PUBLIC WATER SERVICE DELIVERY MECHANISM IN URBAN KERALA: AN ANALYSIS OF GOVERNANCE AND EFFECTIVENESS

Thesis submitted to the University of Calicut
For the award of the degree of

Doctor of Philosophy in Economics

By
PREETHA.P.P

Under the supervision of
Prof. Dr. D. RETNARAJ
Department of Economics
University of Calicut

DEPARTMENT OF ECONOMICS
UNIVERSITY OF CALICUT
DR.JOHN MATTHAI CENTRE
ARANATTUKARA, THRISSUR
MARCH 2024

CERTIFICATE

This is to certify that this thesis entitled **"PUBLIC WATER SERVICE DELIVERY MECHANISM IN URBAN KERALA: AN ANALYSIS OF GOVERNANCE AND EFFECTIVENESS"** being submitted by **PREETHA.P.P** for the award of the Degree of Doctor of Philosophy, to the Department of Economics, University of Calicut, Dr John Matthai Centre, Aranattukara ,Trissur,is a record of bonafide research work carried out by her under my guidance and supervision.The contents of this thesis, in full or in part, have not been submitted and will not be submitted to any otherUniversity/Institution for the award of any degree or diploma.Plagiarism is checked and found within the permitted limits.

Supervising Teacher

Dr. D. Retnaraj
Professor (Retired)
Department of Economics
Dr. John Matthai Centre,
University of Calicut, Thrissur

Co-Guide

Dr. Muneer Babu M
Assistant Professor
Department of Economics
Dr. John Matthai Centre,
University of Calicut, Thrissur

DEPT. OF ECONOMICS, Dr. JOHN MATTHAI CENTRE
UNIVERSITY OF CALICUT
THRISSUR-680 618

Place: Thrissur

Date: 15|3|2024

CERTIFICATE

This is to certify that the revisions are made in the thesis as per the suggestions made by the adjudicators and the contents in the thesis and the softcopy are one and the same of the thesis.

Supervising Teacher

Dr. D. Retnaraj
Professor (Retired)
Department of Economics
Dr. John Matthai Centre,
University of Calicut, Thrissur

Co-Guide

Dr. Muneer Babu M
Assistant Professor
Department of Economics
Dr. John Matthai Centre,
University of Calicut, Thrissur

DEPT. OF ECONOMICS, Dr. JOHN MATTHAI CENTRE
UNIVERSITY OF CALICUT
THRISSUR-680 618

Place: Thrissur

Date 15|3|2024

DECLARATION

I,**PREETHA P.P** ,do hereby declare that this written account entitled "**Public Water Service Delivery Mechanism in Urban Kerala: An Analysis of Governance and Effectiveness"** submitted to the University of Calicut for the award of the Degree of Doctor of Philosophy in Economics is a bonafide record of research work done by me under the guidance of **Dr. D. Retnaraj**, Professor(Retired), Department of Economics, Dr. John Matthai Centre, University of Calicut and **Dr. Muneer Babu M,** Assistant professor, Department of Economics, Dr. John Matthai Centre, University of Calicut. I also declare that this thesis has not been submitted by me earlier for the award of any degree, diploma, fellowship, or other similar title of recognition.

Place: Thrissur

Preetha
PREETHA. P. P

Date : 15/3/2024

ACKNOWLEDGEMENT

First of all I am grateful to the Lord Almighty for his benevolence and mercifulness which has made successful completion of my thesis. Without the Lord's invisible hand I would not have been successfully completed my research work.

With great respect and love, I express my deep sense of gratitude to my Supervising Teacher, Dr. D. Retnaraj, former Head and Professor, Department of Economics, University of Calicut, Aranattukkara, Thrissur for giving me valuable guidance, unfailing support, and dedication towards my work. I am deeply indebted for his kind and patient support during the period of my work. He gave me freedom to think and use all the possible sources for the fulfillment of my work. He has always encouraged and inspired me to accomplish this task. Thank you sir for your care, patience, time, and the vision and sharpness of sight while reading and editing the draft.

I am greatly indebted to my co-guide Dr. Munner Babu. M, Assistant professor, Department of Economics, University of Calicut, Aranattukkara, Thrissur for all the valuable assistance and relentless support provided during the entire research time. His comments and suggestions were very helpful to complete this work.

I am delighted and privileged to express my sincere gratitude to Dr. D. Shyjan Davis, Associate Professor (On Deputation), Department of Economics, University of Calicut, Aranattukkara, Thrissur, who served as a light of knowledge behind this work. His constructive criticism and thought provoking questions helped me a lot in building a good model of my work. He has been a source of strength for me and his broad mindness inspired me to go ahead with my work. I take this opportunity to express my gratitude to him for his insightful comments throughout every stages of this work.

I would like to express my gratitude from the core of my heart to Dr. Zabeena Hameed .P, Head and Assistant Professor, Department of Economics, University of Calicut, Aranattukara, Thrissur for warm encouragement , valuable suggestions and mental support extended to me in all aspects connected with this work. I express my wholehearted thanks to Dr.Sanoop. M.S, Dr. Rejula Helen, the faculty members in the Department of Economics, University of Calicut, for their valuable suggestions and Comments related to my research work.

I express my sincere gratitude to Dr. K.X Joseph, Former professor, Department of Economics, University of Calicut, Aranattukara, Thrissur, Dr. Simon T.D, Assistant Professor, Sreekerala Varma College, Thrissur, for their valuable support to overcome all the difficulties during the sampling stage and also helping of statistical tool selection and application of my research work.

I express my deep sense of indebtedness to Dr. Rajesh, Assistant Professor, Kerala Institute of Local Administration (KILA), Thrissur, Dr. Gini paul, Assistant professor, St. Thomas College (Autonomous), Thrissur, for their warm encouragement, valuable suggestions, mental support rendered to me for the successful completion of this work. I express my sincere thanks to Gini Paul for she has read out the entire thesis and provided with fruitful and useful suggestions. My special thanks to Slipa. K.S who helped me in read and editing purpose of my chapters.

I extend my warm regards to Mrs. Sreeja, Former Librarian, Mr. Hashik. P.M, and Librarian and to the entire office staff of Dr. John Matthai Centre for their services.

I am deeply indebted to the Thrissur corporation water department, Thrissur, Divisional Kerala water authority department, Thrissur, Centre for development studies, Thiruvananthapuram, State planning board, Thiruvananthapuram, Kerala water authority, Thiruvananthapuram, Kerala Institute of Local Administration, Thrissur and to the entire office staff and also sample respondents include field survey, for their co-operation and support during the collection of my research materials.

Let me take this opportunity to express my deep sense of gratitude and love to my friends who supported me in the several stages of my research work. My special thanks to Sreeja.V Athira. K, Sreenji, Sherin, Dr. Umaiban, Dr.Deepa for their sincere support in times of need. I am also thankful to Sunil Kumar M, Assistant Professor, PMGC, Chalakudy, Ajitha chechi, Aneesha chechi, Daisy chechi, Smitha chechi, Vini chechi, Neeraja, Vidya, Suji for their love and support. I am thankful to all my teachers and friends who helped me various ways for completion of this work.

I express my sincere thanks to Mr. Dinops Jose, for service rendered and also the neat execution of the DTP work and support.

I am externally indebted to my Dear Mother (Visalakshy.P) for her love, caring, prayers, mental support and sacrifice to complete my research work. I am externally indebted to my

Father (Parameswaran Nair), Brother (Pramod.P.P) who has done everything possible and they went even beyond their capability for molding my future. I am also externally indebted to my dear husband (Deepak. S.Menon),our child (Diya.D.Menon) and our parents for giving love, caring, support and sacrifice to complete this work. Finally, I deeply thank all who have contributed in some way or other to the final form of this thesis.

Thank you

PREETHA.P.P

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

Abbreviation	Description
PHED	Public Health Engineering Department
KWA	Kerala Water Authority
OECD	Organisationfor Economic Co-Operation and Development
KRWSA	Kerala Rural Water and Sanitation Agency
UNDP	United Nation's Development Programme
NGOs	Non-Governmental Organizations
CAGR	Compound Annual Growth Rate
AAGR	Average Annual Growth Rate
TKWA	Trissur Kerala Water Authority
ULBs	Urban Local Bodies
ARWSP	Accelerated Rural Water Supply Programme
AUWSP	Accelerated Urban Water Supply Programme
JNNURM	Jawaharlal Nehru National Urban Renewal Mission
RGNDWM	Rajiv Gandhi National Drinking Water Mission
LIC	Life Insurance Corporation
HUDCO	Housing And Urban Development Corporation
CPHEEO	Central Public Health and Environment Engineering Organization
UIDSSMT	Urban Infrastructure Development Scheme for Small and Medium Towns
AMRUT	Atal Mission for Rejuvenation and Urban Transformation
JBIC	Japan Bank for International Cooperation
ADB	Asian Development Bank
KIIFB	Kerala Infrastructure Investment Fund Board
AMRUT	Atal Mission for Rejuvenation and Urban Transformation
NABARD	National Bank for Agriculture and Rural Development
JICA	Japan International Cooperation Agency
SAARK	South Asian Association for Regional Cooperation
UWSS	Urban Water Supply System
UIDSSMT	Urban Infrastructure Development Scheme for Small and Medium Towns
NRDWP	Naional Rural Drinking Water Programme
UNDP	United Nations Development Programme
UNCOVA	Analysis of Covariance

ABSTRACT

The study discusses the delivery of water supply services through decentralized and centralized institutions and attempts to find out whether decentralization leads to better delivery of water supply services in Kerala. This is because local governments operate more closely with the people than any other level of government. Therefore, local government would be better able to identify the needs and preferences of communities than central level. In this study, the researcher tried to examine and choose the active Thrissur municipal corporation as an example and analysing its performance of water supply delivery mechanisms. For the purpose,the study is using both quantitative and qualitative research methods. Quantitative and qualitative data was gathered by using primary and secondary sources.Then thestudy illustrates the responses of urban households with respect to water supply services and interviews with respective personalities from the supply side of both state level and local level departments. To capture the difference between the water supply services of the state and local governments, the study has been conducted in the areas of Thrissur district, where the service is provided by the state line department like the Trissur Kerala Water Authority and the local government department like the Trissur Corporation water supply department. The major finding of the study is that,Thrissur Corporation took on a special responsibility and successfully implemented water supply schemes in the long run. AlsoThrissur Corporation has much better, sufficient and highly accessible piping water supply, an affordable price, and good quality with efficient management as compared to KWA water supply. Under the decentralized governance arrangement, administrative, political, and regional features are given prominent consideration in the delivery of public goods and services. Local governance support is a necessary factor for the implementation of strong and successful public water service delivery at grass root levels. Also, the strength of institutions depends on its governance framework. The study found that the involvement of local governance has a favourable impact on the corporation's effective water supply. The study explains the delivery of water services is better through decentralized institutions than centralized institutions. Then the study proves thatDecentralization promises an appropriate and conducive environment for people at the local level through effective water service delivery.

Key Words: Water Service Delivery, Decentralization, Centralization, Governance, Thrissur Corporation, ThrissurCorporationWater Supply Department,Kerala Water Authority.

സംഗ്രഹം

വികേന്ദ്രീകൃതവും കേന്ദ്രീകൃതവുമായ സ്ഥാപനങ്ങൾ വഴി ജലവിതരണ സേവനങ്ങൾ വിതരണം ചെയ്യുന്നതും വികേന്ദ്രീകരണം കേരളത്തിലെ ജലവിതരണ സേവനങ്ങൾ മികച്ച രീതിയിൽ എത്തിക്കുന്നതിലേക്ക് നയിക്കുന്നുണ്ടോ എന്ന് കണ്ടെത്താനുള്ള ശ്രമങ്ങളും പഠനം ചർച്ച ചെയ്യുന്നു. കാരണം, മറ്റേതൊരു തലത്തിലുള്ള ഗവൺമെന്റുകളേക്കാളും പ്രാദേശിക സർക്കാരുകൾ ജനങ്ങളുമായി കൂടുതൽ അടുത്ത് പ്രവർത്തിക്കുന്നു. അതിനാൽ, കേന്ദ്രതലത്തേക്കാൾ ജനങ്ങളുടെ ആവശ്യങ്ങളും മുൻഗണനകളും തിരിച്ചറിയാൻ പ്രാദേശിക ഭരണകൂടത്തിന് കഴിയും. ഈ പഠനത്തിൽ, ഗവേഷക തൃശൂർ മുനിസിപ്പൽ കോർപ്പറേഷനെ ഒരു ഉദാഹരണമായി പരിശോധിക്കാനും തിരഞ്ഞെടുക്കാനും ജലവിതരണ സംവിധാനങ്ങളുടെ പ്രകടനം വിശകലനം ചെയ്യാനും ശ്രമിച്ചു. ഈ ആവശ്യത്തിനായി, പഠനം അളവ്പരവും ഗുണപരവുമായ ഗവേഷണ രീതികൾ ഉപയോഗിക്കുന്നു. പ്രാഥമികവും ദ്വിതീയവുമായ സ്രോതസ്സുകൾ ഉപയോഗിച്ചാണ് അളവും ഗുണപരവുമായ ഡാറ്റ ശേഖരിക്കുന്നത്. തുടർന്ന്, ജലവിതരണ സേവനങ്ങളുമായി ബന്ധപ്പെട്ട് നഗരങ്ങളിലെ കുടുംബങ്ങളുടെ പ്രതികരണങ്ങളും സംസ്ഥാന തലത്തിലും പ്രാദേശിക തലത്തിലുള്ള വകുപ്പുകളുടെയും വിതരണ വിഭാഗത്തിൽ നിന്നുള്ള ബന്ധപ്പെട്ട വ്യക്തികളുമായുള്ള അഭിമുഖങ്ങളും പഠനം വ്യക്തമാക്കുന്നു. സംസ്ഥാന-തദ്ദേശ സർക്കാരുകളുടെ ജലവിതരണ സേവനങ്ങൾ തമ്മിലുള്ള വ്യത്യാസം മനസിലാക്കാൻ, സംസ്ഥാന സർക്കാരിന്റെ കീഴിലുള്ള വാട്ടർ അതോറിറ്റിയും തദ്ദേശ ഭരണ വകുപ്പിന്റെ കീഴിലുള്ള മുനിസിപ്പൽ ജലവിതരണ വകുപ്പും ചേർന്ന് സേവനം നൽകുന്ന തൃശ്ശൂർ ജില്ലയിലെ പ്രദേശങ്ങളിൽ പഠനം നടത്തുന്നു. തൃശൂർ കോർപ്പറേഷൻ പ്രത്യേക ചുമതല ഏറ്റെടുക്കുകയും ദീർഘകാലാടിസ്ഥാനത്തിൽ ജലവിതരണ പദ്ധതികൾ വിജയകരമായി നടപ്പാക്കുകയും ചെയ്തു എന്നതാണ് പഠനത്തിലെ പ്രധാന കണ്ടെത്തൽ. ഇവിടെ കേരളം വാട്ടർ അതോറിറ്റിയുടെ ജലവിതരണവുമായി താരതമ്മ്യപെടുത്തുമ്പോൾ തൃശ്ശൂർ കോര്പറേഷൻ വളരെ മികച്ചതും ഉയർന്ന ഗുണനിലവാരമുള്ള ജലവിതരണവും മിതമായ വിലയും കാര്യക്ഷമായ മാനേജ്മെന്റിനോടും കൂടി പ്രവർത്തിച്ചുവരുന്നു. വികേന്ദ്രീകൃത ഭരണ ക്രമീകരണത്തിന് കീഴിൽ, പൊതു ചരക്കുകളുടെയും സേവനങ്ങളുടെയും വിതരണത്തിൽ ഭരണപരവും രാഷ്ട്രീയവും പ്രാദേശികവുമായ സവിശേഷതകൾക്ക് പ്രധാന പരിഗണന നൽകുന്നു. താഴേത്തട്ടിൽ ശക്തവും വിജയകരവുമായ പൊതു ജലസേവന വിതരണം നടപ്പിലാക്കുന്നതിന് പ്രാദേശിക ഭരണ പിന്തുണ അനിവാര്യമായ ഘടകമാണ്. കൂടാതെ, സ്ഥാപനങ്ങളുടെ ശക്തി അതിന്റെ ഭരണ ചട്ടക്കൂടിനെ ആശ്രയിച്ചിരിക്കുന്നു. കോർപ്പറേഷന്റെ ഫലപ്രദമായ ജലവിതരണത്തിൽ പ്രാദേശിക ഭരണത്തിന്റെ ഇടപെടൽ അനുകൂലമായ സ്വാധീനം ചെലുത്തുന്നതായി പഠനം കണ്ടെത്തുന്നു. കേന്ദ്രീകൃത സ്ഥാപനങ്ങളേക്കാൾ വികേന്ദ്രീകൃത സ്ഥാപനങ്ങളിലൂടെ ജലസേവനങ്ങൾ വിതരണം ചെയ്യുന്നതാണ് മികച്ചതെന്ന് പഠനം വിശദീകരിക്കുന്നു. ഇങ്ങനെ ഫലപ്രദമായ ജലസേവന വിതരണത്തിലൂടെ പ്രാദേശിക തലത്തിലുള്ള ആളുകൾക്ക് ഉചിതമായതും അനുകൂലവുമായ അന്തരീക്ഷമാണ് വികേന്ദ്രീകരണം വാഗ്ദാനം ചെയ്യുന്നതെന്ന് പഠനം തെളിയിക്കുന്നു.

