001	.999
	D	.401[a]	7.031	.000	.328	.241	4.155	.241
	F	.321[a]	8.392	.000	.382	.512	1.954	.512
	W	.219[a]	7.067	.000	.329	.813	1.230	.813
	G	.251[a]	5.011	.000	.240	.330	3.030	.330
2	Z	-.020[b]	-.984	.326	-.049	.994	1.006	.993
	D	.443[b]	12.496	.000	.525	.240	4.164	.240
	F	.338[b]	14.570	.000	.584	.512	1.955	.512
	W	.187[b]	8.998	.000	.406	.809	1.236	.809
	G	.382[b]	12.462	.000	.524	.322	3.110	.322
3	Z	-.003[c]	-.201	.840	-.010	.989	1.011	.509
	D	.320[c]	10.022	.000	.444	.217	4.616	.217
	W	.121[c]	6.602	.000	.310	.745	1.343	.471
	G	.248[c]	8.325	.000	.381	.266	3.763	.266
4	Z	-.003[d]	-.183	.855	-.009	.989	1.011	.217
	W	.099[d]	5.888	.000	.280	.730	1.369	.212
	G	.183[d]	6.414	.000	.303	.247	4.056	.201
5	Z	-.004[e]	-.271	.787	-.013	.989	1.011	.201
	W	.102[e]	6.445	.000	.304	.729	1.371	.197
6	Z	-.006[f]	-.449	.654	-.022	.989	1.012	.197

a. Predictors in the Model: (Constant), N
b. Predictors in the Model: (Constant), N + S
c. Predictors in the Model: (Constant), N + S + F
d. Predictors in the Model: (Constant), N + S + F + D
e. Predictors in the Model: (Constant), N + S + F + D + G
f. Predictors in the Model: (Constant), N + S + F + D + G + W
g. Dependent variable: C

Table No.6.16
Coefficient correlations[a]

Model		N	S	F	D	G	W
1 Correlations	N	.1.000					
Covariances	N	4.354					
2 Correlations	N	1.000	.031				
	S	.031	1.000				
Covariances	N	2.071	.339				
	S	.339	56.394				
3 Correlations	N	1.000	.004	-.698			
	S	.004	1.000	.027			
	F	-.698	.027	1.000			
Covariances	N	2.669	3.673E-02	-25.033			
	S	3.673E-02	37.274	3.595			
	F	-25.033	3.595	481.498			
4 Correlations	N	1.000	-.027	-.212	-.742		
	S	-.027	1.000	.013	.040		
	F	-.212	.013	1.000	-.313		
	D	-.742	.040	-.313	1.000		
Covariances	N	4.786	-.325	-9.606	-3.831		
	S	-.325	30.045	1.478	.514		
	F	-9.606	1.478	429.629	-15.309		
	D	-3.831	.514	-15.309	5.564		
5 Correlations	N	1.000	-.079	-.072	-.583	-.337	
	S	-.079	1.000	-.042	-.005	.159	
	F	-.072	-.042	1.000	-.191	-.342	
	D	-.583	-.005	-.191	1.000	-.269	
	G	-.337	.159	-.342	-.269	1.000	
Covariances	N	4.915	-.925	-3.370	-3.019	-18.681	
	S	-.925	28.072	-4.733	-6.231E-02	21.120	
	F	-.3.370	-4.733	443.128	-9.411	-180.305	
	D	-3.019	-6.231E-02	-9.411	5.462	-15.738	
	G	-18.681	21.120	-180.305	-15.738	626.426	
6 Correlations	N	1.000	-.078	-.068	-.575	-.337	-.012
	S	-.078	1.000	-.023	.007	.156	-.080
	F	-.068	-.023	1.000	-.152	-.341	-.228
	D	-.575	.007	-.152	1.000	-.271	-.143
	G	-.337	.156	-.341	-.271	1.000	.033
	W	-.012	-.080	-.228	-.143	.033	1.000
Covariances	N	4.472	-.832	-2.950	-2.739	-17.012	-.357
	S	-.832	25.700	-2.397	7.429E-02	18.892	-5.896
	F	-2.950	-2.397	425.198	-7.042	-167.721	-68.348
	D	-2.739	7.429E-02	-7.042	5.073	-14.570	-4.692
	G	-17.012	18.892	-167.721	-14.570	570.438	11.466
	W	-.357	-5.896	-68.348	-4.692	11.466	211.233

a. Dependent Variable C

Based on the above results we reject

$$H_0 : \beta_i = 0, \; i = 1,2,3,4,5,6,7$$

Here the fitted model is

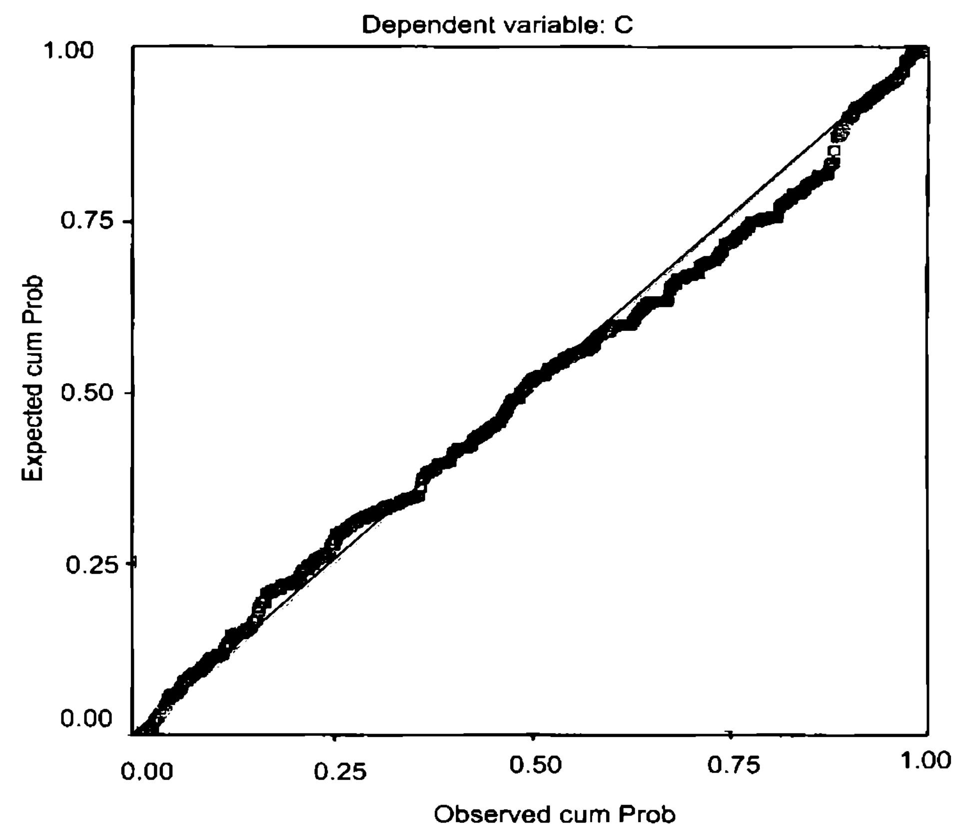
$$C = (\beta_0 + \beta_1 N + \beta_2 S + \beta_3 F + \beta_4 D + \beta_5 G + \beta_6 W)$$

$$= -502.069 + 19.478 N + 167.760 S + 178.141 F + 17.527 D + 165.625 G + 93.666 W$$

Normal P-P Plot of Regression Standardized

Dependent variable: C

Fig. 6.1. Normal P-P Plot of Regression Standardised



So the fitted model is very close to the curve of observed data.

CHAPTER VII

PARTICIPATORY APPROACH IN DRINKING WATER SUPPLY – AN ANALYSIS OF MINI WATER SUPPLY SCHEME IN THE CITY OF CALICUT

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PARTICIPATORY APPROACH IN DRINKING WATER SUPPLY – AN ANALYSIS OF MINI WATER SUPPLY SCHEME IN THE CITY OF CALICUT

Traditionally Kerala had a very sound system of conservation and management of natural resources. These systems not only ensured adequate water for both irrigation and domestic needs but also conserved rain water to offset any variation in its normal flow. However, today the state is moving towards a severe water crisis. Kerala is experiencing acute water shortage. The main reasons for this are: introduction of system with no community participation, choice of inappropriate technologies, neglect of time tested traditional systems, indiscriminate resource exploitation and an ever increasing water demand caused due to the spiraling population growth and aspiration for an increasingly urban life style.

Over the past two decades Kerala has been adopting a centralised strategy of planning, implementing and maintaining water supply systems. Kerala Water Authority (K.W.A) is the sole agency of planning, executing and maintaining all water supply schemes in the state of Kerala. Ever since its formation as an autonomous body in the year 1982, K.W.A has taken over all existing (small, medium and large) public water supply projects throughout

Kerala. K.W.A has constructed many comprehensive water supply schemes most of which are large regional piped water supply schemes that pump water from river or streams, treat the raw water, store it in high Over Head Reservoirs (OHRs) located on elevated places and distributed the water by gravity to vast areas through a net work of pipelines and public stand posts.

However, in many urban and rural areas due to poor and inappropriate design and inefficient operation and maintenance, the schemes are working far below satisfactory level and people in both urban and rural centres are loosing confidence in such schemes. The centralised distribution system as such is not able to cater to the minimum water needs of lower income group. Consumption variation is acute among different social strata within the urban centres. Far away elevated localities in urban centres are not fully and satisfactorily covered by the centralised distribution system. Studies show that larger command area and intermittent supply systems are responsible for this distribution problem. Low tariff rate coupled with poor revenue yield makes the centralised supply system operationally inefficient.