Chapter I

DESIGN OF THE STUDY

1.1 INTRODUCTION

Water, with many distinct properties which are critical in the proliferation of life, is an exquisite gift of nature. Water is essential for the survival of human civilization, living organisms and natural habitat on Earth. The most basic and primary use of water is drinking. Drinking water is generally assigned to meet the needs of living beings. As we all know human and other living beings cannot sustain without water. The basic human needs include drinking, cooking, washing, cleaning, and hygiene which are categorized as domestic needs. Safe drinking water is a basic requirement for the proper functioning of the human body and maintains good health conditions for individuals. WHO recommended a minimum of 7.5 litres /capita/day of water to meet the potable requirement of most people under most conditions (Panwar and Antil, 2015). The European Food Safety Authority recommends 2.0 litres per day for adult women and 2.5 litres per day for adult men in daily life. (EFSA, 2010). The United Nations declared access to safe drinking water as a fundamental human right and took essential steps towards improving the living standards of society (UNGAR,2010).

The Domestic water supply contributes an essential attribute to the physical and mental well-being of humans and provides a key element in the fight against poverty and disease. It helps to improve the living conditions of the residents, as well as the economic and social well-being of the whole society. So, Water supply is fundamental to health and water resource is considered a key element of development (Logan, 1960). On the other side, water is considered the main input to agricultural production that ensures food security for our growing population. Water is also considered a fundamental input to developmental sectors like irrigation, industries, power and transport sectors. Thus water becomes the base of human life and the foundation of human survival as the vehicle of socio-economic development in society.

As the population increases need of allocating more water for domestic, agricultural, industrial and commerce purposes which results in a rapid depletion for water resources. Water is a common good for all sectors of an economy. And demand for water resources is rapidly increasing in all sectors. Also, the present trend of rapid population growth, improvement of living standard of human beings and economic development etc are the most common factors causing rapid demand for limited water resources in the economy. The rapid growth of water demand and its limited availability is the main reason for scarcity. This scarcity tends to lead to tight competition for water among the sectors. The government intervention in balancing the demand and supply side is important here. The population rate is increasing with towns expanding to demand in both quantity and quality public water supply in the state (Adeoye and et al, 2013).WWAP (2009) defined, Provision of a potable water supply as important for the socio-economic development of a country and also one of the main indicators of development.

The broad goals of modern government should create a good quality of life for its citizens (Gildenhuys and Knipe, 2000). The government aims to execute varieties of functions and deliver varieties of essential services to its communities. Drinking water, shelter, health, education, transportation and communication facilities etc are the major civic services needed for the good and healthy life of human beings. The delivery of these essential services is crucial for our existence. Public service production and delivery is the sole responsibility of the state. Most of the public good provision lies in the hands of the government. So the responsibility to produce, provide and implement these basic amenities is vested in the government. Most of the public services delivered by the government have a monopoly in their production and delivery. Governments are allocating a growing portion of their budgets to strongly support the expansion of these services.

Among these amenities, water is considered a primary resource for human life, as humans highly depend on it for existence. Water is a freely accessible essential resource for all generations, yet it often goes unappreciated and is not adequately replenished or conserved. But it is the duty of a responsible government to ensure that the right of every citizen to equitable access to water for his/her basic needs is satisfied. So, the government's responsibility in this sector is huge. Even though privatization in key sectors of the state like health and education produced good results, the water supply stands out, and a dominant share is still under government control.

Since the second half of the 19th century, the centralized water supply system has been expanding all over the world. The provision of water supply is a public service in all most all countries in the world. The responsibility of the water supply should be entrusted to our government for a long period. Water supply is a matter of state subject. It includes entry 6 and entry 17 of the state list of the 7th schedule of the constitution of India. These constitutional provisions give the responsibility and powers concerning water supply to the state government. Traditionally, the drinking water supply is delivered by the state as a public domain. The state, through its various agencies, directly involves in water supply by implementing various plans, programmes and the execution of these policies. In Kerala, institutional and organizational attempts to undertake water supply by the government began in mid-fifties. The public health engineering department was established in 1956, to carry out water-related activities in the state. Until the mid-eighties, public water supply was also under direct control of this department. KWA was established on 1 April 1984 under the Kerala Water and wastewater ordinance 1986, in place of PHED. KWA is one of the main agencies performing to design, construction, operation and maintenance of water supply in the whole state. For urban water supply, KWA also continues its good performance.

In the 1970s, decentralization spread out in all most developing countries in the world, out of dissatisfaction with centralized systems. Decentralization takes care of the needs and preferences of local communities as powers and responsibilities are devolved to lower levels. The 1970s and 80s witnessed the positive movement of involving more people in the planning and decision-making process. However, decentralization assumed gained more importance in world countries in the 1990s, with the fall of socialist countries that followed centralized planning. Globalization played a major role in this movement. Decentralization offers two main benefits to the people. That is, freedom to access and freedom to decide (Murilsa, 2007). The former implies that decentralization enables people to voice their needs and ensure their representation. The second one implies that people take autonomous decisions without influence from the central government.

The 73rd and 74thconstitutional amendment acts mandate the devolution of powers and functions to local government. Local government plays a central role in achieving local development. The Institution of local government is mentioned in Article 243G of the Indian constitution. According to the constitution defined as the power of all local bodies are within the jurisdiction of the state government. Local government is a third tier of government, which operates at the lowest tier of society. It works at the grassroots level with close to the people and working in their everyday life.

As part of Kerala's decentralization, the 73rd and 74th Amendments Acts of 1994 recommended specifying a set of functions transferred to local government from the state level. Local government institutions constituted in rural areas are referred to as panchayath and urban areas are referred to as urban local bodies. The 73rd amendment, the 11th schedule (part IX, article 243G) of the constitution list 29 subjects to be transferred to Panchayath and the 74th amendment, the 12th schedule (part IX-A, article 243 W) of the Constitution lists 18 subjects to transferred to the urban local body. In light of these amendments, the local governments are empowered with the responsible to ensure that water services are delivered to the entire community.

Kerala witnessed rapid decentralization since 1995. Kerala is one of the leading states when comes to the implementation of decentralization reforms, including the transfer of funds, functions and functionaries to the lowest tier of government. Decentralization makes new powers and responsibilities for local government to provide public services at the local level. Constitution recognizes the ability of local self-governments in delivering both growth and service based necessities of various communities. Basic amenities and services are necessary to improve living conditions and the welfare of communities. And since 1996 with the implementation of people's planning in Kerala, local bodies has assumed an important role in providing basic amenity services including public water supply.

Under decentralized Kerala, urban local bodies have the primary responsibility of providing water supply in cities and towns. The urban local government found mention under entry 5 of the state list of the 7th schedule. This entry includes the constitution and powers of Municipal Corporations and municipalities. According to the 74th Amendment Act based, urban local government in Kerala has generally classified into two categories, the municipality and Municipal Corporation, based on the size and density of the population in cities and towns. Municipal corporations are set up for highly urbanized large areas and municipalities are set up for small urban areas in the cities.

Municipal Corporations / Municipality play the most important role in present-day affairs of our city life. It performs a wide variety of functions which help to ensure the overall development of the city. The basic and important services have a direct and immediate effect on the quality of urban life. According to the Kerala municipal act of 1994, the provision of water supply to urban residents is one of the mandatory functions of Municipal Corporations/ Municipalities. Then Corporations /Municipalities have the full freedom in planning and delivering water supply services in their restricted areas. But, most of the Municipal Corporations/Municipalities in Kerala depend on KWA for water supply services. Urban local bodies play only a little role in urban water supply services and are secondary. Now, most of the water supply services are planned and implemented by the urban local government through KWA. But there are success stories of urban local bodies that did remarkably well in this area. However, in state urban water supply, Thrissur Corporation plays the role of primary water supply provider directly supplying fresh water within its boundary. It has prolonged history and is still performing well today.

Kerala has a long history of urban local bodies proving water supply services. Local bodies are mainly involved in city water supply by investing in water supply schemes, design, construction, operations and maintenance of water supply etc. Ten major urban bodies which did a respectable job in this aspect are Cochin, Calicut, Kollam, Kottayam, Alleppey, Aluva, Thrissur, Palghat, Perumbavoor and Pala. They are performing well to provide direct water supply services to the respective cities and municipalities. Unfortunately, in 1989, the duty of water supply and allied services were transferred from the above mentioned local bodies to KWA as per the government order and based on the Kerala water supply and sewage act 1986.

As demanded by the city population, the Thrissur Municipal Corporation has requested the government to get re-transfer the power of the city water supply owned by them. As a result of this resolution, the water supply and allied services in the Trissur Corporation, which was vested in and transferred to the KWA were re-vested and re-transferred to the corporation in 1993. Since 1993, Trissur Corporation continues to ensure that the city water supply in their stipulated areas as self-sufficient. Today, this water supply system is performing well and steps for treatment, storage and distribution are being taken to ensure efficient water supply within the Corporation limit. The Corporation's good performance of the water service delivery mechanism depends on effective governance support and efficient service administration.

1.2 SIGNIFICANCE OF THE STUDY

Kerala is an urbanized state. According to the 2011 census, Kerala's population is 33 million. Kerala has one of the highest population densities in the country with 860 persons per sq. km. Kerala witnessed rapid urbanization since 1980. Recently, shown a rapid increase in its urban share and 47.7 per cent (Census, 2011) of the population is living in urban areas in the state. As per the 2001 census, Kerala ranks 19th position in the level of urbanization among Indian states. Kerala is ranked 9th in the 2011 census. It shows that Kerala is experiencing rapid urbanization.

Kerala also enjoys abundant water resources. The prime source of all water resources in Kerala is monsoon. The state has huge availability of groundwater resources, which spreads all over the state. However, the state experiences extreme drought conditions and drinking water shortages in many places during every summer season. This is because the state receives high temporal and spatial variation of seasonal rainfall resulting in flood by surface water or low recharge of groundwater tables. Kerala Rivers are small and short in length and it depends on monsoon. Most of them are partially dry in the summer season, which results in a drought situation.

Traditionally, domestic as well as public wells play a primary role in the drinking water requirement for every household in Kerala. Kerala state holds the first position in open well density. But, the numbers of wells are few in high land areas due to restrictions in geographic conditions. Low-lying land and coastal areas face the problem of salinity intrusion. Now a day's people of rural Kerala only are depending of well water. But, during summer months the water level of wells falls in many places in the state. Dependence of well water sources is not practical at all times.

Increasing wasteful usage, the threat of pollution and contamination of surface water and urban aquifers, depletion and over-utilization of water tables, and changes in land utilization for buildings, roads, parks etc. are the major problems that deeply decline freshwater availability. This tendency has an immediate effect and leads to acute water scarcity in the state, especially in urban areas. Climatic variation is also contributing to water scarcity in the state. The result is that, although there is an abundance of water in Kerala, obtaining safe drinking water can be challenging due to scarcity (Bohra, 2001).

When comparing urban areas and rural areas, resulted drinking water shortage is a serious problem in urban areas. The main reasons are 1) the number of open wells and its dependency ratio is very high in rural areas. 2) Large share of the rural people still depends on other important sources like ponds, springs, rivers, canals, streams etc. for their water needs.3) Majority of urban areas is insignificant natural sources like pond, springs, rivers, canal and streams (Bhandari and Bajpai, 2001). So, urban people mostly depend on public drinking water supply as compared to rural areas in the state. As a result, demand for supplied drinking water is growing in urban areas is increasing.

As cities grow and develop, need for more water sources arise. But, most of the urban poor are living in slums and informal settlements. The provision of infrastructural facilities and services is lagging in these areas (Tiwari, 1997). The big pressure of urbanization and urban population growth leads to decreasing per capita availability of freshwater resources in cities. As urban areas became more populated, the concentration of humans resulted in increasing levels of water consumption. Rapid population growth coupled with urbanization and economic development has huge implications in cities which increases the demand for water in large volumes. The above picture explains that the increased level of urbanization leads to pressure on urban water service delivery, which is also true for our state. So, public water service delivery is important here.

According to the 2011 census, 34.9 per cent of urban households and 24.5 per cent of rural households are depending on tap water in Kerala. The statistics show the majority of urban households in Kerala depend on municipal water supply for their daily needs as compared to rural people. Municipalities are the lowest tier on the local administrative framework and may be responsible for water service delivery of cities and towns in the state. So, the study will make a deep understanding of the urban water supply performance and depth of effectiveness of the municipality's water service delivery to communities. So, the present study is more significant in urbanized Kerala.

1.3 REVIEW OF LITERATURE

In this section, the study explores various works published in the field of water supply and services in urban areas. The section highlights various reviews of international, national and local-based literature dealing with water supply services and their delivery. Here, the literature review focuses on the present status and its performance, major problems, and various issues related to water supply and its service provision in urban areas. This section also focused on relevant literature on governance support and the various challenges faced in implementing water supply provision in urban areas. The available review of literature is listed in four important heads in the following.

1.3.1 Urbanization and Importance of Water Service

Urbanization refers to the population of a nation living in urban areas. According to the United Nations estimate about 3 percent of the world's population lived in towns and cities by the end of the 18th century (UN, 1998), which increased to about 50.6 per cent of the total world population by the end of 2010 (UN, 2008). In the 21st century, the urbanization phenomenon is growing and spreading in remote areas of the world as the effect of world globalization.

As earlier, India was the least urbanized country in the world. During 1901, only 11 percent of the people of India were living in urban areas and it increased to 62 million in 1951. Since 1981, there have been some changes, along with a steady rise in the proportion of urban residents. In 1991, number of urban population increased to 217.61 million and spread over 3697 towns in the country. The number of persons residing in urban areas has increased from 285 million in 2001 to 377 million in 2011 (Census, 2011). This trend shows a steady increase in the size of the urban population in India. NIUA Report (1998) states that, on average 25 percent of India's population lives in urban areas and it is growing at over 3 percent per year. The rapid growth of the population has been considered to be a special characteristic of Indian urbanization.

Kerala was a state that had only a modest level of urbanization as earlier. This trend changed and urban population of the state is steadily increasing later and recently Kerala remains the most urbanized state in the country (Tewari, 1997, Venkateswarlu, 1998, George, 2009). Now, Kerala's urban share is nearly 48 per cent (Census, 2011). The characteristic of the speedy increase the urbanization is caused by the increased number of census towns in Kerala (Das and Laya, 2016).

Urbanization is a societal process of transforming a rural economy into an industrial and service economy (Heggade, 1998). Urbanity can be described as a spatial concentration of people residing in an area, working in non-agricultural activities within a specified space, density and economic organization (Cohen, 2006). The natural consequence of these economic changes helps to rise in income, a change in lifestyle and superior quality of life (Venkateswarlu, 1998). This change is reflected in increasing their consumption of necessities (Shafi, 1995, Kaleel, 2016). Drinking water, shelter, healthcare, sanitation, transport and communication are some major civic amenities needed for a healthy and comfortable life in urban communities. Water supply is crucial for urban areas as increasing wider growth of the urban population and also most of them are included in the poor category.

Water supply is one of the necessities (Iyer, 2011) fundamental needs (Mohanthy, 1993) and most important spheres of development (Bendahmane, 1993). Access to safe and clean drinking water constitutes a basic human right and human progress (HDR, 1992, WHO, 2000, Holland, 2005). UN suggests that each person needs daily access to 20-50 litres of safe fresh water to ensure the basic domestic purpose of drinking, cooking and cleaning (WWAP, 2003). Human health conditions are improved when enhanced water supply services (Davis & et al, 1993, Fewtrell & et al, 2005) with 90 per cent of the population covering safe drinking water and preventing from incidence of waterborne disease (Anifowoshe, 1987). Water supply is an instrument that builds up the economic well-being of the nation (Saha, 1971) and satisfies health requirements (Niyathi, 1994, UN Water Conference, 1997). Today, the Water supply is in high demand for residential, irrigation, industrial and commercial purposes also (Reddy, 1966). The world is witnessing an ever-increasing rate of population growth and demand for basic necessitates including water is increasing. Increasing urban water supply leads to increasing growth and development of urban settlements with expanding cities (Shah and Kulkarni, 2015).

But, water resource is scarce in urban areas and so, water management is important here. Then, optimum use and management of the available water resource on both the supply side as well as demand side is necessary. On the supply side, more realistic socio-economic management strategies and efficient tools of pricing, water-saving technologies and water policies develop for better management of water supply (Oyebande, 1987). On the other side, urban households carefully develop their daily use and household management strategies with their participation in conservation activities and willingness to pay for water is better for efficient supply (Israel, 2009, Potter & et al, 2010). So, the management of water resources is essential to the development of cities. Urban water supply is a necessary part of urban infrastructure and it is required to attain social and economic development of the cities.

1.3.2 Water Service Provision and its Delivery

DWAF (2003) defines the term water services as water supply services. Euro market (2003) defines Water services as all services that provide water for households, public institutions or any economic activities. The European Union defined water services as the whole series of activities from the abstraction of raw water at the source to the delivery of (treated) water to the consumer and from the consumer back to water sources.

WHO considers water as the essence of human life and it recommends between 20 and 40 litres per capita per day for human survival (WHO/UNICEF, 2010). The International Water and Sanitation Decade Program ensured that everyone in the world would have access to basic water services by 1990. The WHO /UNICEF joining report states that 4.1 billion (78 per cent) people use safe water sources in 1990. This trend increased to 5.3 billion (83 per cent) people using safe water in 2004 (WHO/UNICEF, 2008). The other report shows that 71 per cent of the global population used safe water services in 2015(WHO/UNICEF, 2017). This trend increased with 90 per cent (6.8 billion) of the global population using safe drinking water services in 2017 (WHO, 2019). United Nations Drinking Water and Sanitation Decade Program help to the upliftment of water services and increase the coverage of potable water supply in India (Rao, 1994).

Now, an impressive picture of 90 percent of the households in urban India had access to safe drinking water facilities (Mathur and Chandra, 2008, WHO/UNICEF, 2010). Within, 70 per cent of households depending tap water for their daily requirements in urban India (Bajpai and Bhandari, 2001). The present picture of water supply services of urban India is well performing with an increasing number of water supply connections, extended coverage of service areas, improved quality and quantity of water supply services and extending the coverage of urban poor (Saleth and Sastry, 2004, CPHEEO, 2005, World Bank, 2009). Improving appropriate service delivery indicators and norms is high support in improving this performance level (Paul and et al, 2004, Mathur and Chandra, 2008).

These improvements are deeply reflected in the water supply performance in Kerala. Water Authority is the sole agency performing water supply services in Kerala. It provides high support to improving the performance of water services by implementing the socio-economic well-being of the consumers (Saha, 1971). KWA is performing to achieve extending water supply service connections and area coverage with maintaining equity treatment for all. The study (Ploumen, 2010) uses Rawls theory of justice and fairness to explain the social equity concept which provides a fair and rightful allocation of water resource in all areas of the state.

According to OECD (2010), Public services include all services provided by the government as well as all services where the government has a significant role. That means public services can be provided directly by the government or indirectly, where the government is not a direct provider but still plays a role in their provision through regulation of financial contribution. Service delivery is defined as the provision of basic public goods and services by the state to the society (Provan and Milward, 2009). Service delivery is an important commitment made by the government to provide necessary services to the people. So the government is taking more effort to provide services to our people. It is a crucial responsibility of government institutions, which should deliver services that society requires to maintain and improve its welfare.

Water resources are considered both social good (ADB, 1997, UN, 2002) as well as economic goods (Perry and et al, 1997, Rogers and et al, 1998). Then, the water supply help to protect human health and employment earnings with achieve maximizing the social and economic welfare of the people. Water resources are also treated as public goods (UN, 1992, Richter, 2014). The basic necessitates of water resources as treated must be free (Iyer, 2011). It is compulsory to protect and efficiently use this essential commodity socially, economically and environmentally. So, the interference of government is necessary for the water supply services delivery mechanism. The government is the sole provider of services and it provides effective and efficient ways of delivering services to the public in a manner prescribed by the Constitution. Generally, water supply is undertaken by government institutions that have provided objects as a social service in most countries in the world.

Government institutions play a dominant role in the delivery of water services (Fenta, 2007) and it's committed to solve water supply problems ((Bijlani and Rao, 1990, Edwards, 2013). Then, more people in cities have access to a publicly organized water supply system (Ghosh, 1993). However, the government's share of public spending is very low and inadequate in poor sections especially slum areas in the city. Poor performance and lack of coordination of implementing agencies, poor policies and staff constraints are the main reason for this low public spending. So, the implementation of water supply schemes and programs in these areas is very poor (Panda and Agarwal, 2013). Large sections of the urban population especially the low-income groups are living in informal settlements with a lack of basic services and necessities (National Commission on Urbanization, 1998). Sulaiman and Ali (2006) quote in their study that 70 percent of the urban population lives in informal settlements. So government institutions are not in a position to meet the increasing service needs of the fast-growing urban population, especially in the largest share of urban poor in the society (Khana and Koshy, 1992, Paul, 1994, Kundu and et al, 1999).

The sharp rise in urban population has imposed a strain on urban infrastructure and services with existing large-scale inequalities in the distribution of basic services (Mohanthy, 1993, Sivaramakrishnan, 1993, Ghosh, 1993, Paul, 1994, Bhagat, 2011, Bhuyan and Husain, 2013) and make wide gap between rich and poor (Mohanty, 1993, Mathur, 1993, Sivaramakrishnan, 1993, Ghosh, 1993, Radhakrishan, 2006, Kayaga and Franceys, 2007, Mathur and Chandra, 2008, Mukherjee, 2009). The studies clearly show that the urban poor are as badly off in terms of quantity and quality of water service. Urbanization and population growth are increasing the pressures on expanding cities resulting in more people living without adequate provision of drinking water (Norstrom and et al, 2009).

Quality of life is the central theme of urban planning. However, inadequate funding, lack of urban policies, weak institutions and ineffective management cause urban planning and the delivery of urban water services to lag (Muzondi, 2014). This leads to huge inequality in the distribution of water services in whole cities. Large capital requirements and efficient manpower are necessary for efficient water supply in highly populated cities. The lack of these factors is a major challenge to efficient water supply distribution in the city (Goldblatt, 1996).

Many actors interplay in unsustainable and self–motivating manner also leads to increasing inequality of water supply in urban areas especially in urban poor (Nastar, 2014). Generally, in higher income group use more benefit of services than the lower income group and this poor section is becoming a victim of the inefficient distribution of the city water supply (Hota, 2014). Water consumption in Indian cities is far lower than the norms laid down by the Bureau of Indian Standards. (Shaban and Sharma, 2007) their study point out that the majority of Indian households get water below the standard norms and they are highly dependent on other alternative sources. Water supply is very little per head in slums and concentrates of the poor.

The other important problem of the difficult connection process and the huge and unpredictable cost of new water connections are too risky and unaffordable to the urban poor. The study (Kayaga and Franceys, 2007) recommends adjusting new connection policies with introduced subsidy policies and reducing charge including costs. So, a huge amount of investment is essential for urban water supply service (Vyas and Anand, 1998, Bajpai and Bhandari, 2001, Poornachandra and venkatesh, 2011, Bhatnagar and Ramanujan, 2011) and it is important to build, maintain and expand for improvement of water supply service (Urban Age, 1993, World Bank, 1994, UNEP, 2002, Hall, 2006). But the main problems are decline trend of public investment in basic services (Kundu and et al, 1999, Whittington and et al, 2009) and the lack of financial ability of the institutions (Loe and et al, 2002, Saleth and Sastry, 2004, Boyle, 2014).

Public water supply systems are aimed at assuring water permanently to the people (John, 1997). But water service provision continues to suffer from multiple problems. The various studies by Un-habitat (2002), Graham (2005), and Hall (2006) also confirm that about half the water in the drinking water supply system in the developing world is lost to leakage. India's urban water supply has been declining due to various factors such as tremendous pressure of population growth, area expansion and lifestyle changes (Saleth and Dinar, 1997), high rural–urban migration, regional disparities in water supply sources (Bowonder and Chettrik, 1984), large capital requirement (Goldblatt, 1996), over-exploitation of the resources, lack of water availability, wasteful behavior and climate change (Panwar, and Antil ,2015) etc.

The other major challenges of managerial problems like lack of long term planning and inefficient management of urban water usage (Rathore and et al,1994) lack of appropriate policies (JMP, 2010, Wankhade and et al, 2014), weak decision-making structure, lack of regularity framework, mis-management (Singhal and Johri, 2002, Kundu and Thakur, 2006), institutional problems like confusion and conflict over responsibilities, fragmentation and overlapping responsibilities, gap of institutional coordination (Mehta and Mehta,1993), service delivery problems like intermittent and irregular water provision, inefficient and inequitable allocation of resources (Gupta and et al, 2012, Mayabi and et al, 2014, MDPI, 2016), scarce and rationing water supply (Potter and et al ,2010) inadequate coverage (Wagle and et al, 2011),very low pressure, old and deteriorated water reticulation networks (Vauren, 2013, Mutsuddi, 2015), financial problems like unmetered with inappropriate water tariffs (ADB, 1999), increasing cost of production and distribution charge (Oyebande,1978), the heavy cost of the connection process (Kayaga and Franceys, 2007) and qualitative problems like the bad quality of smell, colour and taste (Mayabi and et al, 2014), low water quality (Potter and et al, 2010), pollution and contamination (Panwar and Antil, 2015, Oyebande,1987) are faced by urban water supply.

These water quality problems seriously affect water-related diseases and various types of health issues with a huge financial burden on households (Bedi and et al, 2015). Two third of Illness in India and estimated 5 million children die (Holgate, 2000) and lose 73 million working days a year (Vedachalam, 2012) due to the use of contaminated water. This disease burden increases medical expenses and caused a huge loss of income with reduced city development. So the poor section of people always achieved poor services with vicious circle problems (Water Aid, 2009). The increasing level of pollution and contaminations reduce the water availability level in plenty of regions. These serious issues are related to the failure of institutional mechanisms in the daily water supply. Amount of water the institutions can deliver is only half of its drinking water requirement. Distributing pipe water quality in the cities is also far below the safety level (Nair, 2010).

The above picture clearly shows multiple problems that highly effects total water supply services in the whole country. Poor water supply services lead to an increase in demand and supply gap in water service (Rao, 2008, Nagendra and Suresh, 2009). The poor performance of water supply service results in low tariff recovery and lack of financial viability making it difficult to improve service level. So the water service effectiveness in India is under a low level equilibrium traps (Mehta and Mehta, 1993). Water supply is a government-driven approach but the government failed to develop an efficient water supply system.

In this situation, it is necessary for urgent reforms in the urban water supply system. The Report on UWRM (1993) recommends the need for formulating and implementing a national policy for the sustainable and environmentally sound development of water resources in urban areas. Increasing financial support and institutional support is necessary for the improvement of water supply services and it brings a new way to the urban water sector (Savage and Gupta, 2006, Sridhar, 2007, Okeke and Agu, 2016). The provision of adequate financing is an important driver of the effectiveness of urban services (Stren, 2013) and the strong support of institutions is helping in the improvement of water services, especially in urban areas (Lawrence, 2010). This study used Scott's institutional theory, which explains institutional importance and its support for water service delivery.

One of the main studies about Kerala (Dolley and Wallis, 2001) points out that, the reason the state faces a major problem with water service delivery is, the inability to meet the total demand fulfilling to our society. This is because various institutions are managing water supply in the state and the government-led Kerala Water Authority is playing the dominant role. But, KWA is economically inefficient and has high revenue losses and faces the problem of resource constraints resulting in not performing well in the state. KWA has not yet achieved its equity goals in drinking water provision in urban areas and impossible to achieve these equity goals alone (Ploumen, 2010). Also, the emergence of an alternative institutional setup in the drinking water supply system is reducing the significance of a centralized system in the state (Dolley and Wallis, 2001).

Another major study about Kerala (Radhakrishnan, 2006) points out that water availability problems and its shortage of supply among different classes are very high and unequal within Calicut city. Distributional and consumption variations are the main reasons pointed out in his study. Some studies (Pretorius and Schurink, 2007, Kundu and et al, 1999) point out the existence of inequality in water supply across the country especially among state and size categories of urban centers are extremely high. The centralized policy recommendation and financing of water supply are not balanced in all places. Governance issues of corruption and accountability are the major problems of the centralized system (Davis, 2004, Bardhan and Mookherjee, 2006) and are also common issues in water supply services in the state. More specifically, the state government's participation is expected to be active in big towns at all times. The above picture shows that the centralized water supply system is a failure in the state.

So it is necessary for the successful implementation of water services in the whole society especially poor areas, for developing policies and strategies and technologies have to be developed on a local basis (Sandelin, 1994). Here, it demands redefining the role of state government in water service in terms of financial assistance to local bodies, implementation of water policies, incorporating stakeholders, and supervising local-level institutions etc (Panickar, 2007).

1.3.3 Water Service Delivery and Decentralization

The word decentralization could be defined as a transfer of power, responsibility and functions from the central government to other levels (local levels) of government (Awal, 2005 and Lai and Vito, 2005). Since1990s, the decentralization process was initiated and strengthened in all countries in the world. This structural reform helps to promote the efficient use of resources and to address the local needs of developing countries (World Bank, 2000). This reform also helps to implement and develop policies, strategies and technologies on a local basis with improving the living condition of people in local areas (Sandelins, 1994). Decentralization recognizes the role of local governments in the implementation and delivery of local services.

The decentralization approach helps to explore local-level financing by extending assistance from state and central levels, and various institutional sources from bilateral, multilateral, internal and external funding agencies (Water Aid, 2008, UNICEF and PIDS, 2009, Bagchi and Chattopadhyay, 2004, PIDS, 2009) etc. Decentralization reforms also help to improve the better allocation of resources which attain equity, effective mobilization of revenues from various sources, improving the quality of services, solving water scarce problems, and increasing degree of municipal involvement in water service delivery (Anifowoshe, 1987, Makhari, 2016, Sreekumar, 2017) etc. This helps to increase the involvement of local government roles in expanding its production, coverage, service volumes and its delivery. Then, Decentralization creates an enabling environment for better service delivery of public goods and services at the local level.

The landmark initiatives under the 74^{th} constitutional amendment act, aimed to strengthen urban local bodies, and empower them in institutional, fiscal and financial manner. This helps to improve the efficiency of resource use and the delivery of services (Ahmed, 1995). In light of the 74^{th} amendment, the role and responsibilities of local government have increased and mandated the functions of water service provision of the society. However, both central and state governments are significant supporters as the largest funder, setting overall policy framework and setting technical standards and norms etc. (Muriisa, 2008). Then the local bodies are empowered financially, technically and institutionally (NIPFP, 1995, Vinod and Biju, 2015).

Generally, local government refers to the lower sphere of government which has the responsibility to provide basic services to its local communities. Agagu (1997) defines a local government as a government at the grassroots level of administration which is meant for meeting the peculiar grass root needs of the people. Lawal (2000) defines local government as that tier of government closest to the people, which is vested with certain powers to exercise control over the affairs of the people in its domain. Aminuzzaman (2010) states that local government organization are closest to people, and quality of service delivery is one of the most critical areas of local government. Water service delivery/water provision is the responsibility of the local government in the country.

Local government is the most significant sphere of government with its close proximity with people and it plays a central role in enabling the achievement of development at the lowest level (Naidoo, 2004, Maserumule, 2011, Thornhill and Dlamini, 2012). Decentralization can help to develop local government capacity with increased local-level potential and its contribution to the positive effect on service delivery (ADB, 2007, Sangita, 2007, Muriisa, 2008, Majekodunmi, 2012). Mainly, strengthening the institutional capacity of local government can develop three levels in an individual, institutional and systematic manner (UNDP, 1998).

Public services are delivered by the nexus of relationships between service providers, politicians and beneficiaries (Besley and Ghatak, 2007).Government institutions require organizational structures and suitably qualified people who must be supported to deliver the services and their responsibility (Whitaker, 1980). It requires a good governance structure from the political side with public servants understanding better its powers and functions for implementing better service delivery. This political reform provides a well-shaped implementation of better water service delivery in society (Singh, 2014). Institutionally and politically viable local government institutions can achieve better implementation, development and delivery of essential services to citizens.

DWAF (2005) defined local government as the sphere of government closest to the people; they are elected by citizens to represent them and are responsible to ensure that services are delivered to the community. Then local government gives importance to people's preference and their necessities at the time of improving service delivery (World Bank, 2009). So, local governments give importance to a needs-driven approach and improving water service delivery (Allen and et al, 2006). This is because the local governments perform only in limited local areas and it can help in concentrating on the overall performance of that limited areas. Its performance is more responsible and efficient. So, decentralization is an effective tool for the delivery of water services to local communities.

In Kerala, the local government can improve administrative and governance functions sustainably and effectively with an effective service delivery mechanism. The KLGSDP baseline and end-line study reports say that local bodies are closely connected with citizens and provide satisfactory water services. However, the study report recommended building strong infrastructure and facilities to improve local government service delivery. The study also finds out citizens' satisfaction with civic services is better in municipalities than in gram panchayath. (KLGSDP,2013,2017). Kerala is considered a successive decentralization initiative implemented state in India. The various studies (DWSS Report, 2017, KLGSDP, 2013, 2017), Chakrapani, 2014) pointed to the successful implementation of the water service delivery mechanism in decentralized Kerala.