By early 1990s the national policy on water supply sector changed radically and it has been widely accepted that decentralised community managed water supply schemes are ideally suited for solving location specific problems in water availability and to ensure a fair distribution of water. Although there is unanimity on the need for decentralization and community participation, the methodology for achieving this has been elusive and is only evolving slowly.

In Kerala the implementation of the national policy, to devolve Government tasks to the local level is gradually taking place. Legislative measures in this regard are underway. However, implementation of these directions in the water supply sector is very time consuming, since the issues involving are fairly complicated particularly in the institutional context.

A number of concepts and institutional models for decentralization of water supply sector are emerging in the rural and urban centres of Kerala catering to the requirements of small groups of families residing in isolated and water scarce localities. The important among them are a) Panchayat (Peoples Planning Campaign Model), (b) Kerala Rural Water Supply Agency Model, (c) Rajive Gandhi Sector Reform Model, (d) N.G.O. Model, (e) Olavanna (Private Community) Model, (f) Mini Water Supply Scheme Model.

'Active community participation' is one major common feature of all these models. It is premature to compare or comment upon these models since all their problems and promises have not yet been delineated. However these models with active beneficiary participation is functioning fairly well in many areas.

In this chapter an attempt is made to critically review the functioning of one such model, the Mini Water Supply Schemes, operative in the city of Calicut, catering to the drinking water requirements of population residing in water scare localities of the city.

In the heart of the city and in coastal areas population depends upon K.W.A supply. But in isolated pockets and water scarce places, where centralised supply is not adequately available, a good number of families are depending on Mini Water Supply Schemes. In the Ninth Five Year Plan, the Corporation of Calicut in order to reduce the water scarcity problem of the city, commissioned a large number of Mini Water Supply schemes involving community participation. Thirty-nine projects were included in the Ninth Plan for completion. So far seventeen projects were commissioned and cater to the requirements of small group of families in different localities. Another fifteen projects are in the process of completion.

The city of Calicut, with high density of population, still continues to experience water scarcity. Even though water supply is the legal responsibility of K.W.A, in water scarce places where K.W.A supply can't reach adequately, the Corporation of Calicut is able to ensure reasonable supply of drinking water through Mini Water Supply Schemes commissioned with community participation. Approximately 1500 families are benefited from these projects.

Another salient feature is that all these projects are located in the water scarce places of the city area, where the centralised supply system failed to operate due to undulating geography and shortage in supply. Another characteristic is that all projects are selected purely based on community demand. The need for a project in a particular locality will be placed for discussion in the concerned ward committee meeting in the first instance. After detailed discussion, the committee will prioratise the projects and submit the same for approval and sanction to the Corporation Council.

The execution of the project and its operation and maintenance is entrusted to a 'Beneficiary Committee' called 'Managing Committee', constituted from among the beneficiaries of the project concerned. In the Beneficiary Committee, one –third of the members are females. This has a direct impact on water utilization practice and water literacy level among the beneficiaries. The operation and maintenance expenditure of the project, which include, operators allowance, maintenance expense and electricity charges are shared by the beneficiaries. Hence it has become a peoples own scheme. Moreover all schemes are utilizing the traditional sources of water supply like open wells, ponds or streams. Raw water supply is ensured either by generation of traditional source in each location or by rennovation of existing traditional source. For many projects local resources like land is pooled as a free gift from among the beneficiaries for construction of well/pond and overhead tank.

In this study, out of the seventeen projects commissioned so far, six projects from different water scarce localities were considered. At random ten beneficiaries from each project was interviewed. Projects were analysed based on water availability, pattern of water use, generation of water literacy, economic viability and cost effectiveness, socio – economic impact, water quality maintenance and the extent of community involvement in running the projects.

A general profile of the projects in terms of number of households benefited, location, water supply duration etc is given in Table No.7.1. A perusal of the data given in Table 7.1 shows that the projects are covering small clusters of houses ranging from 40 in Project No.08 to 150 in Project No. 07. All the projects considered for study is located in water scarce places. Except in Project No.4, in all other projects supply is regulated through public stand post. In project No.4. a few metered connections is provided to consumers. The water supply hours were fairly good when compared to the centralised system of supply. Supply ranges from a minimum of 3 hours to a maximum of 10 hours in different projects.

Table No.7.1

General Profile Of The Project

Project Code	Number Of Households Benefited	Number Of Domestic Connection	Number Of Public Stand Posts	Water Supply Duration (in hours)
05	120	Nil	20	5 – 10
07	150	Nil	20	3 – 5
02	120	Nil	30	3 – 5
03	120	Nil	30	4 – 5
08	40	Nil	8	5 – 10
04	90	38	13	4 – 5

Source : Compiled from Field Survey Data

7.1 Equity In Distribution And Better Availability Of Supply

A salient feature of the Mini Water Supply System is that, it is able to ensure adequate supply of water without much distributional variation. Since each project is confined to a particular locality with small clusters of households, all are able to fetch a reasonable quantity from the supply system. Table No.7.2 gives an analysis of average per capita water consumption per day.

Table No.7.2

Data On Average Per Capita Water Consumption Per Day (In lpcd)

Project code	Average per capita consumption (In liters) per day.		Targeted supply (lpcd)
	Own connection Consumers	Consumers Depending on P.S.P.	
05	Nil.	100	100
07	Nil	85	80
02	Nil	107.50	100
03	Nil	110.25	100
08	Nil	107.50	80
04	137	109.75	100

Source : Compiled from Field Survey Data

Consumption data given in Table No.7.2 shows that in all projects, beneficiaries are able to realize fairly satisfactory level of consumption. In all projects availability exceeds the targeted level of supply. In project No 04, there are a few metered consumers who possess alternative sources like own well. They also receive a reasonable level of supply. Moreover analysis of data given in Table 7.2 clearly indicates that water availability is more or less evenly distributed among the consumers depending on public stand post.

Since the operation and maintenance is carried out by beneficiaries themselves, repair if any, are attended promptly and hence the water supply scheme is highly reliable. Even though the supply hours are limited, the quantity upplied is adequate to meet the demand of the people. Hence beneficiaries are atisfied by the service and supply hours.

7.2 Economy In Water Use Pattern

A perusal of data pertinent to water use pattern of beneficiaries shows that, in all the six projects considered for analysis, nobody was found using water for other purposes like gardening, vehicle cleaning, animal bathing and construction activities. All the sixty respondents were found using water only for heir household purpose like cooking, drinking, bathing, washing and sanitation. This is because of the high degree of water literacy existing among the small group of families in each project. Since each family is involved in the execution and running of the project concerned and since they were experiencing water shortage for a pretty long time till the commissioning of those project, people knowingly restrain from the practice of misuse of water.

7.3 Quality Maintenance Of Water

Quantity and quality are equally important in any supply system. In Mini Water Supply Schemes since the size of the project is small, beneficiaries are able to maintain good quality of water. Out of the six projects surveyed, in four projects overhead water tank is cleaned once in two months. Where as in two other projects cleaning is done once in three months. Secondly three projects resort to the method of chlorination of water once in a month, where as in two other projects chlorination is done once in two week. Only in one project chlorination is done once in a week. Thirdly in all the projects the distribution mains and pipelines were found well protected from waste water flows. Fourthly open wells constructed for water pumping were satisfactorily protected from waste water flows with surrounding parapet walls and well covered with netting. Hence we can ascertain that all the projects ensures good quality water supply.

7.4 Social Acceptability

Although majority of the user community were poor they shared capital cost ranging from 7 to 12 per cent, depending upon the type of supply (public tap or house connection). Table No.7.3 gives a detailed analysis of the beneficiaries contribution or share in total cost.

Perusal of data given in Table 7.3 clearly shows that depending upon their income status beneficiaries have contributed their share in the execution of the project. The percentage share in total cost varies from 7.14 per cent in project 03 to 12.24 per cent in project 07. Apart from the sharing of cost in money terms, the beneficiaries also renders their free service in terms of free labour, and local expertise in the construction of the project. Moreover, in many cases land for construction of well and pump house is provided free of cost by beneficiaries. If this also is taken into account, the involvement of the community in the execution of the project is impressive and meaningful.

Table No.7.3

Capital Cost Structure (Project Wise)

Project code	Total Average Cost (In Rupees)	Beneficiaries share in total cost (In Rupees)	Beneficiaries percentage share in total cost
05	4,80,000.00	50,000.00	10.42
07	4,90,000.00	60,000.00	12.24
02	3,80,000.00	30,000.00	7.89
03	3,50,000.00	25,000.00	7.14
08	3,55,000.00	27,500.00	7.75
04	3,50,000.00	40,000.00	11.43

Source : Compiled from Field Survey Data

Secondly the beneficiaries managed and fully paid for the operation and maintenance of the scheme. This includes the monthly electricity charge, operators allowance, chemical cost, if any, and the expenses for repair works. Out of the six projects surveyed, in four projects the operator's service was voluntarily done by persons authorised by the beneficiary committee. In other four projects the operative expense paid was less than Rs.1000/- per month.

Thirdly the collection of the user charge from all the beneficiaries has enriched the social acceptability of the projects. User charge varies from Rs.10/- to Rs.40/- per household, per month, in all the surveyed projects. The payment of user charge is obligatory on all beneficiaries. Usually it is collected by operators or authorized persons by the beneficiary Committee. Since beneficiaries are residing nearby, the user charge collection is a simple affair and there is hundred per cent achievements in revenue collection in all projects.

7.5 Socio – Economic Impact

The Mini Water Supply Schemes apart from providing drinking water has made its impact on the socio – economic front. Women and children who used to spent a lot of time in fetching water are getting more time for engaging themselves in productive economic activities.