The provision of water supply in cities is the responsibility of urban local bodies. But the following major bottlenecks are affecting the local level performance of water service delivery. Zakaria Committee Report in 1963, observed in general cases of local bodies in India owning poor resources base and lack of adequate financial technical-administrative support from the state government. So the urban local bodies are not in favour to provide basic services. Generally, the norms were set long years ago by Zakaria committee at local levels and the same norms are followed at present. (Mathur and Chandra, 2008, Rao and Bird, 2010) Their studies explained approximately 28 per cent of municipalities provided less than 50 litres per capita per day which is less than half of the norms recommended by the Zakaria committee for towns with less than 20000 persons. In this situation identified water services do not reach all urban areas, especially poor or slum-concentrated areas. It creates a wide gap between the per capita availability of water in proper cities and the areas outside (Banerjee and Roy, 1990, World Bank, 2017). So it is necessary to set a suitable benchmark to measure the progress of water service from a user perspective view, especially from the poor sections of society (Paul and et al, 2004)

Lack of adequate financial resources (low budgetary support, low revenue from various sources, lack of funds from central government etc(Bagchi, 1999, Rao and Bird , 2010, Raj,2013, Boyle ,2014), issues of pricing(low tariff rates), inefficient billing system, high subsidy and low-cost recovery (Chitharanjan and et al, 1993, Mathur, 2001, ADB, 2004, UNICEF/PIDS, 2009, Raj, 2013) are the common constraints faced by local bodies in the country. This problem affects most of the urban local bodies in India, which are under the condition of a "low-level equilibrium trap" in the provision of water services. Briscoe, 1993 study argues that the trap is caused by low-level services provided by local institutions, low tariffs often fixed or approved by the state and for which the users are not willing to pay as they do not find service satisfactory.

The other major issue in the lack of manpower for services (Pradeep, 2011) and lack of material capacity (Aminuzzaman, 2010) is the increased workload of local bodies. Low investment coupled with outdated network technologies, a weak distributional network, and ineffective management (Collins,1985, Whittington & et al, 2009, Mogakane**,** 2018, Adamu and et al, 2019), illegal connections and inconsistent service provisions, poor quality services (low pressure, irregularity, in sufficient quantity, intermittent supply, inadequate coverage) breakdowns and leakages of a piping system (Vhonani, 2010, Olajuyigbe, 2010), issues of mal-administration (Fragmentation and overlapping responsibilities and gaps in coordination) with confused duties and functions in the official level (Pradeep, 2011), lack of administrative & managerial capacity of local bodies (Wagle and et al, 2011), lack of appropriate rules and regulation, poor coordination (Sarshar and Moores , 2006) and issues of beneficiaries who are compelled to pay for inadequate and unreliable services (Whittington and et al, 2009, Malatjie, 2016). Inconsistency in political problems (Pradeep, 2011), also negatively affects the local government water service delivery performance.

1.3.4 Governance Support to Water Service provision and Its Delivery

The governance concept is considered as the sound institutional management for development (MUD, 2012). The OECD report (2009) says, the decentralization process introduced since the 1990s influenced the water sector. Many different institutions were involved in the performance of the water sector at that time. Here, the concept of governance explains as a set of systems that control decision-making in water resource development and management (Araral and Wang, 2013).

Khan (2009) explains governance concept emphasizes a link between the state and civil society (Shai, 2017). The Strong decentralization initiatives help to develop a good governance framework. In the framework, the local community acts as a watchdog in the system and ensures that public officials deliver quality goods and services (World Bank, 2000, Akpan, 2008). That is, increasing client power leads to increase in the service provider's efficiency and power of control over the service system (Teshome and et al, 2013). Effective information and communication from the governance side are the most prominent requirements for increasing community involvement and efficient service delivery mechanism (Schuringa, 2009). Then good governance -renders high support to improve the quality of life of the population.

Good governance, which is good service administration, is enhancing leadership quality at the local level. Effective leadership brings the right direction of its performance and service delivery (Shai, 2017, Pretorius and Schurink, 2007). These studies strongly depend on the leadership model and emphasize that leadership qualities are needed essential for the improvement of service delivery. Generally, the local governance system acts as an agent and it depends on the central mechanism for various assistants and it provides delivered efficient service to communities (Whittington and et al, 2009). In the study, the author used principal–agent theory by considering local bodies as agents and state/central mechanisms as principals and bringing a strong relationship between central/state and local levels by implementing successive service delivery. In the mechanism, the quality of services being provided by the agent and its outcome is the most efficient (Afridi, 2017).

Governance plays an important role in the effective delivery of services in urban areas (Boateng, 1997, Devas, 1999, Boex and et al, 2013). This is because good governance administration creates a good and efficient management mechanism. It also leads to improving the functional and financial performance of urban water supply systems (Gupta and et al, 2011), (Metha and Metha,ed), (Dalhuisen and et al, 2002). So, good governance administration helps to manage water service efficiently and attain adequate quantity and quality of supply service.

The strong governance framework built good accountability networks which reduce corruption and improve quality of services (Davis, 2004, Deininger and Mpuga, 2005, Bardhan and Mookherjee, 2006, Bellaubi and Pahl-Wostl, 2017). The accountability mechanism helps to reduce asymmetric information problem faced by the service providers and help to enhance service delivery (CESPA,2012). The accountability framework includes the relationship between various actors such as clients, politicians, policymakers and service providers (public, private, and self-organized groups (World Bank, 2004, Birner, 2007). The principal-agent theory provides a framework for understanding accountability in public service delivery (Farris and Graddy, 1996, World Bank, 2004, Reinikka, 2007, Awortwi, 2012). The studies (Ndiaye and et al, 2013, Mintesnotbeyene, 2016) point out that transparency, accountability, and responsiveness are the major factors influence to enhance water service delivery.

Urban water governance is emerging as a critical development challenge, particularly in developing countries that are experiencing a high rate of urban growth (WWAP, 2015). The various issues of lack of quality governance (insufficient data sharing and coordination between offices, lack of water quality laws, unclear policies, lack of technical and administrative management capacity) (Kayser and et al, 2015), corruption, lack of accountability, lack of public participation, lack of transparency, weak decision-making structure of top-down institutions (Sahu, 2010, Sing, 2017) badly affect the performance level of service delivery institutions and its service delivery mechanism. The main governance constraints like political market imperfections(councilor interference and political manipulation), policy incoherence, insufficient performance (lack of employee capacity, poor planning, monitoring and evaluation), weak accountability and transparency, and inadequate citizen participation also highly influence ineffective water service delivery(Bakker, 2008, Wild and et al, 2012, Makanyeza and et al, 2013).

The above review of literature provides detailed information on water service provision and its delivery mechanism in urban areas. First section of the literature deals with available urban water supply and some of them relevant to water supply services are essential to the increasing development of the urban economy. The second section proves water supply is a public utility and the government's institutions own the sole responsibility of providing better water service delivery to society. In this section, several studies have explained the importance of centralized water supply service delivery and its performance status elaborately. The other several studies highlight various issues and challenges of centralized urban water supply delivery systems in society. They point out that institutional, financial and managerial problems pose high threats to water service performance and its delivery.

Third section explains the role of the new institutional arrangement provided to water service and detailed information on performance, problems and issues related to water supply service delivery. In this section, several studies explain that local governments are enjoying successful implementation of water service provision and delivery. The several other studies explained various issues and challenges faced by urban local bodies in their water service delivery. In the review analysis, the researcher identified that the governance factor is unavoidable in water service delivery performance by the institutions. Fourth section explains the importance of the government's role and its involvement in water service provision. Several studies explain that governance factor help to improve water management and service provision. The several other studies point out that governance failure is badly affecting water service performance. Governance factors highly influence either positively or negatively the performance of the water service system.

Research Gap

In review analysis, several studies highlight the effectiveness of water service performance in urban areas in various aspects. This analysis shows the significant role played by new institutional (local government) arrangements in the delivery of water service at the local level. However, the municipal bodies do not get a significant role in their water service performance in the state of Kerala till now, as defined water service provision is mandatory for local bodies in the state. Also, need is there to examine the role of municipal bodies' performance level of water service delivery in urbanized Kerala. The review analysis also examines that the governance factor is the backbone of municipal water service delivery performance over all. So it is necessary to incorporate the governance factor to redefine the role of municipal bodies' performance level (effectiveness) of water service delivery mechanism in the state. Only limited work has been done in the field focusing on municipal bodies' performance (effectiveness) of water service delivery mechanisms in Kerala. Hence the present study is filling this gap.

1.4 STATEMENT OF THE PROBLEM

Kerala is one of the leading states in India in the field of successful implementation of decentralization reforms. From the beginning of the 1990s, the positive movement of decentralization initiatives commenced and state witnessed rapid decentralization since mid - of nineties. Decentralization helps to transfer development functions and different types of funds to the lowest tier of government from higher levels. This movement actively supports wide development of the local government institutions in the state. The 73^{rd} and 74^{th} constitutional acts provide the power of local bodies to take legal responsibility of water supply to rural and urban areas in the state. Under the Kerala, Panchayati Raj act 1994 and Kerala Municipal Act 1994, providing water supply as a mandatory function of panchayath and municipal bodies in the state.

But, water supply and its services are carried by mixed agencies of KWA, KRWSA and local government in present decentralized Kerala. Now, KWA continues to be the primary water service provider in the state. However, on one side panchayati raj institutions have been actively involved in water supply and services since 1995. As per a government order in 1998, panchayath is responsible for direct ownership and management of entire small rural water supply schemes and their service performance. Also, the state started to emerge and widely accepted decentralized community-managed water supply schemes taken up by panchayath with the big support of beneficiary groups. A large volume of central and state assistance promoted rural local water supply in the state. Unfortunately, KWA still performs as the primary water service provider on the other side of the urban water supply. Urban local bodies only play a very little role in local water supply provision, and most of the municipal bodies in Kerala depend on KWA for their water supply (DWSS Report, 2018).

With rapid urbanization and increasing pressure on urban water service delivery, the role of urban local bodies is undoubtedly becoming more important. The central and state government-sponsored schemes are also providing strong financial support to urban local bodies in Kerala. In this situation, it is necessary to discuss the serious subject of urban local bodies' involvement and their performance of the water supply service system in Kerala as well as the real fact of the marginal role played by municipal bodies in the topic of water supply delivery mechanism in Kerala state. As the majority of municipal bodies have an insignificant role at present on this topic, the researcher choose only the active Thrissur Municipal Corporation in Kerala as an example and analyzed its performance of its water supply delivery mechanism in depth and detail. Here, the researcher would like to state that in Kerala's urban water supply, municipal bodies have an important role to play. In this context the present study deal with the effectiveness of Municipal Corporation in delivering water service.

1.5 RESEARCH QUESTIONS

The research questions attempted to answer through the study are

1. What is the current status of the urban water service delivery mechanism in Kerala? How effective are Kerala's various tiers of government? What part do urban local government entities play in this service delivery?

2. What is the status of Thrissur Municipal Corporation's water service delivery? How well have the needs of the communities been satisfied by this service delivery? How much did the poor section profit from service delivery? Is the delivery of services efficient?

3. What part does the government play in successfully providing water services? How much the administrative governance system does contribute to the efficient supply of water services? Does the governance structure facilitate the efficient provision of water services?

1.6 OBJECTIVES

1. To examine the existing pattern of urban water service delivery mechanism in Kerala since decentralization.
2. To examine the effectiveness of the water service delivery mechanism in Trissur municipal corporation.
3. To analyze the role of governance on the enhancement of Trissur Municipal Corporation's water service delivery.

1.7 HYPOTHESIS

1. Decentralized system appears to be better than a centralized system in performance in terms of water service delivery.
2. Involvement of good governance and its good support in ensures better water service delivery performance of the government.

1.8 THEORETICAL FOUNDATIONS

1.8.1 Theoretical Background

Water is the most precious natural gift, available on the Earth. It is essential for human survival, the critical element of good health and ensuring socio-economic development and environmental benefit to the economy. Water is valuable as an essential resource to human life. This statement is proving Smith's 'Value theory'. Adam Smith explains his 'Value theory 'as the difference between value in use and value in exchange of commodities. Smith uses the diamond-water paradox to explain valuation is human preferences and 'water' which has the greatest value in use and 'diamond' which have the greatest value in exchange. He uses the paradox to highlight the significance of water's inherent value and to argue that there is nothing more essential than water for human survival. Water has also a much higher marginal utility than diamond. So water is a more valuable resource.

The water resource is a basic necessity and every person has the right to demand drinking water. So the provision of water supply service is vested as one of the primary responsibilities of the government. Then, the urban water supply is the responsibility of the municipal government. Generally, government provides basic social services including water supply that are regarded as public good. The characteristic of water supply is monopolistic with primarily remaining within the public sector service in the state.

Water supply is a public good, which implies that water service is non-rivalry in character. That means the consumption of public goods by one household does not reduce the quantity available for consumption by other people. The non-rivalry features consider that all households can simultaneously consume a level of water proportionate to the total supply. The public provisions of water supply are extended by the government through public financing, to ensure that water supply service is included in a non-excludable character. That means, if water is supplied, no household can be excluded from consuming it. Here, the pricing system of water supply is not affected by the household consuming level of water because they expect it possibly at an infinite cost. However, a large number of poor people suffered lack of this service in the state.

Fresh water is considered a “common pool resource” defined as the characteristic of 1) the exclusion of potential users is costly and difficult 2) the utilization of the resource by one user limits another's potential user (Ostrom, 2010). Water is considered an open-access resource here. It can easily be accessible to any common person and in which a user ignores the effects of his action on others. This leads to problems that have been exacerbated by the growing number of water users. This tendency creates a threat of overuse and degradation problems of both groundwater and surface water resources on the earth. Garrett Hardin (1968) describes this bad condition and popularized his concept of “Tragedy of the commons”. He explains the reason for this ’tragedy’ means rational individuals who share a common resource; each decides to satisfy their short-term interest. Then increasing the consumption of each individual from the common pool resource resulted in the use and degradation of this public good. The individual’s personal short-term decisions threaten an entire group sharing this common public good. In this situation, Hardin (1968) proposed ways to find effective solutions to complete government ownership or complete privatization of this public property.

Government plays a dominant role in the provision of water supply in the state. The government provides the provision of water service to the people through effective policies and sound implementation practices. Water is supplied in the market. A free market leads to many problems and inefficient social outcomes. In a free market, inefficient distribution of supplied public water and misallocating of this scarce resource can occur. In some cases, water services became non-priced assets and people show a tendency to take it as granted and the product will suddenly disappear from the pricing mechanism of the market. This leads to market failure. Externalities, asymmetric information, the nature of public good and Market power etc. are the major causes of failure to perfect the market.

Price is an important variable in the water supply market. But, the possibility of water service charges equilibrium does not reflect the true costs and benefits of that service in the free market as the result of the producer does not bear all cost of service problems (negative externalities) or the buyer does not get all benefits of that service (positive externalities).

Both conditions are reflecting in an inefficient market. Asymmetric information is a common problem in a free market. The problem arises when party's information is not accessible to another person. In the water supply market, generally, the seller is selling the usual quantity of water. But the buyer cannot communicate what they want through the actual water demand. Lack of equal information causes economic imbalances that result in adverse selection and moral hazards. All of these economic weaknesses lead to market imperfections.

Investment is the unavoidable element for efficient water supply service. Water supply is considered a public good and it faces the free rider problem. The cost of water supply does not increase with an increased number of users of that good. This is because certain users continue to use public water supply but they do not like to pay for it. In this situation, it is necessary for government involvement in water investment. The government also plays a central role in setting a correct price in uncertain and ignorant situations in the water supply market. The characteristic of the water supply is monopolistic. In such a situation, the single seller has control over whole areas of the market and therefore can strongly influence the price, demand and supply of water in the market. This is lead to imperfect market conditions.

The above conditions strongly affect the functioning of the market for water supply and services. The market is failed to provide the right amount of water for society. Government intervention is necessary in the water supply market. Government interventions such as policy tools like taxes and tariffs, subsidies, price control, and new laws and regulations help to solve the problem of market failure and enables perfect market conditions for water supply. So, complete Government ownership is necessary and appropriate for an efficient water supply system. Local Government can play a big role in the water supply service delivery mechanism in society.

Generally, the principal-agency theory explains the relationship between both the principal and agent and its effect on services on the demand side (Jensen and Meckling, 1976, Brown and Potoski, 2003 Collier, 2007, Arwortwi, 2012). The theory provides a good basis to understand the relationship in which the principal delegates work with the agent, who performs the task (Jensen and Meckling, 1976, Collier, 2007). The triangular relationship of principal-agent-client is necessary to be involved in effective service delivery to a multi-level governance model. The principal holds the agent accountable; the client can hold both the agent and principal accountable. However, in the multi-level approach, there is no direct connection between the principal and the client. Here, the principal may difficult to determine the demand for service offered by the client. On the other side, negative characteristics of the agent behaviour of self-interest are also creating principal-agent problems. The principal-agency problem arises in a situation in which principals do not exactly have the same interest as their agents.

The local-delivery chain provides a strong relationship between both institutions and communities helping to implement a healthy principal-client relationship. The ability of the client to hold the service provider accountable and the willingness of the service provider to account for the client are fundamental to effective service delivery (CESPA, 2012). So the principal-agent problem is not arising here. The local government is performing more effectively than higher levels.

Williamson(1979) in his 'Transaction cost theory 'points out in the hierarchal organizational structure help to, include each level that can easily minimize their transaction costs or costs of exchange and achieves an optimum level of economic efficiency. The local bodies can easily, possibly minimize their transaction cost and achieve maximum efficiency in service delivery mechanism as in their characteristic of more transparent and highly accountable manner working closely with people or consumers.

Good governance and leadership are regarded as critical elements for contributing to effective service delivery. Sadler (1997) defines leadership as the ability to influence and motivate subordinates to effectively and successfully contribute towards institutional goals and objectives. Mafunisa (2013) argues that leadership is the capacity for accepting full responsibility, and the willingness to accept risk for an ideal in which belief is maintained. Good leaders should have confidence in their future success and they provide service in a cost-effective, efficient and equitable manner. Water supply is a mandatory function of local bodies and therefore, holds responsibility for providing effective water service to communities as a good leader. Good leaders can always provide efficient service delivery and good leadership is critical ingredients of successful organizations.

The above theories are providing strong support to the present work.

1.8.2 The Basic Theoretical Framework

Federalism refers to the system of power-sharing between two or more levels of government. In a federal structure, powers and responsibilities are distributed across different layers of government. In this system, governments at different levels perform their function and provide efficient levels of output in their jurisdictions. Here, all layers of government enjoy self-autonomy of power and perform their service delivery functions.

In Kerala, the multi-level governance model is popular in the water supply service delivery mechanism as earlier. The concept of the Multi-level governance model was initially formulated and directly applied to the European Union. Simply defined, multi-level governance is a process of governing at different levels of government from local to international, all have some power and operate together and affect one another. The multi-level governance model is defined by Gary Marks (1993) as "a system of continuous negotiation among nested government at several territorial tiers which super national, national, regional and local governments are enmeshed in territorially overreaching policy networks". Jachtenfuchs (1995) extended this institutional definition as "the relationships between governance processed and different government levels". Later elaborated, Multi-level governance is a model which identifies the participation of different networks and political communities in the decision-making process, problems are solved after reaching a negotiation through the aggregation of the various divergent interests (Stubbs, 2005, Ivan and Cuglesam, 2009).

A multi-level governance structure includes two dimensions, horizontal and vertical dimensions. In the horizontal dimension, the government interacts with non-state actors like NGOs, community institutions and civil society. The upward and downward relationships between the national and sub-national levels of governance are included in the vertical dimensions. In water service provision, the power is divided into three levels of government central, state and local levels in the state. In-state water supply delivery is carried out by the combination of state government, and local governments with central government assistance. Now the state enjoys the water service provision, including all actors in different levels at which they are located at national, local, regional, community institutions and civil society with sum up different forms of partnership and aggregation of their various interests and successfully implemented water service delivery.

Among the state of India, Kerala enjoys a long period of experienced and successful implementation of decentralization reforms since 1995. Decentralization provides new powers and responsibilities for local government to provide public services at the local level. The 73rd and 74th Amendments Act was formulated to enable a good local governance system and transfers the power of autonomy to the local level of government. The autonomy power is guaranteed by limiting the supervision of the superior government authorities to local government functions.

According to UNDP (1999) service delivery is a set of institutional arrangements adopted by the government to provide public goods and services to its citizens. Since decentralization, the state followed a decentralized service delivery model in water service provision. This model explains as, a rule where provision, production and delivery of services are to be devolved to local bodies. On model base delegation of decision-making, powers should be rest with the lowest level of government. Then the legislative, executive and administrative actions must be decentralized as possible. Then the entire functions that can be optimally done at the lowest level should be reserved for that level.

A decentralized system is more responsible for achieving communities' basic needs and is closest to individuals in trying to provide maximum social welfare. Local government should be the smallest and very close to citizens who help to empower communities and their participation in the collective decision-making process. The communities also engage with administrative officials and elected representatives to provide good governance practices at the local level. Local governments are in a better position to more efficiently provide public goods because they possess knowledge of local costs and benefits (Goel and Saunoris, 2014). Also, the local government is closer to local communities to know the better position to match the supply of given services to citizens' demand. So the power needed to be vested in the lowest level is necessary. Also stated local government participation in the provision of basic services is expected to increase the efficiency of service delivery (Tiebout, 1956, Oates, 1972, 1977). Then lower levels of government could deliver water services as effectively as the central government. The situation is suitable to the stated dominant political theory of the subsidiarity principle.

The subsidiarity principle states that 'doing things at the level at which they can be best done'. The concept of the 'principle of subsidiarity' has its root in 'the social doctrine of the catholic church and it is widely introduced and accepted in European Union. The subsidiarity principle is contributing to the strength of the theory of decentralization. Oates (1972) in his theory of "optimal level of decentralization" is help to explain in the local government carries out their functions without the benefit of the central government. This autonomy provides local bodies with maximum freedom for their performance and achieves an efficient level of output to minimize cost. This is popularly described as the "Decentralization theorem". The subsidiary principle is applied to Oates's decentralization theorem to introduce a new governance structure of public service delivery mechanism and ensure better service quality and optimal allocation of resources with maximize individual welfare.

The subsidiarity principle states that, the process of transferring functions and powers should start from the lowest levels of gramsabha and ward committees and go up to higher levels of government. This principle is applied in the multi-layer governance model to make co-responsibility between a local, regional, and central government with each level providing an efficient output of public service to their constituency. It leads to increasing the overall quality and effectiveness of this governance system with increasing power and capacity of all levels of government, especially sub-national levels with maintaining good relationships between different levels in the multi-layer governance model. Here the subsidiarity principle again states that action should be taken at the lowest effective level of governance.

According to the present study, local body water supply service delivery is more effective than at the state level. The effective representation of communities in the decision-making process and their involvement in the delivery of water service can help to maintain the total quality of water service by the local body. Civil servants and politicians give importance to take care of the needs and preferences of communities and make them more responsible in service delivery than other levels of government. It creates speed, quality and quantity of local-level public service delivery than in the state level

1.9 CONCEPTUAL DEFINITIONS

The present study used various concepts and terms differently. The core concept of the study is used in drinking water. Drinking water or potable water is defined as having acceptable quality in terms of its physical, chemical and bacteriological parameters so that it can be safely used for drinking and cooking (Gadgil, 1998). In the study, water supply is considered a public good as well as a public utility. Generally, public utilities are organizations, which provide basic service to the public. Utilities are considered to be "What is essential to life". Here, a public utility is mentioned as the provision of water supply should be free of charge or highly subsidized rates from the concerned authority. The study is also deconstructing five important concepts of Decentralization, Local government, Service delivery, Effectiveness and Governance in a simple and useful manner. For this study, these core concepts and terms are defined as follows.

1.9.1 Decentralization

World decentralization could be defined as a transfer of power, authority, responsibility and functions from the central government to other levels of government (Hussain, 2005, Lai and Cistulli, 2005). Ronedenelli (1981) defined decentralization as a transfer of authority to plan, make decisions and manage functions from the national level to any individual organization or agency at the sub-national level. World Bank (2004) uses the term decentralization as the transfer of authority and responsibility for public functions from the central government to intermediate and local government or quasi-independent government organization and/or the private sector.

Decentralization is a comprehensive concept that takes three important forms. That is De-concentration, Delegation and Devolution. De-concentration means the redistribution of administrative powers, functions and responsibilities only within the central government (Rahaman and Khan, 1997). It is a process that involves the transfer of powers, functions and responsibilities within the central government hierarchy. Here, the local administrative bodies are part of the central government structure (Hussain, 2005, Rahaman and Khan, 1997). Delegation means the central government transfer powers or responsibility for decision-making and administration of public functions to semi-autonomous organizations that are not directly controlled by the central government, but accountable to it (Lai and Cistulli, 2005). Devolution is the preferred form of decentralization and it means to transfer of full powers, functions and responsibility for the delivery of public goods and services to the local government bodies, including law-making and revenue-raising powers (Hussain, 2005, Rahaman and Khan, 1997).

The level of decentralization is measured by the extent of administrative, political and fiscal dimensions. An aggregate index of decentralization is developed with these parameters. This study discusses these three major dimensions of decentralization. Administrative decentralization (institutional)seeks to redistribute authority, responsibility and financial resources for providing public services among different levels of government (Hussain, 2005). It means transferring the responsibility of the planning, management and rising and allocation of resources from the central government to other stakeholders (subordinate units of levels of government, semi-autonomous public authorities, non-governmental organizations, voluntary organizations etc (Lai and Cistulli, 2005, Rahaman and Khan, 1997). Political decentralization allows for more participation in decision making from both citizens and elected officials. Political decentralization assumes that decisions made with greater participation will be better informed and more relevant to diverse interests in society than those made only by national authorities (Hussain,2005). Fiscal decentralization means the transfer of financial responsibility of collecting and allocating revenue as well as the authority to make expenditure decisions from the central government to the lower levels of government (Nsibambi,1998). However, some important decisions and responsibilities remained at the Centre.

1.9.2 Local Government

According to Cloete (1995) local government is the lower sphere of government which is decentralized. The word "local" connotes that councils are meant for small communities and the word "government" means that they have certain attributes of government Ojofeitimi (2000). According to Ikelegbe (2005) the Local Government is a segment of a constituent state or region of a nation-state, established by law to provide public services and regulate public affairs within its area of jurisdiction. Agagu (1997), Lawal (2000) and Mascrumule (2005) also defined local government as a grassroots level of administration, meeting peculiar grass root needs and services to local communities.

DWAF (2005) defined Local government as the sphere of government closest to the people; they are elected by citizens to represent them and are responsible to ensure that services are delivered to the community. Emezi (1984) point out local government as a "system of local administration under local communities that are organized to maintain law and order, provide some limited range of social amenities, and encourage cooperation and participation of inhabitants towards the improvement of their conditions of living. Adeyemi (2012) defined local government as a multi-dimensional concept. The author clearly explained the characteristic of important dimensions of local government in his work. He explains the important dimensions are Social (to promote a social entity), Economic (economic well-being to people), Geographic (specific and defined territorial jurisdiction), Legal (legal autonomy to make policies and prepare its budget), Political (a political entity) and Administrative (local bureaucracy) dimensions.

Above definitions, identifies that local government is a viable, political and administrative instrument for the development and delivery of essential service to the people.

It is the third tier of government which is subordinate to central or regional government. It performs in local limit with constitutionally mandated power to perform certain legislative, administrative and judicial functions. A local government plays a central role in enabling the achievement of development as its defined geographic area promotes the well-being and quality of life of citizens. So the local government must create an appropriate and suitable environment for the local people through efficient and effective service delivery.

The 73rd and74thAmendment acts of the Indian constitution empowered rural local bodies in villages and urban local bodies in cities and towns. In this study, the local government is considered an urban local government. Urban local government is a mother institution of urban development in respective cities and towns. The present structure and style of functioning of urban local government are based on British rule in India. Powers and functions of urban local bodies include part IX-A in article 243 of the Indian constitution. The urban local bodies are responsible institutions in urban areas, fulfilling the functions as enlisted in the 12th schedule of the Indian constitution.

For smooth functioning of administration in urban areas, Kerala, formed several types of municipal bodies in cities and towns based on their size population. Generally, urban local governments are divided into two, namely municipal corporation and municipality. Municipality/municipal Corporation refers to an organ of the state within the local sphere of government exercising legislative and executive authority within an area determined in terms of the local government (Muriisa, 2008). In this study, the researcher considers one Municipal Corporation and its performance in the provision of water supply to their local communities.

1.9.3 Service delivery

Generally, service is a valuable action, deed, or effort performed to satisfy a need or to fulfill a demand (Mogakane, 2018). Rao (2005) defines services as intangible activities performed by machines or persons or both to create perceptions among customers. Public services include all services provided by the government as well as all services where the government has a significant influence (OECD, 2010).

Service delivery is defined as the provision of basic public goods and services by the government to society (Fox and Meyer, 1995, Provan and Milward, 2009). That means the government is delivering its services to citizens. UNDP (1999) clearly defines it; service delivery is a set of institutional arrangements adopted by the government to provide public goods and services to its citizens. Briner (2010) defined public service delivery refers to the production and delivery of public service through the involvement of multiple governments that include public agencies, private enterprises, NGOs and communities at large. Public services are delivered by a nexus of relationships between three broad categories of actors like citizens/clients, politicians/policymakers and providers (Besley and Ghatak, 2007). Improved public service delivery is needed to increase the capacity and incentives of government institutions and also other service providers' participation in different ways.

Service delivery is mostly considered the classic principle of market thinking (Eigeman, 2007). That means the people request a payment service and may expect to be helped for a reasonable price within a reasonable period thus forming a friendly relationship between provider and user. Improving service delivery leads to improvement in relationship between government institutions and citizens.

Eigeman (2007) in his study, discuss the main four type of service delivery relationship. That is, 1) Direct service deliver involves directly reaching out to citizens in order to provide the intended services. In this service, a product from which the user benefits is get directly and the user often pays directly.2) Indirect service delivery is protecting firstly user interest and but other’s interests are also to be weighed. This service effect both applicants as well as others. 3) In individual service delivery, the effect on an individual or a limited group will be strictly private in nature.4) Collective service delivery is in which the service effect is proliferated to a whole community.

In this study, the researcher specifies the concept of water service delivery. DWAF(2003) defines the term water services as water supply services. Euro Market (2003) defines water services as all services that provide water for households, public institutions or any economic activities. The concept of water service delivery focuses on ensuring universal access by households to at least a basic water supply (DWAF, 2003). It means that water service authorities have a responsibility to progressively provided at least basic water service ensuring to all citizens living within their jurisdiction. According to Devisser and et al (2003) basic water supply is the prescribed minimum standard of water supply services necessary for the reliable supply of a sufficient quality and quantity of water to households, including informal households to support life and personal hygiene.

1.9.4 Effectiveness

Generally, the concept of effectiveness measures the extent to which original objectives and policy goals are achieved. The term effective refers to the capacity of producing a desired result. Effectiveness is the measured degree to which the result has been achieved. Dollery and Wallis (2001) argues that effectiveness has been often used to access the overall performance of service delivery by an organization. According to Nash (2004), effective service delivery is the provision of services to a buyer in such a way the buyer's expectation can be met or exceeded while, at the same time, the business remains viable.

The concept of effectiveness used in water services means, everyone, and everywhere can access sufficient water of safe quality for domestic purposes. Charles and Mertler (1993) have considered effectiveness as the optimal, hygienic and consistent use of water supply facilities to maximize benefits and minimize the negative consequences over some time. In this study, the concept of effectiveness considers as a water service delivery performance indicator by an urban local body.

1.9.5 Governance

The concept of governance is defined as "the action or manner of governing a country" (Oxford English Dictionary, 2010). That means what is done by a government. It simply defines the management of public affairs by the government. In general, governance is the process (or manner) where power (or authority) is exercised to manage the collective affairs of a community, a country, a society or a nation (Baron, 2003, Gisselquist, 2012).

The concept of 'governance' is used with different meanings in different contexts. A few of them are explained here. According to UNDP (1997), governance is "the exercise of economic, political and administrative authority to manage a country's affairs at all levels. It comprises all the mechanisms, process, relationships and institutions through, which citizens and groups articulate their interest and exercises their rights and obligations. GDN (2010) roughly defined the concept of governance as the set of formal and informal institutions that explain the decision-making process and action in a country. That means governance is the process of decision-making and the process by which decisions are implemented, an analysis of governance focuses on the formal and informal actors involved in decision-making and implementing the decisions made and the formal and informal structures that have been set in place to arrive at and implement the decision.

Bovaird and Loffler (2003) also defined governance as the interaction between different stakeholders to influence public policies. According to Naidoo (2004), governance is the combined efforts of public institutions and the private sector as well as other stakeholders to provide efficient and effective services to citizens. Khan (2009), Mubangizi and Tshishonga (2013) agree with Naidoo's definition and explain that governance emphasizes a link between government and civil society.

Based on the above scholar's definition, the concept of governance is a process within which government institutions coordinate processes and implements policies in prescribed norms and standards. The governance system involves a multiplicity of actors and deals with issues related to processes, organizational relations, networks, communication and coordination. This concept also promotes a good relationship between authorities and the general public.

The researcher used the term water governance in the study. It simply defined water governance as the set of systems that control decision-making about water resource development and management. Water governance should only deal with the processes and institutions that make decisions about water resources (Lautze and et al, 2011). Water governance is defined as the social function that regulates the development and management of water resources and provision of water service at different levels of society and guides the resource towards a desirable state and away from an undesirable state (Pahl-Wostl, 2009). However, Rogers and Hall (2003) publicly says that, the global water partnership defines "water governance as the range of political, social, economic and administrative systems that are in place to develop and manage water resources, and the delivery of water service at different levels of society" is most commonly used definition of water governance.

The above definitions, clearly explain that the government plays an important role in water resource management and water supply. They also simply states that the governance system determines who gets what water, when, how and who has the right to water and related services and their benefits (Allan, 2001). In the water sector, governance includes institutions, organizations, policies and practices, which shape and manage water resources, including the delivery of water services for diverse populations.