Table No.7.4

Distance From Public Stand Post To The Beneficiaries House

Average distance of Public stand posts	Frequency
Below 25 Meters	14 (25.92)
25 – 50 Meters	30 (55.56)
50 - 75 Meters	10 (18.52)
Total	54 (100.00)*

Source : Compiled from Field Survey Data

(* Out of the 60 samples selected, 06 are having metered water connection and 54 depend on P.S.P)

Perusal of data given in Table No.7.4., shows that majority of beneficiaries (55.56 per cent) has proximity to public stand posts with in a distance of 25-50 meters, and for 25 per cent of beneficiaries, the facility is available within a distance range of below 25 meters. The remaining 18.52 per cent of ɔeneficiaries are having the pubic stand post within a distance of 50-75 meters. [he nearby availability of water source, helps the women and children in the 'amily to save precious time and energy. Table No.7.5 gives an insight into the ɪverage time spent by women and children in collecting water form public stand ɔosts.

Table No.7.5

Average Time Spend to Collect Water from P.S.P

Average time spent to collect Water from P.S.P.	Frequency
Below 30 minutes	25 (46.30)
30 – 60 minutes	20 (37.04)
60 – 90 minutes	9 (16.66)
Total	54 (100.00)*

Source : Compiled from Field Survey Data
(* Out of the sixty samples selected 06 are having metered connection and 54 depend on P.S.P).

Analysis of data shows that 46.30 per cent of beneficiaries are able to collect the required quantity of water within 30 minutes time; where as 37.04 per cent spent 30 – 60 minutes to collect water. The percentage of consumers spending more than 1 hour is only 16.66. Survey results shows that women and children are engaged in collecting the water for household use. Hence in these projects, the time spent by women and children in collecting water is lesser because of the proximity of source. Though not measured directly availability of good drinking water indirectly contribute to the improvement of health of the local community. Thus the time, place and cost of supply are affordable and suitable to local conditions.

7.6 Better Management

Due to resource crunch, shortage in raw water source, undulating geography and distributional problems, the centralised water supply schemes are not able to provide a satisfactory level of service and supply to the citizens of Calicut. Since the decentralised model is specifically catering to the requirements of small clusters of houses, it is expected to provide better and reasonable level of water supply. Moreover, community movement in its execution and management also ensures good governance. The beneficiaries of Mini Water Supply Schemes were asked to make an assessment of the general performance of the supply system and in particular the functioning of the Managing Committee which is running the project. Beneficiaries after making a comparative weighing of the situation before and after the commissioning of the project gave different opinion. The beneficiaries perception about the performance of the supply system and the functioning of beneficiary Committee is given in Table No.7.6 and 7.7.

Table No. 7.6

Beneficiaries Perception On The Performance Of The Mini Water Supply System

Perception	Frequency
Extremely satisfied	6 (10.00)
Good	32 (53.33)
Average	22 (36.67)
Total	60 (100.00)

Source : Compiled from Field Survey Data

Analysis of data given in Table No.7.6. shows that 53.33 per cent of the respondents are of the opinion that the supply system performs fairly good. Where as 36.67 per cent gave average rating regarding performance of the system, and 10 per cent were extremely satisfied with the performance of the system. Here no respondent is reported to have any complaint about the supply system. Hence we can conclude that the supply system is able to ensure reasonable level of water availability and better service to the beneficiaries. The reason is obvious. Before the commissioning of these projects, people in the concerned localities were forced to travel more than one kilometer to fetch water from distant wells and public taps of the centralised system situated at far away places.

Table No.7.7

Beneficiaries Perception On The Functioning Of The Managing Committee

Perception	Frequency
Excellent	8 (13.33)
Good	34 (56.67)
Satisfactory	18 (30.00)
Total	60 (100.00)

Source : Compiled from Field Survey Data

Data given in Table No.7.7 clearly shows that out of the sixty respondents, nobody expressed any difficulty or dissatisfaction with the performance of the Managing Committee. 56.67 per cent of the respondents gave rating 'good' and 30 per cent rated the performance at satisfactory level. Only 13.33 per cent were of the opinion that the functioning of the Managing Committee is excellent. Since the supply system covers a limited number of families and the Managing Committee (Beneficiary Committee) is democratically constituted from among the beneficiaries who knows each other, the chances for complaints and inefficiencies in performance are rare to occur.

7.7 Water Demand Management

Demand management depends upon water conservation measures and reduction in unaccounted water and control over consumption. Since the distribution system is rather small, and in most of the projects pipeline is laid at shallow depth in beneficiaries on land, repairs are attended and completed fast. Moreover pipelines are properly protected from wastewater flows, which helps to reduce pipe breakage, leakages and disruption in supply.

7.8 Sustainability

Mini Water Supply Schemes are based on the time tested traditional system. The system taps water from natural sources like river, pond and well and after proper processing supplies to its beneficiaries. The system is basically designed with the motivation of conserving and developing the traditional sources of water. The decentralised conservation of unevenly distributed water source ensures greater sustainability of the system. Moreover in each project water supply connections and public stand posts are provided only after considering the capacity of the well or pond serving as raw water source. So the probability of generation of demand, supply gap in water supply is not likely to occur. Hence these projects are able to generate sustainability in production and supply of water.

7.9 Economic Viability And Cost Effectiveness

Another highlight of the scheme is its economic viability and cost effectiveness. Large scale centralised water supply system require large mobilization of resources which is beyond the reach, as far as the present financial position of the state of Kerala is concerned. Compared to other schemes, the construction, operation and maintenance cost of K.W.A schemes are high due to

(a) involvement of contractors in the construction and maintenance of the project, (b) overhead expenses and higher salaries of staffs, (c) better quality of materials of construction practices adopted, (d) the need to fulfill stringent project specifications and e) long procedural delay and overruns.

Hence considering the resource crunch and stipulations regarding cost and production procedures, the best system suitable for the undulating geographical condition of Calicut city is the community participated Mini Water Supply Schemes. These schemes are designed and executed with local resources, local expertise and locality based management experiences. These systems are in line with the development strategy based on the conservation and renovation of traditional water sources. In these projects there is a harmonious blending of local resources, local knowledge and modern technology.

Therefore the cost effectiveness of these schemes are much higher, when compared to projects executed by K.W.A. A cost comparison is given in Table No.7.8. Here an alternative cost model is prepared for each project under study. What will be the cost, if the project of the same size and specifications, when commissioned under the K.W.A system? With the help of the experts in the field, the alternative cost is worked out. A sample cost model is given in Annexure 1 to show the method adopted for computing the alternative cost model.

Table No.7.8

Project-Wise Average Cost Of Mini Water Supply Schemes – Comparison With Alternative Cost Models

Project Code (1)	Average cost Of each project (in Rupees) (2)	Period taken for Completion of the project (in Years) (3)	Estimated cost if Commissioned Under K.W.A Scheme (in Rupees) (4)*	Percentage Variation In cost (5)
05	4,80,000.00	3	8,25,000.00	+71.88
07	4,90,000.00	3	8,50,000.00	+73.47
02	3,80,000.00	3	5,60,000.00	+47.37
03	3,50,000.00	3	5,25,000.00	+50.00
08	3,55,000.00	1	5,40,000.00	+52.11
04	3,50,000.00	2	5,30,000.00	+51.43

Source : Compiled from Field Survey Data

Note: * The gestation period is assumed as period given in column No.3.

Perusal of data given in Table No.7.8 shows that the gestation period of the project commissioned with community participation is comparatively low, than under centralised schemes. In the case of all the six projects considered for study the maximum period taken for completion is three years. In the case of project 08, it took only one year for completion and commissioning.

Column No.4 of Table No.7.8 shows the probable cost of each project, if it is executed and implemented under the centralised system of K.W.A.

It is evident from the table that except in project 02, in all the other five projects, the cost increase is even more than fifty per cent. In project 05, and 07, it is even above 70 per cent, than the original cost measured. Hence we can safely conclude that Mini Water Supply Schemes are cost effective and therefore economically viable. The popular theory that the per capita capital and operation and maintenance cost of smaller schemes will be more than large centralised schemes has been completely demolished from the experience of this study.

7.10 Generation of Community initiative

The process of peoples monitoring, transparency in functioning, execution of the work by Beneficiary Committee, increased female participation, in management, execution of demand driven projects, generation of water literacy are some of the salient benefits flowing from these community initiated Mini Water Supply Schemes. Coupled with this it's cost effectiveness and utilization and conservation of traditional time tested water sources makes these projects environmentally, economically and technically suitable to local conditions.

This community initiative has created a positive degree of peoples involvement and responsibility in running development projects, which can be extended to other spheres of development activities.

Hence it can be concluded that Mini Water Supply Schemes involving community participation is best suited to solve the location specific problems in water availability in the city of Calicut. Secondly since all these projects are located in water scare regions, where centralised supply system failed to ensure reasonable supply to economically and socially backward population, it can be ascertain that these schemes are best suited to cater to the water requirements of households in the lower income strata. Hence the analysis vindicates the hypothesis that: a) Mini schemes can function effectively as an alternative system in solving location specific problems in water availability and b) the user friendly mini schemes are much better than the centralised supply system in ensuring efficient water supply, economy in water use, cost effectiveness and generation of water literacy.