UNESCO (2006) considers four fundamental dimensions of water governance. That is Social (Equitable access and use of water resource), Economic (Efficient water allocation and use), Political (Equal democratic opportunities) and Environmental (Sustainable use and related service for all) dimensions.

Water necessities of fast-growing cities can be extremely challenging and it is necessary to invent new ways of responding to these rapid changes and making a good urban environment. So, good governance is essential for these activities. Effective urban governance is about devising strategies through which the various actors or stakeholders come together to solve problems of urbanization, each taking on issues with which they are well equipped and thus contributing constructively to the governance of a city.

This study also specifies the concept of urban governance. UN-Habitat states "Urban governance is the sum of the many ways as individuals and institutions, public and private, plan and manage the common affairs of the city. The concept of urban governance is commonly used to qualify the evolution of management, functioning and rules governing city development. Urban governance is strengthened by decentralization initiatives envisaged in the 74thamendment act. Decentralized governance is the provision of certain basic services and infrastructures of standard quality at the local level.

For, this study uses the core concept of good governance in Transparency, Accountability, Reliability, Communication and Participation.

Transparency- Transparency refers to the openness of government processes and free access to official information. Kroukamp (2007) states that transparency includes access to reliable and comprehensive information on government transactions and activities.

Accountability- Accountability implies that actors involved in the provision and regulation of water services must have clearly defined duties and responsibilities and performance standards (Responsibility), actors must be answerable to affected people and groups for their actions and decisions, which includes access to information in a transparent manner (Answerability) and mechanisms should be in place that monitors actors complains with established standards, imposes sanctions and ensure that corrective and remedial action is taken(Enforceability) (Ohcher, 2013).

Reliability- Reliability is defined as an entire system will perform its functions for a specified period. It implies "saying what you do and doing what you say" (Eigeman, 2007).

Communication-communication is simply defining the act of transferring information from one place, person or group to another. It is a process of creating and sharing ideas, information, views, facts, and feeling among communicating parties.

Participation- participation refers to the involvement and possibility for citizens to provide information with timely and meaningful input and to influence decisions at various levels. Communities are required to get involved in the planning, implementation and evaluation phases of projects to ensure the transfer of skills, knowledge and ownership to local inhabitants (Taylor, 2009).

1.10 DATA SOURCE AND METHODOLOGY

The study is based on both primary and secondary data. Primary data was collected by using a structured questionnaire among the household members and interviewing with open-ended questions among the representatives, who are responsible for delivering water service in the municipal area. This study also used a mixed approach of both quantitative and qualitative research methods. For the quantitative survey, data were collected from randomly selected households by using a well-structured questionnaire survey method. For the qualitative survey, data were collected from purposively (non-probability sampling) selected representatives and officials such as the mayor of Trissur corporation, administrative officials from the corporation and Kerala water authority, and councilors representing from corporation supply ward and Kerala water authority supply wards and experts in the field by using a semi-structured interview schedule. For this purpose, selected 5 service providers, who are responsible for this water service delivery.

The major secondary data information was collected from concerned institutions of the water department of Thrissur Corporation and Trissur Water Authority. The main official documents such as Annual Reports, Administrative Reports, Progress Reports, Annual Budget Reports and Minutes of meetings offered a large volume for information in the study. The other major secondary sources are the Five-year plan document; Census Report, Budget Report and RBI bulletin etc were used for the study. The data concerning the number of water supply schemes, population coverage of water supply schemes, internal and external financial sources, drinking water sources, service level benchmarks of water supply and budget allocation for water supply etc are provided by these documents. Economic Review by the state planning board and urban water supply services by the National Institute of Urban Affairs are also offered big support to the present study.

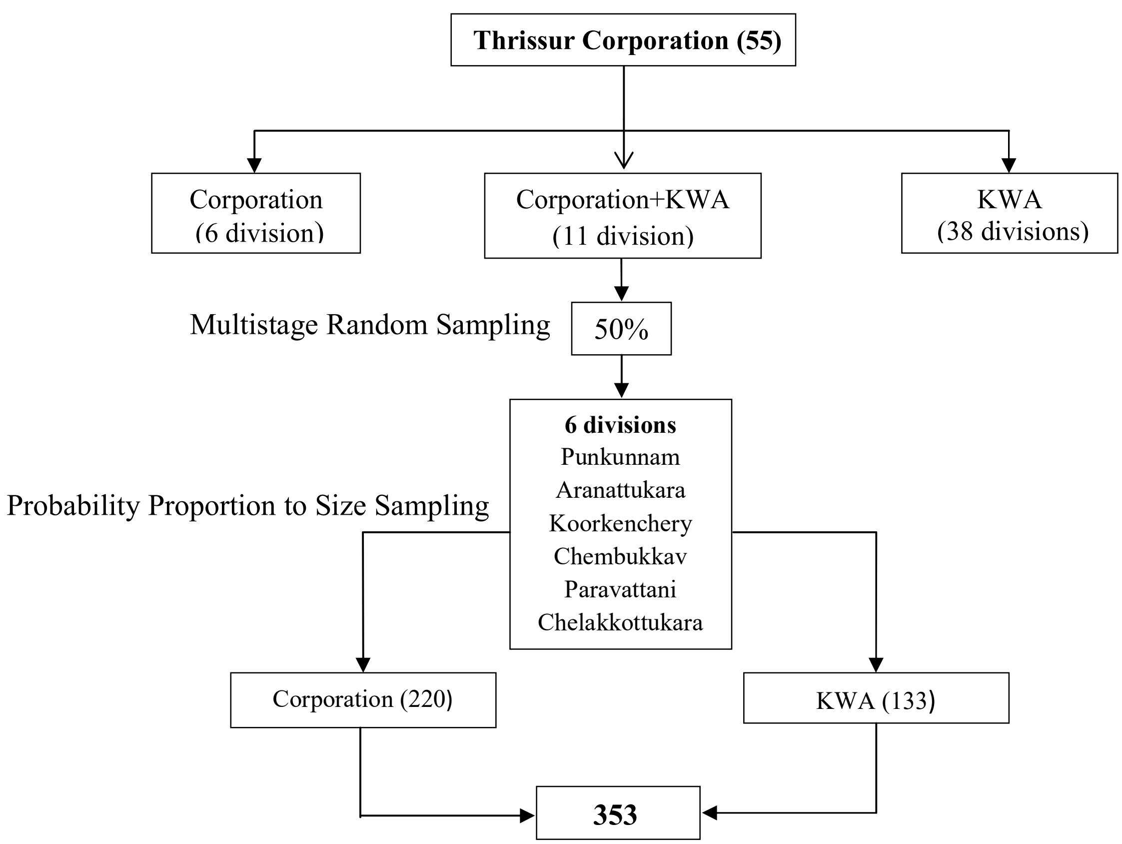
The data relating to general information on water resources, freshwater availability, water withdrawal and water consumption by the Indian Water Portal, the volume of rainfall, availability, usage and consumption of surface water resources by the Central Water Commission, groundwater resource potential, usage and consumption by Central Ground Water Board, institutional and financial arrangement and support for the water service by Ministry of Water Resource etc are the secondary sources include in the present study.

1.10.1 Study Area and Sample Frame

The study is conducted in Trissur municipal corporation area in Trissur district. Among the districts of Kerala, Thrissur district has been selected as a peculiar feature of the one and only Trissur municipal body performing drinking water supply service delivery to communities for a long period in the state. Only, Thrissur Municipal Corporation undertakes the mandatory function of water supply delivery as its responsibility and performance in its area. In line with this municipal body is selected as an example in the research.

The following chart depicted the study area and sample frame in detail.

Figure 1.1: Sample Frame



The chart explains Trissur Corporation has 55 divisions. Out of these divisions, the water supply in 6 divisions was supply controlled by Thrissur Corporation only and 38 divisions' water supply was controlled by Kerala water authority of Trissur division alone. The other 11 division's water supply was controlled by a partnership of both corporation and the Kerala authority. For the study, 11 divisions are selected.

In the present study, multistage random sampling as a probability sampling technique is used. Multistage sampling is a method that distributes the population into clusters or groups for conducting research. The sampling is based on the hierarchical structure of natural clusters and draws a sample from the population using smaller and smaller groups at each stage. In the first stage, the above 11 divisions are selected. In the second stage, 6 divisions selected out of 11 divisions, as the base of above 50 per cent of these 11 divisions. The 6 divisions also select to base the following special characteristic of 1) a large number of domestic water connections included and approximately equalize the number of both corporation and Kerala water authority connections. 2) Included the main zones like Ayyanthole, Koorkenchery, Villvattam and Ollukkara.3) Included the directions like east, west, north and south. And 4) selecting the large sample size is necessary for applying probability proportion to size sampling accuracy. In these 6 divisions, the sample is drawn from using to simple random sampling method. In the sampling, the selection is purely depends on equal chance to every population.

Table 1.1: Total Water Connection of Thrissur Corporation

Trissur Corporation	KWA water connection	Corporation water connection	Total water connection
Total water connection(55 divisions)	23380	18011	41391
Total domestic connection(55 divisions)	22926(98)	14949(83)	37875(91.5)
Total domestic connection(11 divisions)	4367(19.5)	8358(55.5)	12725(33.5)
Total domestic connection(6 divisions)	2656(60.5)	4413(52.5)	7069(55.5)

Source: Thrissur corporation service book, 2020

The total water connection of the Trissur municipal corporation is 41391. Out of these connections, 37875 (91.5 per cent) of connections are included under the domestic category. Out of the total domestic connection, the selected 11 divisions contribute 12725(33.5 per cent) of domestic connections. Out of this, the selected 6 divisions contribute 7069(55.5 per cent) of domestic connections. Thus, the total population drawn in the study is 7069. Out of this, 4413 population drawn from Trissur Corporation and 2656 population drawn from Kerala water authority in Trissur division in the study.

The population of the study is households in the Trissur municipal area. The present study, drawn total sample size is 353(5 Per cent of the study population). Out of this, 220 households were selected from depending corporation water supply and 133 households were selected from depending Kerala water authority water supply. This 353 sample is drawn, from selected 6 divisions and the proportional wise sample is drawn from each division. The probability-proportional-to-size sampling method is used for this sample selection procedure in the study. This sample selection procedure is depicted below table.

Table 1.2: Total Domestic Water Connection and its Proportional Percent in 6 divisions

KWA (5 %)	6 Divisions	Corporation (5 %)
805(40)	Punkunnam	567(28)
310(16)	Aranattukara	844(42)
400(20)	Koorkenchery	389(19)
447(22)	Chembukkav	1057(53)
244(12)	Paravattani	438(22)
450(23)	Chelakkottukara	1118(56)

Source: Author Calculation

1.10.2 Methods of Data Analysis

In this study, both quantitative and qualitative data analysis methods are used. The major statistical technique like Multiple Regression Analysis, Simple Correlation, Compound Annual Growth Rate, Average Annual Growth Rate and Water Service Delivery Index is used for quantitative analysis. Content analysis (content analysis technique is interpreting the content of text data using conventional, direct and summative forms) is used for qualitative data analysis.

The study used simple and popular traditional tools like Percentage, Simple Growth Rate, Compound Annual Growth Rate, Average Annual Growth Rate etc. for measuring the growth trend of long-term water supply delivery performance. The growth rate helps to measure the performance of institutions. CAGR help to measure short-term fluctuations in a specific period. AAGR provides a numerical average of the annual growth rate and it measures long-term fluctuations efficiently.

The Simple Correlation Coefficient measures the strength of linear association between two variables. The study is used for simple correlation coefficient to examine the relationship between monthly income and basic household expenditure first and also measure the relationship between income and water consumption later. The study also used multiple regression models to determine the socioeconomic factors that influence water consumption among urban households in the sample area.

Apart from these popular tools, the researcher tries to develop a new methodology for measuring to performance (Effectiveness) of water service delivery by the institutions for developing to Water Service Delivery Index. This Index based on the construction and development of the methodology is followed by the existing literature (Luis Andres & et al, 2016) study in Kerala. The Water Service Delivery Index is constructed, which combination of Availability, Accessibility, Affordability, Water quality and Water management indicators is used in the present study. More detailed methodology and other various sources are presented in respective chapters. The researcher also presented simple and suitable Graphs, Charts and Diagrams for analyzing data in the respective chapters in the present study.

1.11 CHAPTER SCHEME

The study consists of 6 chapters.

Chapter 1: **Design of the Study**

The introduction chapter outlined an overview of the research study. The chapter presents the introduction, significance of the study, literature review and theoretical background, statement of the problem, research questions, objectives, hypothesis, important concepts of related topic, Data source and methodology and chapter schemes as the key themes including the chapter priorities.

Chapter 2: **Water Resource and its Service Mechanism- An Overview**

Chapter two gives a general background of the study. This chapter discusses the general concept of water and its constitutional, legal and judicial powers as elaborately. Water availability and its utilization and future demand sector-wise explore the importance of domestic demand for water in this chapter. The chapter also explained the importance of drinking water and widely explained public water supply service mechanism in general and urban supply in particular in the world as well as the Indian context.

Chapter 3: **Water Supply Service Mechanism in Kerala**

Chapter three discusses the history, evolution and present scenario of water resources and the water service delivery mechanism of Kerala. The chapter provides a clear picture of the characteristic of state water resources and sector-wise availability, utilization and future demand for water resources and explores the importance of the drinking water segment in the state. The chapter gives a wide picture of the existing water service performance of urban areas and proves the state and municipal bodies' role in water service delivery in the state.

Chapter 4: **Effectiveness of Local Government Water Supply Service**

The fourth chapter discussed outcomes from the field survey. This chapter explains the depth of effectiveness of Thrissur Corporation's water service delivery and its mechanism. This chapter analyzed the present performance of Thrissur Corporation's water supply delivery and find out to what extent they are effective in their water service.

Chapter 5: **Role of Governance for Effective Water Supply**

The fifth chapter deals with the importance of governance system support in maintaining an effective water supply. This chapter proves it the governance system is the most important factor influencing Trissur Corporation's effective water supply.

Chapter 6: **Summary, Findings and Conclusion**

The sixth chapter presented the conclusions, which are drawn based on the finding of the study. The chapter includes a summary of the findings of the study, major conclusions and recommendations also drawn from best practices.

Chapter II

WATER RESOURCE AND ITS SERVICE MECHANISM-AN OVERVIEW

2.1 INTRODUCTION

Behold, in the eloquent verses of the esteemed Tamil poet and philosopher, Tiruvalluvar, in “Thirukural”, the profound declaration: “Water is the elixir of life.” These words not only resonate thought the annals of time but also encapsulate the very essence of water’s significance in the sustenance of all living beings. The prime necessity of water is drinking and other domestic purposes like cooking, washing, bathing, cleaning and personal hygiene for human beings. Adequate quantity and quality of water supply are achieved public health with the economic and social development of the society. Water supply helps to ensure an equitable supply to the entire society as scarce resource. Water is treated to achieve food security, livelihoods, employment earning and prime input of important development sectors like agriculture, industrial and commercial sectors etc.

The vital resource enhance economic activities by increasing the growth of agricultural crops, sustaining forest resources, and increasing the number of livestock and all other living things. Water is a component of all stages of human activity and it is unavoidable things in human life. Water resources play a fundamental role in human development. This fact is epitomized in Koranic words, “by means of water, we give life to everything” (HDR, 2006). However, always we have kept in mind the most important point “water is a finite resource and cannot replace it”. So, we have followed up the slogan“Jal hi jivanhai”.

The chapter is divided into 5 sections. The first section deals with the general concept of water resources. It includes the general meaning of water and a detailed picture of constitutional provisions which include legal and judicial power regarding resources. The second section explains the total water resources distribution of the earth and the present scenario of freshwater availability. Fresh water is essential for water supply. So the examination of the freshwater situation is required. The third section deals with a detailed picture of freshwater resources availability, utilization and future demand in three major sectors namely agriculture, industrial and domestic sectors in the world and Indian context. This section, explains the difference between water withdrawal and water consumption. Here, identified water use in the domestic sector is lesser when compared to the other two sectors. The fourth section, explains the concept and importance of drinking water. Significantly, the last section explains the detailed picture of the public water supply services mechanism at the world and Indian levels. The section gives a beautiful description of the historical movements and present conditions of water supply in the world and India. This section mainly focuses on the public water service mechanism in an urban context. The overall picture explains the huge volume of public water supply demanded by society.

SECTION 1

2.2 CONSTITUTIONAL PROVISIONS OF WATER RESOURCE

The constitutional provisions determine the jurisdiction of the Centre, and state and local government in its functioning of water resources. The different constitutional provisions speak about the different uses of water resources. According to the Indian constitution, the prime responsibility of water resources is vested with state governments. So, a state government has the power to make laws with respect water resources of that state. Under the constitution "water" is a matter included in entry 17 of the list ll (state list) in the seventh schedule.

Entry 17 of list ll in the 7thschedule says:

"Water, that is to say, water supplies, irrigation and canals, drainage and embankment, water storage and water power subject to the provisions of entry 56 of list 1" (Planning Commission, 2007).

Water is a state subject. There for water resource projects are designed, executed, owned and operated by the state government. However, Water is subject to the provision of entry of list l (union list) also. The union government has been given powers to regulate and develop inter–state rivers and river valleys.

Entry 56 of list l in the 7th schedule says about

"Regulation and development of inter-state rivers and river valleys to the extent to which such regulation and development under the control of the union are declared by Parliament by law to be expedient in the public interest" (Planning Commission, 2007).

Here, the important provisions of article 262 say about "Parliament may be law provide for the adjudication of any dispute or complaint concerning the use, distribution or control of the waters of, or, in, any inter-state river or river valleys". Article 248 says about "Parliament has exclusive power to make any law concerning any matter not enumerated in the concurrent list or state list". The power and role given to the union government in the management of inter-state rivers are very important and necessary (Hydrology & Water Resource Information System for India, 2020).

Article 246 of the constitution of India deals with the subject matter of laws to be made by parliament and by the legislature of the states:

1. Parliament has exclusive power to make laws concerning any of the matters enumerated in list one in the 7thschedule.
2. Parliament and legislature of any state also, have the power to make laws concerning any of the matters enumerated in the list in the 7th schedule.
3. Legislature of any state has exclusive power to make laws for such state or any part thereof concerning any of the matters enumerated in list ll in the 7th schedule. (Handbook on Water and Related Information, 2017)

The important constitutional provisions of article 15(2) state that “there is no discrimination in religion, race, caste, sex, place of birth about the subject of use of water resources”. This most important constitutional provision determines the person's access to water under is subject to fundamental rights of human beings (Muralidhar, 2006).

The important constitutional provision of article 21, says about “the protection of life and personal liberty”. In India, both Supreme Court and the state high court interpreted the right to water as a part of the right to life under Article 21 of the constitution. This provision also helps to empower the citizens to approach the courts in any case of violations regarding water availability. The Supreme Court of India invoked Article 21 of the constitution which guarantees the right to life and hence to water and the environment in 1980 (Ballabh, 2008). Then the courts of India have intervened in most cases in the provisioning of drinking water to the citizens. Courts have also derived the fundamental right to water from Article 47 of the Constitution. Article 47 states every citizen of India to provide pure drinking water (Cullet, 2011). All these types of interventions help to strongly support the Indian judicial system for the provisioning of water resources.

Local government institutions are an integral part of the Indian federal system. The constitution of India has inserted the subject of local self-government in the 7th schedule. In this schedule, article 243 provides the support of respective state governments to devolve their powers and functions to local bodies (George, 2007). Article 243(d), 243G and 243p (e) defines panchayaths and municipalities as institutions of self-government (CRRID, 2006). The 73rd& 74th Amendments added two new parts to the Constitution.73rd amendments added part IX titled “the panchayaths” and the 74th Amendment added part IXA titled “the municipalities (Mathew, 1999)”. A list of 29th functions that must be performed by a panchayathraj institution is provided to the state in the 11thschedule (article 243G). Water supply is mentioned as one of the 29 tasks that each panchayati raj institutions must perform. The state is given a list of 18 functions that an urban local government must carry out in the 12th schedule (article 243W).Water supply is mentioned as one of the 18 tasks that every urban local bodies must perform.

This amendment acts empowered devolution and delegation of power to local government. So the new fiscal arrangement is necessary for every state. Under Article 243Yconstitute a finance commission, at regular intervals of every five years, and assign to the task of reviewing the financial position of ULBs and making recommendations on sharing various financial sources and grant-in-aid. Also, article 280 was amended to add clause (3) (c), as the state government has the responsibility under article 243(y) to devolve resources to ULBs.

SECTION 2

2.3 PRESENT STATUS OF WATER RESOURCE

The section explains the present condition of water resource availability on Earth.

2.3.1 Total Water Reserve on Earth

Food and agriculture organizations of the United Nations quoted, the total volume of water on earth is about 1.4 billion km3 (Water and Related Statistics, 2019) as the form of liquid, soiled and vapour generally. In total, 97.5 per cent of the world's water is in the form of ocean which is salt water. While fresh water constitutes a very small portion available on the earth. It is only about 35 million km3 or 2.5 per cent of the total volume (Water and Related Statistics, 2019). The world’s water is distributed naturally in different forms and locations. The table shows how the water resource is distributed on the earth.

Table 2.1: Earth Wise Distribution of Water Resource

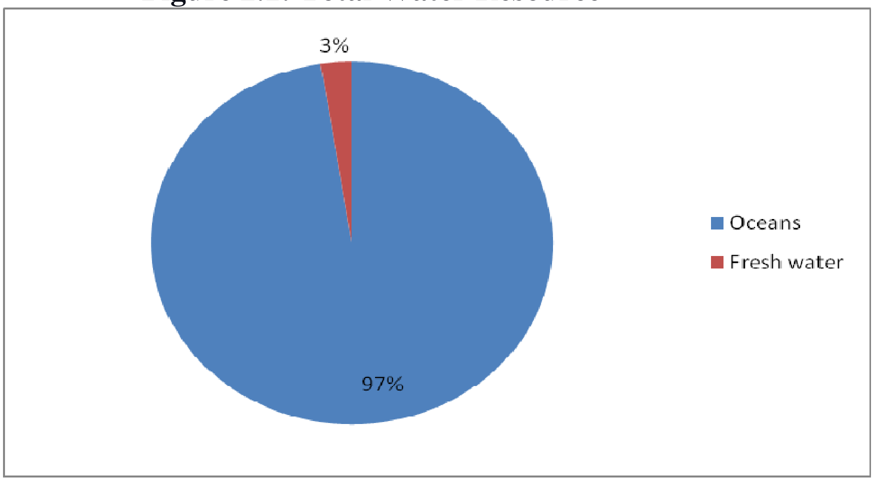
Sl.No	Water Source	Water volume (in cubic miles)	Percent of total water in global	In percent of total fresh water in global
1	Oceans	321,000,000	97.5	-
2	Ice caps, Glaciers and permanent snow	5,773,000	1.74	68.9
3	Ground water	5,614,000	1.69	-
a	Fresh	2,526,000	0.76	30.1
b	Saline	3,088,000	0.94	-
c	Soil moisture	3,959	0.001	0.05
4	Ground ice permafrost	71,970	0.022	0.86
5	Surface and atmospheric water	-	-	0.4
a	Lakes	42,320	0.013	-
b	Fresh	21,830	0.007	0.26
c	Saline	20,490	0.006	-
d	Rivers	3,095	0.0002	0.006
e	Atmosphere	2,752	0.001	0.04
f	Swamp water	509	0.0008	0.03
g	Biological water	269	0.0001	0.003

Source: Earth Water Distribution, USGS (United State Geological Survey), 2009.

Oceans cover a huge portion of water (97.5) on the earth. Only a very little portion of fresh water is available on the earth. On this little portion, over three-quarters of the world's fresh water are locked up in ice sheets, which is inaccessible. Other major portions are stored in underground form. The most familiar form of water resources like lakes and rivers contain an estimated 105000 km3 or 0.3 percent of world fresh water.

2.3.2 Fresh Water Availability on the Earth

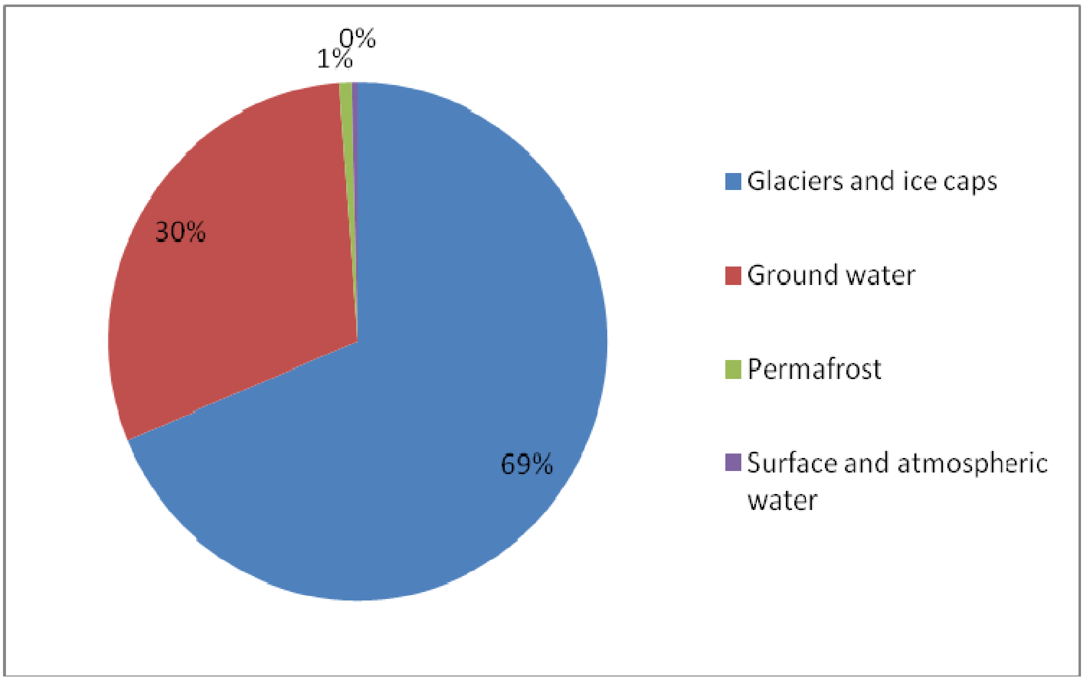
Figure 2.1: Total Water Resource



Source: Fact on water resources: a summary of the United Nations world water development report 2, Green fact, 2009.

The pie diagram explains in total water reserve on the earth. It shows world oceans cover about three–fourths of the earth's surface with saline (generally called sea water). Only a few portions (2.5) are fresh water. Fresh water is most important for life to survive, though.

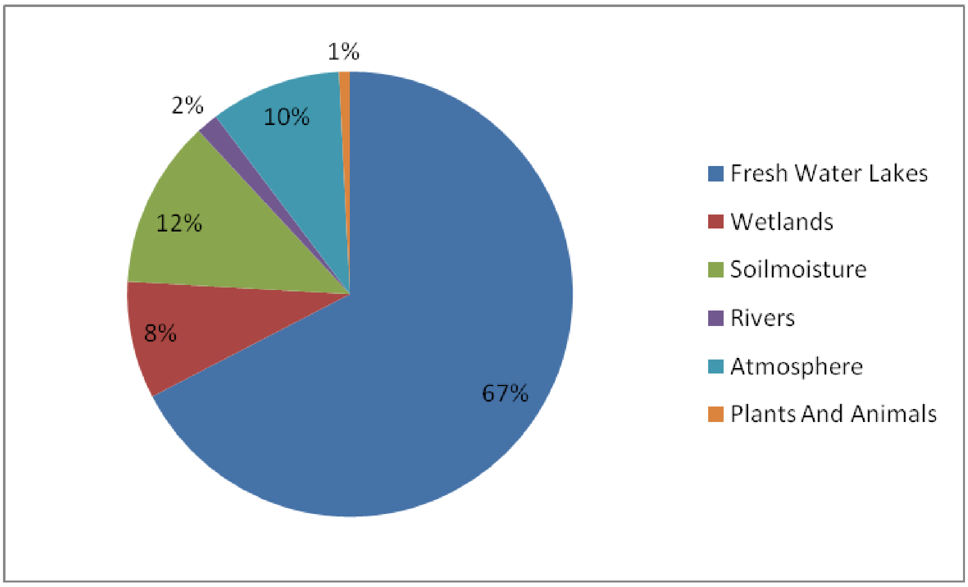
Figure 2.2: Fresh Water Resource



Source: Fact on water resources: a summary of the United Nations world water development report 2, Green fact, 2009.

The diagram depicts total freshwater resource availability on earth. In the freshwater portion, two third occur as snow and polar ice cover in mountainous regions such as the Antarctic and Arctic regions. That means 24 million km^3 or 68.9 per cent of world fresh water is locked up in form of ice sheets and glaciers. Another 8 million km3 or 30.1 per cent of fresh water is stored underground in form of groundwater. Surface water holds only a small 0.4 per cent of the earth’s total freshwater resources. Most the people use surface water sources like rivers, lakes, reservoirs and streams of water for their everyday life.

Figure 2.3: Surface and Atmospheric Water



Source: Fact on water resources: a summary of the United Nations world water development report 2, Green fact, 2009.

The diagram explains a detailed picture of surface freshwater distributed on the earth. The total rainfall on the earth's land surfaces amounts to 110000 km^3 (Catherine and et al, 2012). In total surface water, 67.4 per cent of the largest volume is contributed by the lake water. The world's 145 largest lakes are estimated to contain over 95 per cent of all lake freshwater (WWDR,2006).Wetlands, which include swamps, bogs, marshes, and lagoons, make up 8.5 percent of the earth's land area and are crucial for averting floods and preserving ecosystems. Reservoirs are estimated to cover a total area of about 2.7 million km2 which represents 2 per cent of the surface of the land (Lehner and Doll, 2004). Lakes, rivers, streams and groundwater basins are the principal water sources of human use.

The United States Geological Survey report explains that 96 per cent of the world's fresh frozen water (glaciers and mountainous ice caps) is at the south and north poles, with the remaining 4 per cent spread over the entire world (UNEP, 1992). Approximately 99 per cent of all form of water is not accessible for our use. Then available only 200000 km^3 or one per cent (0.01) of freshwater is used form on the earth (UNEP, 2002). Of this per cent, 98 per cent is groundwater and the rest 2 per cent in streams, rivers and lakes as a form of surface water (Thippesamy, 2005). The vast majority of the freshwater available for our use is stored in the form of groundwater. About 5 billion people depend upon groundwater for their drinking water supply.

SECTION 3

2.3.3 Water Availability, Water Demand and Water Utilization in World Countries

The section gives a detailed explanation of water resource availability at the global level and specifically explains the picture of water resource availability in the country. The section also explains in detail the present stage of water resource utilization and its future demand in India as well as at the world level.

2.3.3.1 Global Water Availability

On the landscape, fresh water is stored mainly in three forms. One is the glaciers & ice caps second is, surface water and the other is groundwater. Mainly surface water is stored as rivers, lakes, reservoirs, streams and wetlands etc on the earth's surface. Groundwater or sub-surface water is located in the pore space of soil and rocks on the earth. Both surface water and groundwater are the most usable water sources on the earth. Groundwater has become a significant source of water for human consumption, supplying nearly half of the world's drinking water (WWDR, 2009).

Table 2.2: Region-Wise Global Fresh Water Resource Availability (Km^3) in the World

Regions	Glaciers and Permanent ice Caps	Ground water	Surface water (Wetlands, Large lakes, Reservoirs &Rivers)
North America	90000	4300000	27003
South America	900	3000000	3431
Europe	18216	1600000	2529
Asia	60984	7800000	30622
Africa	0.2	5500000	31776
Australia	180	1200000	221
Antarctica	30109800	-	-

Source: Global Water Resources, UNEP (United Nations Environment Programme), UN, 2002.

Globally, groundwater is the most important and a largely available form as compared to other sources. Regional wise data shows the big volume of groundwater available in Asian countries and it's followed by North American countries. At the time, a large volume of surface water sources is available in African countries. Antarctica regions are fully covered by permanent ice caps and low-level water is available in Australia regions in the world.

Water resources are the most important input to the development of the economy and growth of nations. The following table explains region wise amount of long-term average water available to the world. The water resource is available in the form of precipitation, groundwater recharge and surface inflows etc in regions.

Table 2.3: Region-Wise Internal Renewable Fresh Water Resource Availability in World

Sl.No	Region	Volume per year (km^3)	Percent of world fresh water resource
1	Africa	3931	9.2
a	Northern Africa	47	0.1
b	Sub-Saharan Africa	3884	9.1
2	America	19536	45.6
a	Northern America	6077	14.2
b	Central America& Caribbean	735	1.7
c	Southern America	12724	29.7
3	Asia	11865	27.7
a	Middle east	848	1.1
b	Central Asia	242	0.6
c	Southern &eastern Asia	11139	26.0
4	Europe	6576	15.4
a	Western and central Europe	2129	5.0
b	Eastern Europe	4448	10.4
5	Oceania	902	2.1
a	Australia and new Zealand	819	1.9
b	Other pacific islands	83	0.2
	World	42810	100

Source: FAO (Food and Agriculture Organization), AQUASTAT data base, 2016.

The availability of total water resources in the world is estimated at 42810 km^3 in 2016. America holds the first and largest share of the world's freshwater resources with a contribution of 45 percent. It's followed by Asian, European and African countries that contribute fresh water resources at 28 per cent, 15.5 per cent, and 9 per cent respectively.

Central intelligence agency's World Fact Book listed 171 countries including rich and poor countries. This categorization is based on the average amount of water available over a long period to the countries. On the base, the top ten water-rich countries and the top ten water worse countries in the world are listed in the below table.