CHAPTER VIII

SUMMARY AND CONCLUSION

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Urban public water supply system seems to be plagued by two major problems. Firstly the rapid growth of urban population in our country put a great strain on already installed capacities. A second and related problem is that of poor management, a reflection both of under development of technical and managerial skill and of the difficulty of relating costs to benefits. Thus the coming years are bound to see a series of issues crop up in water management. Still four key challenges with respect to urban water supply will overshadow all else. They are: (1) How can water consumers be sensitized to the scarcity of water? (2) How can we ensure that a sense of equity pervades in water provision that enables the country to reach this vital resources to everyone of its citizens at a reasonable standard and at an affordable price? (3) How can water utilities be made financially self -sustaining which will allows continuous investment in water supply capacities? (4) How can we ensure an increased participation of the community in the present decentralised planning process, in production, processing and distribution of water and for sustainability of the system? In the context of these challenges, issues relating to the management of scarce water resources will emerge as the crucial component of our economic consciousness. A good deal of research at the micro level is needed in this area, to ascertain the availability problem of drinking water, shortage in its supply and issues relating to water quality and management problems. However, studies on the different aspect of urban piped water supply system are few. This study assumes significance in this context.

In the state of Kerala too, this is a little researched area. In the case of water pricing a number of studies are available. However no serious and systematic study has come up so far relating to water demand analysis and the distributional system of urban water supply. This study is first of its kind, which focuses on the distributional and availability problems of piped water supply in an urban center in Kerala.

Hence there is a felt need for enquiring into the sufficiency of potable water supplied to people in urban areas and the efficiency maintained in providing the scarce resource and preventing its misuse by the consumers. Moreover a large number user friendly Mini Water Schemes, with community participation, has been commissioned in different localities within Calicut city. This eco-friendly projects are catering to the drinking water requirements of small clusters of households residing in water scarce locality in the city. No study has come up taking into account the socio-economic impact of these projects in the supply system. It is in this backdrop that this study was undertaken and its empirical part was conducted in Calicut city in the state of Kerala

8.1 Objectives of the Study

Objectives of the study are:

1. To analyse issues related to water availability faced by different categories of consumers within Calicut city.
2. To investigate the water use pattern of the beneficiaries of the system.
3. To identify the socio-economic variables influencing household water demand.
4. To analyse the overall efficiency of the city water supply system and
5. to analyse the feasibility of Mini Water Supply Schemes, as an alternative for solving the water availability problems of the consumers within the city.

8.2 Hypothesis

The following hypothesis have been examined.

1. Consumers belonging to the lower income group, who are socially and economically backward are badly affected by the public delivery system of piped water. The water availability problem is acute in this category of consumers, compared to consumers in higher income groups.
2. Given certain conditions Mini water supply, involving community participation appears to be better than the centralised supply system managed by the Government, in terms of equity in water availability, economy in water use, cost effectiveness, quality maintenance and generation of water literacy.

8.3 Data and Methodology

The major source of primary data was interview of 414 heads of households selected on a random basis from the various types of consumers in Calicut city. A well structured interview schedule was used for collecting data from the respondents. For the analysis of the user friendly nature of the mini water scheme six representative schemes which are functioning in the various parts of the city were selected. Ten beneficiaries were selected on a random basis from each project for collecting data. Information were collected from the managers and beneficiaries of the schemes.

Sources of secondary data were published materials and experience surveys.

The four important aspects under investigation in the study are: 1) A descriptive analysis of the present water supply system in Calicut city, in terms of source, augmentation, transmission and distribution by the Kerala Water Authority. 2) A detailed analysis of the efficiency of the water supply system, in terms of water availability, , use pattern, quality and management based on the beneficiaries perception on it. 3) Household water demand analysis and 4) An analysis of the role of mini water supply schemes, as an alternative system in solving the location specific water availability problem, based on beneficiaries perception.

The methodology adopted for studying these four aspects and the summary of the major findings of the study are detailed below.

8.4 Calicut Water Supply System

For studying this aspect secondary data source is used. Administrative reports, budget papers, Accounts and other related literature available at K.W.A., Regional office, Calicut and Head office Trivandrum were collected and examined. Personal interviews and discussions were also conducted, with corporation council members and experts in fields, to ascertain location specific problems in water availability. The major findings are summarized below.

1. The present supply of piped water in the city of Calicut is just sufficient to meet fifty per cent of the requirements in the city. The city receives only 55 MLD of treated water, as against the demand of 114.3 MLD in 2001. Hence supply is restricted on alternative days, that too for a few hours.
2. Running projects are insufficient to meet the steadily increasing drinking water demand. Since projects are not properly planned and executed, considering future demand, water scarcity increases yearly.

3. Poor quality of other sources of supply also helped to increase the demand for public supply, leading to widening of the demand, supply gap in the system.
4. Due to supply demand gap and intermittent supply, available water is not distributed equally among consumers in different water distribution zones. The 'hoarding syndrom' among consumers also lead to excess draining of water from water mains in lower areas, thereby affecting availability of water in elevated areas and far away places from the distribution zones.
5. Resource crunch is a major problem affecting the supply system. Average monthly revenue collection is not sufficient to meet the monthly electricity charge for running Calicut city water supply scheme.
6. Hence the main problems of the present system are; defective distribution system, insufficiency of the treated water, reduction in efficiency of the system, undulating geographical features of the city, insufficient power supply and insufficient funds available. The most urgent need is to utilize the drinking water in a sustainable manner. Rehabilitation of the existing Calicut water supply scheme is another crying need for an effective utilization of the present installed capacity.

8.5 Perception on the Water Supply System

This chapter contains a detailed analysis of the efficiency of the water supply system based on beneficiaries perception on it. For convenience of analysis and presentation, the summary of the chapter is organized in two section. Section A, contains an analysis of the water availability problem faced by consumers residing in pucca, semi-pucca and katcha houses from the public delivery system of water. For the purpose of analysis tabular presentation of the per capita water consumption per day (lpcd) computed from field survey data is coded and analysed. The test of significance for the difference in average percapita consumption per day (lpcd) obtained from field survey data and admissible consumption as per standard norm is compared by using 'Z' test. To find out the variability in water availability among consumers in the same category coefficient of variation is estimated for the three category of consumers under consideration. A graphical presentation of tabulated data on the variability in water availability is projected in a Lorenz curve.

Section B, contains an analysis of the water use pattern of different category of consumers. It also contains a detailed analysis of the quality problem and management problem perception by beneficiaries of the system. The tabular presentation method is adopted for data analysis. In appropriate context chi-square tool is used. The major findings are summarized below.

1. From the analysis of water consumption data, it can be conclusively stated that consumers residing in pucca houses are better benefited from the pubic distribution system, where as consumers residing in Katcha houses and belonging to lower income group is getting less than what they deserve.

   The economically well of households may be using efficient gadgets to ooze out the precious commodity at a higher rate than what is allowed to them. Large storage facility possessed by the higher income consumers also help them to drain out excess water from the distribution system.

2. Statistical analysis of water availability problems by using Z test reveals that

   a) The average per capita water consumption of consumers residing in pucca houses is significantly higher than the admissible consumption as per standard norms.

   b) Where as average per capita water consumption of consumers residing in katcha houses is significantly less than the admissible consumption as per standard norms.

3. Hence the analysis adequately support the hypothesis that the residents of katcha houses are getting lesser quantity of water than what they are entitled to.

4. The test of coefficient of variation applied to find out the variability in water availability among consumers in the same category shows that,

a) Variation in water availability is highest among consumers residing in semi-pucca houses. This variation in availability can be attributed to difference in household income level and its composite effect on built in facilities in the house and consumer durables the household possess.

b) In the case of consumers residing in pucca houses, the variation in availability is less than that of consumers in semi-pucca houses. This can be attributed to the large water storage facility possessed by consumers in this category.

c) However, as far as katcha house category consumers are concerned, the variation in water availability is very low compared to the other two categories. Hence it can be concluded that all the consumers in katcha house category experience water shortage problem uniformly and they are badly affected by the public distribution system

d) The graphical presentation of tabulated data on variability in water availability support this finding.

8.6 Water Shortage Problem

1. Water shortage is a perennial problem in Calicut city, inspite of the many measures taken by the authorities to alleviate it. The public supply in most areas are on alternative days, that too restricted for a few hours. As a result people experience acute shortage of water.

2. Zone wise analysis of data shows that majority of respondents (64.73 per cent) experience water shortage. However there are zonal variation in water shortage due to larger command area and undulated geography of distribution zones.
3. Analysis shows that water shortage problem is acute among consumers in lower income group. Every one in this group experience water shortage to a maximum extend. It is interesting to note that none of them is getting steady water supply. This is because of the large water storage facilities possessed by the higher and middle income group and the lack of storage facility to consumers in lower income group.

8.7 Water Use Pattern

1. An analysis of water use pattern of different category of consumers reveals that those residing in pucca houses utilizes 12.45 per cent of their average daily consumption for other purpose like gardening, cleaning vehicles, animal bathing etc. Where as consumers residing in semi pucca and katcha houses utilizes filtered water for their domestic needs only. Out of the 414 respondents, 56.28 per cent utilizes scarce treated water for domestic as well as other purposes, wheare as 43.72 per cent utilizes it only for domestic purpose.
2. Study of the distribution system behaviour shows that disrupted supply and irregularity in availability leads to a 'hoarding syndrom' among consumers.

As a result higher income consumers tend to store up water largely in excess of their domestic needs which gets diverted for non-domestic use.

8.8 Water Quality

Water quality problem is an important aspect of water supply system in Calicut city. Disrupted supply leads to infiltration of contaminant from rusted points in the pipe system, polluting the treated water. Analysis of data shows that 1) brackishness, bad odour, excessive chlorine smell are some of the major quality problems of public supply. 2) Majority of respondents uses methods like boiling or filter or both to purify water. A small portion of the consumers use the water as it is supplied. 3) The different purification methods adopted by majority of beneficiaries indicate the awareness among consumers regarding the quality problems of public water supply.

8.9 Water Supply Management

Supply disruption due to pipe breaking is a frequent mishap in the supply system in Calicut city. Worn out pipe line, causing frequent breakage and its replacement is a major problem in the supply system. Revenue crunch is a major constrain for carrying out the maintenance work timely. A perusal of data in general shows that 1) The present supply system is grossly irregular and majority of consumers are not at all satisfied with the supply system. 2) In terms of sufficiency of supply also the system is not up to the expectation of the consumers. 3) When we consolidate the views on efficiency of functioning of the supply system, and in restoring the disrupted water supply, an overwhelming majority (70.95per cent) stated that it took one week time to get the repair done and supply reinstated. Taking one week time to restore the supply of this life supporting commodity, in no way can be taken as a sign of efficiency. Regarding the impression of the different Zones, it can be seen that the problem is acute in Zone II and least in Zone III. It is to be inferred that in getting things right, the consumers of the city area are not supported by the authorities uniformly. Supply areas of Zone II is vast and hence complaints from them are more. This might be one of the reasons which delays the reinstating of the disrupted supply inordinately.

8.10 Demand Analysis of Piped Water Supply

In chapter six an analysis of the socio-economic factors determining water demand of households is presented. The summary of the chapter is presented in two sections.

Section A, gives a brief analysis of the different approaches for estimating household water demand. For this secondary data source is utilized.

Section B, analysis the role of socio-economic variables in demand for publicly distributed water for residential household use. The average household water consumption per day is estimated as a function of socio-economic variable that is,

$C = f(S, X)$ where 'C' is the household water consumption, 'S' household size and 'X' for socio economic variables. The socio-economic determinants of water demand in analysed by using a) Tabular presentation b) Empirical estimation by using multiple Linear Regression Analysis. Major findings of the analysis are summarized below.

1. Tabular analysis of consumption data exhibits that those who dwell in pucca and semi-pucca houses do have the average water consumption much higher than, those staying in katcha houses. This can be attributed to difference in the characterstics of house, better storage facility, difference in social status of households measured in terms of index of household durables, and income effect.
2. The regression analysis shows that household water consumption (C) is influenced by size of household (S), Number of water taps in the house (N), type of flushing system in the toilet (F), index of household durables (D), garden attached to the house (G) and frequency of cloth washing (W).

8.11 Participatory Approach in Drinking Water Supply – An Analysis of Mini Water Supply Schemes

Chapter seven contains a critical analysis of the Mini Water Supply Schemes commissioned in Calicut city with community participation. These projects are catering to the drinking water requirements of households residing in water scarce localities in the city. Out of the seventeen projects commissioned, six projects from different water scarce localities were considered for the study. At random ten beneficiaries from each project was taken as samples. Such profiles of the people's projects as water availability, pattern of water use, generation of water literacy, economic viability and cost effectiveness, soci-economic impact, water quality maintenance and the extend of community involvement in running the project were analysed. The major findings are summarized below.

1. A salient feature of Mini Water Supply is that it is able to ensure adequate supply of water without much distributional variation. Mini schemes ensures equity in distribution and better availability of water.
2. Since operation and maintenance is carried out by beneficiaries themselves, repair, if any, is attended to timely. Hence the water supply scheme is highly reliable.
3. There is economy in water use. Perusal of data pertaining to water use pattern of beneficiaries shows that no consumer uses the water for other purpose like gardening, vehicle cleaning, construction purpose, animal bathing etc,.
4. There is good quality maintenance of water.
5. Social acceptability is another feature of these projects. Even though majority of user community is poor, they shared 7 to 12 per cent of capital cost depending upon nature of supply (public tap or house connection). Apart from the sharing of cost in money terms, the beneficiaries also render their free service in terms of free labour and local expertise in the

construction of the project. Operation and maintenance of the scheme is carried out by the beneficaries. The collection of user charges from all the beneficiaries has enriched the social acceptability of the project.

6. Mini water supply scheme may be seen as beacon of social change. Women and children who used to spent a lot of time in fetching water are getting more time to engaged themselves in developmental activities.
7. The community involvement in its execution and management also ensures good governance.
8. Mini Water Supply Schemes are based on time tested traditional system. There is decentralised conservation of unevenly distributed water source, ensuring greater sustainability of the system. Water supply connection are provided only after considering the capacity of well or pond serving as raw water source. Hence there is no possibility of generation of demand supply gap in water supply.
9. Another highlight of the scheme is its economic viability and cost effectiveness. Considering the resource crunch and stipulations regarding cost and production procedure, the best system suitable for the undulating geographical condition of Calicut city is community participated Mini Water Supply Schemes. There is a harmonious blending of local resources, local knowledge and modern technology, in these schemes..
10. Mini Water Supply Schemes involving community participation is best suited to solve the location specific problem in water availability in Calicut

city. Since all the projects are located in water scarce region where centralised supply system failed to ensure reasonable supply to economically and socially backward population, mini schemes ensure efficient water supply..

The results of the study indicate that the major problems of the present water supply system are; defective distribution system, insufficiency of the treated water, reduction in efficiency of the system, insufficient power supply to run the system, over and above insufficient fund availability. The most urgent need is to utilize the drinking water in a sustainable manner. Rehabilitation of Calicut Water Supply Scheme is another crying need for an effective utilization of the present installed capacity. The paucity of funds is a stumbling block in carrying out this work.

The research analysis adequately support the hypothesis that the residents of katcha houses are getting lesser quantity of water than what they are entitled to. Efficiency of water supply system means ensuring steady supply at the required qualitative and quantitative standards. In terms of these indices Calicut water supply system is quite inefficient. The unpredictability of availability of water is the major reason behind the hoarding syndrom shown by households. This research concludes that only through constant supply of water this mishaps can be avoided. The centralised supply system is not able to provide a satisfactory level of service and supply to the citizens of Calicut. This research analysis further concludes that the user friendly mini water schemes with active community participation is best suited to solve the location specific problem in water availability. The user friendly mini schemes are much better than the centralised supply system in ensuring efficient water supply, economy in water use, cost effectiveness and generation of water literacy.

To overcome the demand supply gap in water availability, new augmentation scheme should be speeded up. The project formulated by K.W.A. in 1986, to meet the increase in demand with source as Peruvannmuzhi reservoir of Kuttiyadi irrigation project should be accelerated. Although there were some initial problem, the new augmentation scheme with assistance from Japan Bank of International Co-operation (JBIC) is being taken up for implementation. When the JBIC funded mega project of new augmentation gets completed, the drinking water problem will get alleviated to a certain extend. However, on completion of the scheme, a considerable quantity of sewage will also be generated. This will be another problem, since there is no pucca sewerage system for the city. Hence it is high time to think of a modern sewerage scheme for the entire city with the latest treatment techniques.

In order to prevent the misuse of water and to do away with the practice of large scale hoarding of water, cess should be imposed on higher income consumers of their excess consumption, over and above the admissible consumption as per standard norms. This research study further recommends that an effective and efficient inspection wing should be formed to detect theft, hoarding, meter default etc., to prevent wastage and misuse of water. Moreover rain water harvesting should be made mandatory and compulsory on all High Rise Apartments and housing colonies to be constructed in the city in future as a measure to promote water conservation and literacy. These measures can do a lot in solving the acute water problems of Calicut city.

APPENDIX

Annexure I

Estimate of Alternative Cost – Mini Water Supply Scheme – Project code 07		
No.	Particulars	Amount
1	Construction of well 5.5 inside dia and 5m depth with laterite lining in cm 1:5 from bottom to top, including platform 1m width and parapet wall 1m height of laterite masonry	75,000.00
2	Construction of pump house with 1.8m x 2.4m inside size with laterite wall x Rcc roofing	25,000.00
3	Construction of Over head tank 48000 liters capacity	3,00,000.00
4	Laying pumping main including all cost of pipe and earth work excavation for trenches 1m depth x 0.5m width Laying charges	
	65 mm GI pipe medium class 30m @Rs.225/m	6,750.00
	75mm PVC 10kg/cm^2 300m @Rs.155/m	46,500.00
	75mm PVC 6kg/cm^2 120m @Rs.125/m	15,000.00
5	Laying Distribution line	
	90mm PVC 6kg/cm^2 600m @Rs.145/m	87,000.00
	75mm PVC 6kg/cm^2 600m @Rs.125/m	75,000.00
	50mm PVC 6kg/cm^2 300m @Rs.85/m	25,500.00
	40mm PVC 6kg/cm^2 300m @Rs.75/m	22,500.00
	32mm PVC 6kg/cm^2 200m @Rs.70/m	14,000.00
6	Erection of pump sets including all set of electrical fitting starter, connection pipe etc. 10. H.P. centrifugal pump	1,00,000.00
7	Construction of street tap 20 nos. @1500/nos	30,000.00
8	Power allocation	25,000.00
9	Unforeseen item	2,750.00
	Total (Rupees Eight Lakhs Fifty Thousand Only)	8,50,000.00

ANNEXURE – II

URBAN WATER SUPPLY MANAGEMENT (CENTRALISED) SCHEDULE ON WATER CONSUMPTION/ DEMAND/ MANAGEMENT

SCHEDULE FOR BENEFICIARIES

SECTION-I – GENERAL INFORMATION

1. Name of the Respondent
2. Age and Sex :
3. Religion and Caste
4. Occupation — a. Agriculture b. Business c. Salaried Class d. Others (specify)
5. Household income (Monthly in Rs.) : a) Upto 1000 b) 1001-2500 c) 2501-5000 d) 5001-10000 e) 10001-15000 f) 15001–25000 f) 25001-35000 h) 35001 & above
6. House No and Locality :
7. Ward No and Zone No :
8. Nature of Locality : Plain / Elevated

SECTION-II – SOCIO ECONOMIC INDICATORS

9. Literacy Level (Round the Code)

Level	Head of Household	House Wife	Highest level in the House
Illiterate	I H H	I H W	I H L
Up to Primary	P H H	P H W	P H L
Up to Secondary	S H H	S H W	S H L
College	C H H	C H W	C H L
Post Graduation/ Professional	P H H	P H W	P H L
Others	O H H	O H W	O H L

10. No. of people in the house :

- a) Children : Below 5 years
  - : 5 – 15 years
- b) Adults : Male
  - : Female
- c) Total

11. Household Wealth Composition

1) Consumer Durables

- a) Car : Model Brand Nos
- b) Air Conditioners/ Freezers
- c) Computers/ Telephone/ Television (Colour/B.W)
- d) Two wheelers/ shops/ taxis etc.
- e) Fridge, Mixi, Grinder, Washing Machine, Gas etc.
- f) Basic utensils only.

2) Size of land (For those with own House and not a Flat) Roughly what is the size of the land in which your house in located (check answer by observation) ☐☐ Cents

12. Household Expenditure (Rs. Per month)

Range From To

a) Food											
b) Clothing											
c) Education											
d) Rent/House maintenance											
e) Medical											
f) Entertainment											
g) Repayment of loan											
h) Transport											
i) Newspaper											
j) Electricity											
k) Water											
l) Telephone											
Total											

(If annual or half yearly expenses are indicated convert to month and record. If no range is indicated record in 1st column. Total indicated by respondent need not be tallied with break up in the table)

SECTION-III – HOUSING AND WATER SOURCE

13. Ownership Owned (O) Rented (R) Leased in (L)

14. If rented monthly rent paid : [ ][ ][ ][ ][ ] P. M

15. a) Type of structure : Pucca (1) Semi pucca (2) Katcha (3) Flat (4)

b) Year of Construction [ ][ ][ ][ ]

c) No. of storey Single/Multi storeyed [ ]

16. Can you tell me the total floor area of your house:

< 100 sq. feet	(1)	751 – 1000 sq. feet	(5)
101 – 250 sq. feet	(2)	1001 – 1500 sq. feet	(6)
251 – 500 sq. feet	(3)	1501 – 3000 sq. feet	(7)
501 – 750 sq. feet	(4)	> 3000 sq. feet	(8)

17. Please tell me the different source of water you depend on for different purpose. (Record answer by rounding the code in table below)

Purpose	Pipe Connection Inside House	Own Bore	Own Well	Outside Well	Public Tap	Others
Drinking	DPC	DOB	DOW	DWL	DOT	
Cooking	CPC	COB	COW	CWL	COT	
Bathing	BPC	BOB	BOW	BWL	BOT	
Washing	WPC	WOB	WOW	WWL	WOT	
Sanitation	SPC	SOB	SOW	SWL	SOT	
Gardening	GPC	GOB	GOW	GWL	GOT	
Vehicle Cleaning	LPC	LOB	LOW	LWL	LOT	

18. **(THOSE HAVING TAPS INSIDE THEIR HOUSE)**

(a) Do you have water storage facility in your premises : Yes/No

(b) What is the type of storage facility available (In the case of those having overhead tank and sump, mark both) : Tank/Sump/Both

(c) What is the approximate capacity of the sump : | | | | | | Ltrs

(d) What is the approximate capacity of the overhead tank : | | | | | | Ltrs

(e) Do you get water daily : Yes/No

(f) If yes how many hours a day, on an average do you get water into your tank/sump : | | | Per day

(g) If no storage facility, record number of hours water comes directly into the taps. :

(h) If water is not coming daily, when exactly the water is available: : Once in two days/ Alternative days
Once in week

(i) How many times a month (average) do you get no water or very less water into your tanks or in your taps. : | | | Day

19. **(THOSE HAVING SOURCES OTHER THAN KWA CONNECTIONS)**

a. Do you have any other sources other than KWA connection. : Yes/No

b. If yes specify the type of source. Well/Bore well/Pond/Others

c. Do you use the water from these sources for domestic purpose. Yes/No

d. If 'No' why

e. If 'Yes' specify approximately how much water is used for
   a) Domestic Purpose
   b) Gardening Purpose

20. **ASK THOSE DEPENDING PARTLY OR WHOLLY ON PUBLIC TAPS**

a.	Do you have any stand post nearby	: Yes/No
b.	If yes how far is it away from your house	Below 0.50 meter / 50-100 meter 100-150 meter / 150 meter and above
c.	Do you experience any difficulty due to distance from house	: Yes/No
d.	How many hours a day on an average is water supplied through public tap on which you depend.	: [|] Hours a day
e.	Are you satisfied with the timing of water supplied through the public tap.	: Yes/No
f.	Are you able to get adequate quantity of water supply through public stand post	: Not at all / Some what sufficient Sufficient / No response
g.	Who used to fetch water from public tap to your house	: Male member in the Home Female member Housewife / Children
h.	How much time is spend to bring water from stand post (including waiting time)	: [ ] Hours per day
i.	How much times in a month (average) do you get no water or very less water in the public tap	: [|] Day
j.	How many households collect water at the public taps.	[| |] Households
k.	Is the water pressure at the public tap adequate in your opinion	Yes/No
l.	Are the surrounding near the public tap neat and clean	Yes/No.

SECTION-IV – WATER CONSUMPTION AND DEMAND

21. How much water did you use yesterday for all your requirements : [| | | |] Ltrs/day

(If answer is given in buckets/pots make an estimation based on the size of the bucket/pots after seeing them)

22. What is the approximate floor area of your House. : ______________ sq. feet

23. No. of water taps in your House : ______________ Nos

24. No. of bathrooms/ Toilets in your house : ______________ Nos.

25. Whether connected with flush : Yes/No

26. If yes, capacity of the flush tank
    Less than 5 ltrs.
    >5 ltrs. And <8.5 ltrs.
    All > 8.5 ltrs.

27. No. of times flush used average per day. :

28. How many times do the family members take bath (pipe water only). :

29. How many times do you cook daily : Once in a day – I / Twice daily – II
    Thrice daily – III

30. How do the clothes are washed : Household member – I/ Servant– II
    Dhobi – III / Washing Machine -IV
    Others - V

31. What is the frequency of washing : Daily – I / Once in 2 days – II
    Once in 3 days – III / Weekly – IV

32. On an average how many liters of water is used for washing : ______________ ltrs per day
    (If weekly figures are given convert it into daily)

33. Do you clean the house using pipe water. Yes/No

34. Frequency of cleaning Daily-I / Once in 2 days - II
    Once in 3 days-III / Weekly-IV

35. How much quantity of water does you use for gardening :

36. **HOUSEHOLD EQUIPMENTS POSSESSED**

a. Do you have a washing machine Yes/ No
b. Do you have a geeyser Yes/No
c. Do you have dish washer Yes/No

d. Do you have pressure cooker Yes/No

37. Did these equipments been used regularly : Yes/No

38. How many times in a week : Nos________________

39. Do you have a vehicle : Yes/No

40. If yes, which type : Car – I / Two Wheelers - II
Other four wheeler – III
Others – IV

41. Do you use to wash your vehicle : Yes/No

42. If yes how many times in a week : Nos____________

43. Average quantity of water used for washing. : __________ ltrs

44. Can you tell me how much water you used yesterday from different sources and for different purpose (answer should be recorded in liters per day)

Source Source cook	PC	OB	OW	WL	PT	LS	OT	Total
<u>Purpose</u>								
Drinking/Cooking								
Bathing								
Washing/Cleaning								
Sanitating								
Gardening								
Vehicle Cleaning								

(If answer is given in buckets/pots make an estimation based on the size of the buckets/pots after seeing them)

<u>(Source Code are as follows)</u>

Pipe Connection in house	PC
Own bore well	OB
Own open well	OW
Outside well	WL
Public taps	PT
Tanker lorry supply	LS
Other (stream pont etc.)	OT

(Please do not try to match total here with total in question no: 26)

45. Do you experience any water shortage — Never (N) / Occasionally (O)
Frequently (F)

46. When did you experience water shortage — Only in summer / All seasons.

47. During normal time how much additional water would you like to get (answer mean **additional water not total water)**

a) For Drinking / Cooking : ☐☐☐☐ Ltrs day

b) For other purpose : ☐☐☐☐ Ltrs day

48. What are the alternative sources ponded : Water in tanker lorry / None

49. Do you make use of alternative arrangements — Yes/No

50. Do the alternative arrangements provide you with sufficient water : Yes/No

51. Is the arrangements regular during shortage season : Yes/No

52. If no on what other sources do you depend :

53. Is the alternative arrangements free of cost : Yes/No

54. If no what is the rate : Rs. 2/- per liter
Rs. 2.5/- per liter
Above Rs. 5/- per liter.

SECTION-V – PAYMENT FOR WATER

55. Do you have water connection — Yes/No

56. If yes, how many connection do you have

57. Consumer connection number :

58. Is your connection metered : Yes/No

59. How often do you pay for water
1) Once in a month
2) Once in two months
3) Once in a quarter
4) Once in six months
5) Once in a year.

60. Could you tell how much you paid the flat rate/ meter charge last time and for how many months consumption was it for.

a) Bill amount Rs.________________ for ________________ consumption
Nearest Rs. Nearest Month

61. What is the type of payment you make for water : Flat rate / Meter Charge

62. What is your average monthly bill. Compute the average by taking the last six months bill. Rs [| | |] For one month (average)

63. In your opinion the amount you pay for water consumption (Flat rate/ meter charge) high, reasonable or low)

High - H Reasonable - R Low - L

64. What is your average monthly electricity bill :

65. Is your meter working now : Yes – Y / No – N
Don't Know – D

66. If the meter is not working how long far it not been working : [|] Day/ Months

67. How much time is normally taken by KWA/authorised service personnel to repair your meter after your complaint. : [|] Day/ Months

68. Are you satisfied with the method adopted for computing your water charges, when your meter is not working (Round the code)

Yes - Y No - N Cant Say - C

69. Whom do you pay your water charges to (Round the code)

Land lord (L) Meter Reader (M) K W A Office (K)

Corporation office (O) Bank (B) Others (Specify)

70. How do you like to settle your water bill? Round the code if more than one answer is given. Ask for 1st preference and then code.

Land lord (L) K W A Office (K) Bank (B)

Corporation Office (O) Spot Billing (S)

71. How often would you like to be billed for water charges (Round the code)

Once in a month	- 01	Once in three months	- 03
Once in two months	- 02	Once in six months	- 06
Once in a year	- 12		

72. Are you ready to pay more charges, if you are provided with better quality and sufficient quantity of water. : Yes/No

73. What is the maximum water charges you will be willing to pay per month if you are given in your connection as much water as you require

Rs. [| |] Per month for [| | |] Ltrs/month

If requirement is given in ltrs or buckets per day, convert to ltrs per month and record above.

74. **<u>ASK THOSE WITH NO OWN CONNECTION</u>**

a) Are you willing to take an own House connection if connection charges are reasonable (Round the code)

Yes - Y No - N Cant say - C

b) In your opinion what is a reasonable connection charge Rs. [| | |]

c) What is the maximum water charges you will be willing to pay per month if you are given in your connection as much water as you require?

Rs. [| | | |] Per month for [| | |] Ltrs/month

(If requirement is given in ltrs or buckets per day, convert to ltrs per month and record above)

d) If you do not want an own connection, what is the maximum amount you will be willing to pay for taking water from public taps : Rs [| | |] Per Month
(If answer in not willing to pay anything record 'O' in the box above)

75. How much water charge you will be willing to pay per month if you are given as much water as you require through public stand post

Rs. [| | | |] Per month for [| | |] Ltrs/month

SECTION-VI – WATER QUALITY AND RELATION TO HEALTH

76. In your opinion did the pipe water you get for use good or bad in quality.

Good - G   Bad - B   Cant Say - C

77. Have you experience any of the following difficulties with the water you use

Bad odour	-	BO	Turbidity	-	TY
Bad Taste	-	BT	Brackishness	-	BR
Chlorine smell	-	CS			

78. Do you purify pipe water   Yes/No

79. If yes how   Boil only (BO),   Filter only (FO)
Boil and filter (BF), Don't do Anything (DA)

80. Have you or anyone in your house suffered from these disease in the last one month. **Round one or more codes if suffered from the disease below. Prompt** the names of diseases.

Cholera	-	C	Typhoid	-	T
Malaria	-	M	Jaundice	-	J
Worm Disease	-	W	Dysentry / Diarrohea	-	D
None of the above	-	N	Weels	-	R

81. **WELL WATER**

a. Is the well at a safe distance from septic tank : Yes/No

b. How far in the septic tank from the well. :

c. Are you aware that the minimum distance of well from septic tank in 15mtr : Yes/No

d. If yes do you follow the above instruction

e. If no why is the hesitation

f. Does the water got polluted during rainy season

g. If yes what measures do you take

h. Whether it is properly protected by concrete rings

i. Is the well protected by a parapet well   Yes/No

j. If no why

k. Does your domestic drainage have a proper outlet

l. If no is it polluting the water source

m. If yes what measures have you taken to prevent this

SECTION-VII – MISUSE OF WATER

82. How much water do you use daily : a) Drinking/Cooking _____Ltrs
b) Washing/Bathing _____Ltrs
c) Other purpose (Gardening, Cleaning Vehicle, animals etc.) _____Ltrs

83. Do you use piped water for non-domestic purpose : Yes/No

84. If yes specify the uses a) Gardening c) Vehicle cleaning c) Bathing of Animals

85. In summer season do you use piped water for other purpose other than Cooking/ Washing and Bathing. : Yes/No

86. If yes, again specify the uses for which you put piped water : Gardening / Vehicle / Bathing of Animals

87. Are you aware of the fact that safe drinking water in scare in Calicut city. : Yes/No

88. Are you aware that KWA's piped water supply is scare and always less than demand : Yes/No

89. Do you take bath more than one time in a day : Yes/No

90. If yes how many times do you take bath Two times/Three Times More than three times.

91. If 'No' specify your reason Lack of water/Other reason

92. Do you wash your cloths daily Yes/No

93. If 'No' what is the reason

94. Specify how often you wash Daily / Alternative days/ Once in three days / Once in week

95. Are you aware that misuse of water should be prevented as far as possible : Yes/No

96. In your opinion how can a better use of scarce piped water can be achieved :
1) Using it not for gardening, cleaning animals and vehicles.
2) Reducing the frequency of bathing/washing.
3) By applying all the said methods in usage.

97. Why should you like to store pipe water on a large scale in sump/tank :
a) There is no continuous and regular supply through out in a day.
b) Water is available in alternative days.
c) Supply is unreliable
d) There will arise frequent shortage
e) All the above reasons

98. How long since you have the plumping system in your house : 10 years/ 20 years/ 20 and above

99. What is the type of material used : GI / PVC Pipe

100. Is it properly maintained Yes/ No

101. If no what is the reason

102. If you have any suggestion to prevent misuse of scarce piped water :

SECTION-VIII - MANAGEMENT

103. Is there any disruption in the supply of piped water Yes/No

104. Is the water supply disrupted due to frequent breaking of pipelines : Yes/No

105. If yes, do you report the matter immediately to the authorities concerned : Yes/No

106. If 'Yes' do the authorities concerned take immediate action Yes/No

If 'No' when exactly do they respond :
Within 2 days
Within 1 week
1 week & above

107. Do you feel content over the present condition Yes/No

108. Do you feel that influence over the concerned authorities can resume the water supply immediately after disruption : Yes/No

109. Do you feel that timely intervention by authorities can solve the disruption in piped water supply : Yes/No

110. Do you get piped water regularly and continuously : Yes/No

111. With adequate pressure : Yes/No

112. In sufficient quantity : Yes/No

113. Are you satisfied with the current water supply system : Extremely satisfied/ Good/Average/ Not at all

114. If you are satisfied explain the reason :

115. If 'No' explain the reason

116. Any suggestion for improving the current status of distribution of piped water :

117. Does the corporation provide a cleaning service for the facilities you use?

Yes - Y No - N Occasionally - O

118. Is the present outside sanitation facility inconvenient to you? (Round the code)

Yes - Y No - N

119 If a good sanitation facility with proper maintenance in provided, will you be willing to pay for it? Round the code.

Yes - Y No - N Cant Say - C

120. Are you suffering from any vector born diseases?

(1) Fileria (2) Other type (3) No

121 Is your area endemic for fileriasis

(1) Yes (2) No (3) Don't Know

122. Are you satisfied with the service of the municipal sweeper in your locality

(1) Satisfied (2) Some what (3) Not satisfied

123. Is their sufficient drainage facility in your locality

(1) Yes (2) Some What (3) No

124. Is it properly maintained

(1) Yes (2) Some What (3) No

125. Are there enough number of waste receptacles QUESTIONNAIRE of the corporation in your locality

(1) Sufficient Nos. (2) Few (3) None

126. Do you feel any problem due to the wastes dumped on the roadside by your neighbouring households?

(1) Very much (2) Some what (3) No

127. If yes, what remedy do you suggest

128. Details of Household Composition

No.	Name	Relationship to respondent	Sex & Age	Marital Status	Educational Qualification	Occu-Pation	Monthly Income	Other Income	Total

ANNEXURE – III

COMMUNITY PARTICIPATION IN URBAN WATER SUPPLY THE CASE OF MINI WATER SUPPLY SCHEMES UNDER PEOPLES PLANNING PROCESS

SCHEDULE FOR BENEFICARIES

SECTION A : PROJECT DETAILS

1. Name of the Project
2. Location
3. Ward No. and Zone No.
4. Year of Commissioning
5. Time taken for Completion :
6. Nature of the Project : New Renovation
7. Source of Raw Water : Open well / Tube well
8. (a) What is the Capacity of the well :

   (b) What is the capacity of tank
9. Average Capital Cost :
10. Average Beneficiary share in Capital Cost :
11. Nature of Beneficiaries Contribution : (a) Sharing money cost

    (b) Sharing the cost of land for well construction

    (c) Voluntary Laborer Service for Construction of well, tank and pipe line

    (d) Sharing the cost of land for tank construction
12. Frequency of water pumping in a day
13. Capacity of the Motor :
14. Fuel used : Electricity / Diesel
15. Total length of pipe line :
16. Length of pipe line Connecting well to tank :
17. Total number of families benefited :

18. Total number of House connection

19. Total number of public stand post

20. Average number of Households depending per tap :

21. Total O & M Cost per month for the project

:a) Electricity charge Rs.
b) Operator's allowance Rs.
c) Maintenance work Rs.
d) Others Rs.
Total Rs.

22. Average Beneficiary share in O & M Cost per month

a) own connection :
b) P S P. :

SECTION .B: SOCIO – ECONOMIC INDICATORS OF BENEFICARIES:

23. Name of Respondent

24. Age and Sex :

25 Religion and Caste :

26. Occupation : 1. Agriculture ☐ 2. Business ☐
3. Salaried class ☐ 4. Others specify ☐

27. Nature of locality : Plain / Elevated

28. Literacy Level :

Level	**Head of Household**	**House Wife**	**Highest level in the House-**
Illiterate	I H H	I H W	I H L
Up to Primary	P H H	P H W	P H L
Up to Secondary	S H H	S H W	S H L
College	C H H	C H W	C H L
Post Graduation/ Professional	P H H	P H W	P H L
Others	O H H	O H W	O H L

29. Monthly Family Income (Rs.)

a.	Upto 1000	e.	10,001 - 15,000
b.	1,001 – 2,500	f.	15,001 - 25,000
c.	2,501 - 5,000	g.	25,001 - 35,000
d.	5,001 - 10,000	h.	35,001 & above

30. No. of people in the house :

a) Children : Below 5 Years ☐☐

: 5 – 15 Years ☐☐

b) Adults : Male ☐☐

: Female ☐☐

c) Total ☐☐

SECTION - C – HOUSING AND WATER SOURCE

31 Ownership : Owned (O) Rented (R) Leased in (L)

32 If rented monthly rent paid ☐☐☐☐☐ P. M

33 a) Type of structure : Pucca (1) Semi pucca (2) Katcha (3)

c) No. of storey Single/Multi storeyed ☐

34 Can you tell me the approximate floor area of your house:

< 100 sq. feet	(1)	751 – 1000 sq. feet	(5)
101 – 250 sq. feet	(2)	1001 – 1500 sq. feet	(6)
251 – 500 sq. feet	(3)	1501 – 3000 sq. feet	(7)
501 – 750 sq. feet	(4)	> 3000 sq. feet	(8)

35. Please tell me the different source of water you depend on for different purpose. (Record answer by rounding the code in table below)

Purpose	Pipe Connection Inside House	Own Bore	Own Well	Outside Well	Public Tap	Others
Drinking	DPC	DOB	DOW	DWL	DOT	
Cooking	CPC	COB	COW	CWL	COT	
Bathing	BPC	BOB	BOW	BWL	BOT	
Washing	WPC	WOB	WOW	WWL	WOT	
Sanitation	SPC	SOB	SOW	SWL	SOT	
Gardening	GPC	GOB	GOW	GWL	GOT	
Vehicle cleaning	LPC	LOB	LOW	LWL	LOT	

36. Can you tell me the number of hours on an average water supplied through the pipe : a) 2 – 3 hrs b) 3 – 5 hrs. c) 5 – 10 hrs d) 10 – 20hrs e) 24 hrs

37. Is there any change during summer season Yes/No

38. If yes indicate the Summer Supply hours

39. Is water connection metered : Yes/No

40. Can you tell me the water requirements of your house per day : Ltrs per day

41. Are you able to satisfy your water requirement fully from Mini water supply : Yes/No

42. If no how much water

(a) Your family gets daily from this source

(b) What is the other source upon which you depend

43. <u>(THOSE HAVING TAPS INSIDE THEIR HOUSE)</u>

(a) Do you have water storage facility in your premises Yes/No

(b) What is the type of storage facility available (In the case of those having overhead tank and sump, mark both) : Tank/Sump/Both

(c) What is the approximate capacity of the sump : ☐☐☐☐☐ Ltrs

(d) What is the approximate capacity of the overhead tank : ☐☐☐☐☐ Ltrs

(e) How many hours a day, on an average do you get Water into your tank/sump : ☐☐

(f) If no storage facility, record number of hours water Comes directly into the taps.

(g) How many times a month (average) do you get no water or very less water into your tanks or in your taps : ☐☐ Days

44. **ASK THOSE DEPENDING PARTLY OR WHOLLY ON PUBLIC TAPS**

a. Do you have any stand post nearby Yes/No

b. If yes how far is it away from your house Below 0.25 meter / 25-50 meter 50-75 meter/ 75-100 meter / 100 meter and above

c. Do you experience any difficulty due to distance from house : Yes/No

d. How many hours a day on an average is water supplied through public tap on which you depend. : ☐☐ Hours a day

e. Are you satisfied with the timing of water supplied through the public tap. : Yes/No

f. Are you able to get adequate quantity of water supply through public stand post : Not at all / Some what sufficient Sufficient / No response

g. Who used to fetch water from public tap to your house : Male member in the Home Female member/Children

h. How much time is spend to bring water from stand post (including waiting time) ☐ Minutes/Hours per day

i. How much times in a month (average) do you get no water or very less water in the public tap ☐☐ Day

j. How many households collect water at the public taps. ☐☐☐ Households

k. Is the water pressure at the public tap adequate in your opinion : Yes/No

l. Are the surrounding near the public tap neat and clean : Yes/No.

SECTION – D – WATER CONSUMPTION AND DEMAND

45. No. of water taps in your House : ______________ Nos.
46. No. of bathrooms/ Toilets in your house : ______________ Nos.
47. Whether connected with flush : Yes/No
48. If yes, capacity of the flush tank : Less than 5 ltrs./ >5 ltrs.& <8.5ltrs. all > 8.5 ltrs.
49. No. of times flush used average per day.
50. How many times do the family members take bath (pipe water only).
51. How many times do you cook daily : Once in a day – I / Twice daily – II Thrice daily – III
52. How do the clothes are washed Household member – I/ Servant– II Dhobi – III / Washing Machine -IV Others - V
53. What is the frequency of washing : Daily – I / Once in 2 days – II Once in 3 days – III / Weekly – IV
54. On an average how many liters of water is used for washing : ________________ ltrs per day (If weekly figures are given convert it into daily)
55. Do you clean the house using pipe water. : Yes/No
56. Frequency of cleaning : Daily-I / Once in 2 days - II Once in 3 days-III / Weekly-IV
57. How much quantity of water does you use for gardening :

58. Can you tell me how much water you used daily from different sources and for different purpose (answer should be recorded in liters per day)

Source Source code	PC	OB	OW	WL	PT	LS	OT	Total
Purpose								
Drinking								
Cooking								
Bathing								
Washing clothes								
Washing utensils								
Cleaning of house								
Sanitation								
Gardening								
Vehicle Cleaning								

(If answer is given in buckets/pots make an estimation based on the size of the buckets/pots after seeing them)
(Source Code are as follows)

Pipe Connection in house	PC	Public taps	PT
Own bore well	OB	Tanker lorry supply	LS
Own open well	OW	Other (stream, pond etc.)	OT
Outside well	WL		

SECTION- E – WATER QUALITY AND RELATION TO HEALTH

59. In your opinion did the pipe water you get for use good or bad in quality.

Good - G   Bad - B   Cant Say - C

60. Have you experience any of the following difficulties with the water you use

Bad odour	-	BO	Turbidity	-	TY
Bad Taste	-	BT	Brackishness	-	BR
Chlorine smell	-	CS			

61. Do you purify pipe water : Yes/No
62. If yes how : Boil only (BO), Filter only (FO)

Boil and filter (BF), Don't do Anything (DA)

63. Did you or anyone in your house suffered from any of diseases in the last one month. Round one or more codes if suffered from the disease below. Prompt the names of diseases.

Cholera	-	C	Typhoid	-	T
Malaria	-	M	Jaundice	-	J
Worm Disease	-	W	Dysentry / Diarrohea	-	D
None of the above	-	N	Weels	-	R

64. Did the overhead tank is usually cleaned Yes/No.

If yes, what is the frequency of cleaning : a) 0 – 15 days b) 15 – 30 days c) 30–60 day d)3months e)6 months

65. Is water subject to laboratory testing to assure quality Yes/No

66. Is clorination done regularly Yes/No

67. Is supply pipe line protected from waste water flows Yes/No

68. Is open well protected properly by a parapet wall Yes/No

SECTION- E – MANAGEMENT

69. Is there any disruption in the supply of piped water : Yes/No

70. Is the water supply disrupted due to frequent breaking of pipelines : Yes/No

71. If yes, do you report the matter immediately to the authorities concerned (Management Committee) Yes/No

72 If 'Yes' do the authorities concerned take immediate action : Yes/No

73. If 'No' when exactly do they respond : Within 2 days Within 1 week 1 week & above

74 Do you get piped water regularly and continuously : Yes/No

75. With adequate pressure Yes/No

76. In sufficient quantity Yes/No

77. Are you satisfied with the current water supply system Extremely satisfied Good/Average/Bad

78. If 'No' explain the reason

79. What is your opinion about the functioning of the Managing Committee : (a) Excellent ☐
(b) Good ☐
(c) Satisfactory ☐
(d) Average ☐
(e) Not at all satisfactory ☐

80. Any suggestion for improving the distribution of piped water

SECTION- F - MISUSE OF WATER

81. Do you use pipe water for non- domestic purpose : Yes/No.

82. If yes specify the uses : a) Gardening b) Construction Purpose c) Vehicle cleaning d)Animals bathing

83. Are you aware of the fact that drinking water is scarce in Calicut city : Yes/No

84. In summer season do your use pipe Water for other purpose other than Drinking, Cooking, Washing, Bathing and sanitation : Yes/No

85. If yes specify the uses for which you put piped water : a) Gardening b) Vehicle cleaning c) Animals bathing d) Construction purpose

86. Are you aware that misuse of water should be prevented as far as possible : Yes/No

87. In your opinion how can a better use of scarce pipe water be achieved : Using it not for
1) gardening ☐
2) Cleaning animals and vehicles ☐
3) Conducting water literacy compaign at ward level ☐
4) Creating awareness in annual General Body meeting of the Beneficiary Committee ☐

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