Table 2.4: Internal Renewable Fresh Water Resource Availability in the World

Water Rich countries	Total renewable water resources (km^3)	Water Poor countries	Total renewable water resources (km^3)
Brazil	8233	Saint Kitts and Nevis	0.02
Russia	4067	Kuwait	0.02
United states	3069	Bahamas	0.02
Canada	2902	Maldives	0.03
China	2840	Malta	0.05
Colombia	2132	Antigua and Barbuda	0.05
European union	2057	Qatar	0.06
Indonesia	2019	Barbados	0.08
Peru	1913	Bahrain	0.12
India	1911	United Arab Emirates	0.15

(**Note**: based 2011 data, (Fact book, Entry provides the long term average water availability for the country in cubic kilometers from precipitation, groundwater recharge and surface inflows from surrounding countries)

Source: Fact Book, CIA (Central Intelligence Agency), Government of India, 2015.

The availability of water resources has spatial variation from time to time. Water is sufficiently available in some areas while, some other areas are very scarce at the same time. A large number of factors influence these high spatial and temporal variations. Some important factors like different volumes of available rainfall, climatic conditions and the nature of land and soil etc contributed in increasing the depth of variation. Brazil holds the top most sufficient water resources available county and Saint Kitts and Nevis hold in most water-scarce country according to the available statistics.

2.3.3.2 Global Water Utilization

United Nations world water development report 2020 reported that, global water use has increased and continues to grow steadily at a rate of about 1 per cent per year since the 1980s. Water consumption increases with increase in the world population. Water consumption is growing at more than twice the rate of population increase in the world (FAO, 2013). Increasing population leads to increasing demand for food and other necessities. This leads to increasing demand for domestic, agricultural and industrial outputs. These development sectors are highly in demand for water resources and also major water consumers in the world.

2.3.3.2. a)Fresh Water Withdrawals by World Countries

Table 2.5: Trend of Fresh Water Usage in World Countries (m^3)

Periods	Global Fresh Water Use
1900	500 billion
1960	1.5 trillion
1980	3trillion
2000	3.5 trillion
2014	4 trillion

Source: Hannah Ritchie and Max Roser "Water Use and Stress" From Article Our World in Data, 2017

The trend shows global freshwater usage had increased sharply since 1900s. This means the fresh water withdrawals from the agriculture, industrial and domestic sectors are steadily increasing over the periods. In total global water withdrawals, 20 per cent of withdrawals represent ground water (WMO, 1997).

Water use pattern differs from region to region and country to country. The following table draws in a detailed explanation of world freshwater withdrawal by regions. It also presents an idea about sector-wise water usage by regions in the world.

Table 2.6: Sector- wise Water Withdrawal by Regions in World (Km^3/year)

Sl. No	Region	Total fresh water withdrawal	Agricultural withdrawal	Industrial withdrawal	Municipal withdrawal
1	Africa	220	184(81)	9(4)	33(15)
a	Northern Africa	101	84(84)	3(3)	14(13)
b	Sub-Saharan Africa	119	96(79)	6(5)	19(16)
2	America	855	415(48)	321(37)	123(14)
a	Northern America	605	241(40)	289(47)	79(13)
b	Central America & Caribbean	33	20(59)	6(18)	8(23)
c	Southern America	216	154(71)	26(12)	36(17)
3	Asia	2421	2069(81)	253(10)	234(9)
a	Middle east	268	231(84)	20(7)	25(9)
b	Central Asia	136	128(89)	10(7)	7(5)
c	Southern &eastern Asia	2017	1710(80)	224(10)	202(9)
4	Europe	332	84(25)	181(54)	69(21)
a	Western and central Europe	246	66(27)	131(53)	51(21)
b	Eastern Europe	86	18(21)	50(58)	18(21)
5	Oceania	25	16(65)	4(15)	5(20)
a	Australia and new Zealand	24	16(65)	4(15)	5(20)
b	Other pacific islands	0.1	0.05(59)	0.01(11)	0.03(30)
	World	3853	2769(69)	768(19)	464(12)

Source:FAO (Food and Agriculture Organization), AQUASTATdata base, 2016.

The table draws a detailed explanation of world freshwater withdrawal by regions. Asia holds the first position and it's withdrawing the largest volume of fresh water annually. It was followed by America and Europe. America is withdrawing 855 km^3 of water per year and Europe is withdrawing 335 km^3 per year. The table explains major share (69 per cent) of world freshwater resources are withdrawn in the agriculture sector. It was followed by the industrial sector withdrawing 19 per cent of world freshwater resources and the other 12 per cent of freshwater withdrawing in the domestic sector respectively.

Sector- Wise Fresh Water Withdrawal by World

Water is an essential input of agriculture, industrial and domestic sector development. The agriculture sector is the world's largest water user, including Irrigation, livestock and aquaculture accounting for 69 per cent of water withdrawal (Water and Related Statistics, 2019). While 15-35 per cent of water withdrawing for irrigation (WBCSD Water Fact and Trends, 2009). Aquaculture is proportionally a small sector, but the largest agricultural water user in the world. Asian and African countries are withdrawing the largest share of water for their agricultural purpose. The countries like North Africa, the Middle East, Central Asia, South and East Asia etc are withdrawing more than 80 per cent of water for agricultural purposes per year. At the time, European countries are withdrawing only 30 percent of water for agricultural purposes.

Globally, 19 per cent of the world’s freshwater withdrawals are used for industrial purposes. The energy sector alone was estimated to have taken about 10 per cent of industrial water withdrawal recently (IEA, 2016). The major industries like thermo electric Power plants, oil refineries, chemical industries and manufacturing plants are the major water users in the world. UNESCO estimates that roughly 75 per cent of industrial water is used for energy production and 90 per cent of global power generation is water-intensive (Water and Related statistics, 2019). Only European countries use more than 50 per cent of water withdrawal for industrial purposes per year. North America came in second, taking 47 percent of the world’s freshwater each year for industrial use. At the time, Africa is withdrawing only 4 per cent of water for industrial uses per year.

12 per cent of the world's water is withdrawn for drinking and other household purposes. According to World Health Organization, approximately 50 litres of water per person per day are needed to meet basic needs. Depending on diet and lifestyle, about 2000 to 5000 litres of water are used to meet drinking water needs per head, for daily food and

sanitation requirements (water and Statistics, 2019). European countries are withdrawing 21 per cent of water for municipal use per year. It's followed by Oceania withdrawing 20 per cent of water per year. The Bahamas, Gulf of Guinea and Caribbean are withdrawing the largest share of domestic water per year. Asia is only withdrawing 9 per cent of water for domestic purposes. The majority of countries are withdrawing less than 30 per cent of water for domestic purposes.

On the database of world fact book 2015, the following table presents the top ten countries that are performing well in the amount of water withdrawal for their activities. The table also presents the sector-wise volume of water withdrawal by these countries annually.

Table 2.7: Top Fresh Water Withdrawal Countries in the World

Country	Total withdrawal (km^3/year)	Per capita withdrawal (km^3/year)	Agricultural withdrawal (Percent)	Industrial withdrawal (Percent)	Domestic withdrawal (Percent)
India	645.84	585	86	5	8
China	549.76	415	68	26	7
United state	477	1600	41	46	13
Vietnam	169.39	1072	96	2	2
japan	88.43	690	62	18	20
Indonesia	82.78	1288	95	2	2
Thailand	79.4	560	96	1	3
Uzbekistan	78.22	731	77	5	17
Mexico	76.68	535	18	3	19
Russia	76.68	535	19	63	18

(**Note**: based on 2000data)

Source: World Fact Book, CIA (Central Intelligence Agency), Government of India, 2015.

India holds the first position in terms of water resource withdrawal in the world. It withdraws 645.84 billion cubic meters of water per year. It was followed by China and the United States. The countries are withdrawing the amount of water in 549.76 and 477 respectively per year. On the country-wise analysis, the average agricultural water use dominates 90 per cent in low-income countries, 79 per cent in middle-income countries and only 41 per cent in high-income countries in the world. The average industrial water use dominates 17 per cent of high-income countries and only 2 per cent of low-income countries in the world (FAO, 2010). The World Vision's report "the use of water today" (1995) explains that out of the total renewable water resource, only 10 per cent of water resource is withdrawn globally. Of this water withdrawn, only 5 per cent is consuming it. This means the world countries are consuming half of the water resources in their withdrawal (WWC, 1995).

2.3.3.2 b) Global Fresh Water Consumption by World Countries

The world statistics of 2020, state that China is the world's largest water consumer in the world. It consumes 1370 trillion litres of water per year. It is followed by the United States of America (817 billion litres), Brazil (359 billion litres), Russia (268 billion litres) and Mexico (200 billion litres) etc. Now the countries like America, Australia, Italy, Japan and Mexico consume 300 litres of water for daily use. Countries like Mozambique, Haiti, Ethiopia and Uganda consume only 15 litres of water for daily purposes.

Sector Wise Water Consumption of World Countries

India is considered the world's largest agricultural water consumer with nearly 700 billion m3 of water consumed per year. It is followed by china who consumes approximately 385 billion m3 of water and the united States with 175 billion m^3 of water respectively (Ritchle and Roser, 2017). Western European countries like Germany and the Netherlands consume less than one per cent of water for agriculture (Ritchle and Roser, 2017). The United States is the largest industrial water consumer, withdrawing over 300 billion m^3 per year. It was followed by China consuming 140 billion m3 of water in the world. Europe, America, East Asia and pacific regions consume more than one billion m3 of water for industrial uses per year (Ritchle and Roser, 2017).

World largest populace country, china’s domestic water demand is highest at over 70 billion m3 per year. The United States is the second largest domestic water consumer and its per capita availability of water per person is high. The second largest populated country, India is the third largest domestic consumer in the world (Ritchle and Roser, 2017). For residential purposes, each Canadian consumes about 335 litres of water each day (OECD, 2001). Now, the United States per capita water consumption is 2842 cubic meters per annum. Americans consumed around 380 litres of water for residential purpose each day. Every day, New Zealanders use 227 litres of water for domestic purposes. While only 20 percent of people used it for kitchen and laundry and 70 percent of people used it for personal hygiene.

2.3.3.3 Future of Global Water Demand

Global environment outlook predicts that world water demand in 2025, will increase by 50 per cent in developing countries and 18 per cent in developed countries (Water and Related Statistics, 2015). The increasing growth of the global population leads to increasing demand for freshwater, as the supply of water resources is remaining constant. In 2000, the world population was 62 billion. The global population reached 7.6 billion in 2017. It is expected to reach about 8.6 billion by 2030 and further increase to 9.8 billion by 2050 (UNDESA, 2017). The world population is growing by about 8 million people per year, implying increased freshwater demand of about 64 billion cubic meters per year (WWDR, 2009). The future water resource demands of the various sectors are highly affected by the needs of those sectors.

The Food and agriculture organization of the United Nations estimated a 5.5 per cent increase in irrigation water withdrawals from 2008 to 2050 (FAO, 2011). In future, more water will be needed to produce food as the world population is expected to rise to around 9 billion by 2050 (WWDR, 2006). Feeding 9 billion people by 2050 will require a 60 per cent increase in agricultural production and a 15 per cent increase in water withdrawals (World Bank, 2017). The industry and energy sector's share in global water demand has been projected to grow by 24 per cent by 2050 (Burek et al, 2016). Projections by the IEA anticipate that global water consumption by the energy sector will increase by nearly 60 per cent by 2040 (IEA, 2016). Global water demand is expected to steadily increase at a similar rate until 2050 and the trend is expected to continue in 2060s. This increasing level of water use depends on the rising demand of industrial and domestic sectors (WWDR, 2019).

2.3.4 Water Availability, Water Demand and Water Utilization in India

India, 7th largest country with a geographical area of 3287263 km^2 and 2nd most populated country with over 1.2 billion people, holds 4 per cent of the world's freshwater resources (River Basin Atlas of India, 2012). It simply means, 2.4 per cent of India's geographic area supports 17.5 per cent of the world population and 30 per cent of livestock, but only holds 4 per cent of the total freshwater resources (General Guideline for Water Audit and Conservation, 2017).

2.3.4.1 Water Availability in India

Freshwater resources in India include rainfall, surface water and groundwater. Generally, sufficient water is available in seasonal monsoon rains. However, the southwest monsoon between June to September every year, contributes major portion of rain water. Nearly 80 per cent of the annual rainfall is received in these four rainy months (Dynamic groundwater resources of India, 2017). Most of India gets southwest monsoon rainfall. North-East monsoon from October to November also influences water resource availability in the whole country except in Tamilnadu. The table explains the availability of the total volume of rainfall in the country in the last 10 years.

Table 2.8: Volume of Rainfall in the Country

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Total rainfall(mm)	954	1216	1116	1055	1243	1045	1085	1083	1127	1021
Total volume of rainfall(bcm)	3136	3997	3669	3468	4086	3435	3567	3560	3705	3356

Source: Water and Related Statistics, CWC (Central Water Commission), Government of India, 2019.

India is the highest rainwater available country. But the precipitation is not normal in all years. It shows upswing and downswing. This is because the rainfall pattern is widely vary according to time and places in the whole country. The area on the Western Ghats and the sub-Himalayan areas in the northeast and Meghalaya hills receive heavy rainfall of over 250 cm annually, whereas the areas of other parts of Kashmir and western Rajasthan receive rainfall less than 40 cm (GWYB, 2017-18). The Mass of the Himalayas in the north and the ocean in the south are the two major factors that influence the changing climate with a high spatial and temporal variation of rainfall in the whole country.

Rainfall is the main source that supplies India's surface water and groundwater resources. Surface water sources are mainly visible bodies such as rivers, lakes, ponds, wetlands and artificial reservoirs (dams) etc. India is blessed with a large number of rivers. Major rivers of the country are inter-state in nature (originate in one state and flow through another state). The Indian River system is classified into four: Himalayan Rivers, Deccan Rivers, Coastal Rivers and Rivers of inland drainage. It is generally divided into 12 major basins and 8 composite basins in India (River basin atlas of India, 2012). Thus total of 20 river basins are the major contributors to the surface water resource availability of our country.

In total 20 river basins, the 12 large basins aggregate 2.6 million km2 of catchment areas with covering 81 per cent of the country (River basin atlas of India, 2012). The first-ever attempt to assess the average annual flow of all river systems in India was made by the irrigation commission of 1901-03. According to this estimate, the average annual flow of all river systems of India was 1443.2 BCM (Reassessment of Water Availability in India, Using Space Inputs, 2019). In 1949, Dr A.N. Khosla, based on empirical formula estimated the total average annual runoff of all the river systems of India including both surface and groundwater resources as 167 M.ham (GWYB, 1995).

Table 2.9: Water Resources Availability of Indian Basins (BCM)

Name of Basins	Annual surface water potential average	Utilize surface water resources	Utilize ground water resources	Total utilizable water
Indus (up to Border)	45.53	46.0	26.49	72.49
Ganga- Brahmaputra-Meghna Ganga Brahamputra Barak& others	 509.52 527.28 86.67	 250.0 24.0 -	 170.99 26.55 -	 420.99 }59.07
Godavari	117.74	76.3	40.65	116.95
Krishna	89.04	58.0	26.41	84.41
Cauvery	27.67	19.0	12.30	31.3
Subarnarekha	15.05	6.8	1.82	8.63
Brahamani&Baitarni	35.65	18.3	4.05	22.35
Mahanadi	73.00	50.0	16.46	66.45
Pennar	11.02	6.9	4.93	11.79
Mahi	14.96	3.1	18.22	7.3
Sabarmati	12.96	1.9	26.41	4.93
Narmada	58.21	34.5	10.83	45.33
Tapi	26.24	14.5	8.27	22.77
West Flowing Rivers From TapitoTadri	118.35	11.9	7.19	20.64
West Flowing Rivers From TadritoKanyakumari	119.06	24.3	17.69	33.27
East Flowing Rivers Between Mahanadi &Pennar	26.41	13.1	18.22	22.11
East Flowing Rivers Between PennarandKanyakumari	26.74	16.5	18.84	25.93
West Flowing Rivers Of Kutch andSaurashtra including Luni	26.93	15.0	11.23	26.21
Area of Inland drainage in Rajasthan	negligible	-	-	-
Minor River Draining into Myanmar (Burma) & Bangladesh	31.17	-	-	18.8
Total	1999.20	690.1	431.43	1123

Source: Water and Related Statistics, CWC (Central Water Commission), Government of India, 2019.

Central water commission's basin-wise estimate shows the available river water in the country accounts for 1999 BCM per year. Out of this total available water, the utilizable water source is 1122 BCM only, which includes surface water and groundwater 690 BCM and 432 BCM per year. The table shows a high difference between availability of water resources in one basin to other basins. The three main river basins, the Ganga-Brahmaputra-Meghna system are the largest with a catchment area of about 11 lakh sq. km. This system is a major contributor which accounts for 56 per cent of total surface water resource potential with utilizable 40 per cent of water in the country. Nearly 62 per cent or 1,202 km3 of the total water resources is available in the Ganga-Brahmaputra-Meghna basin. The remaining 23 basins have 751 km^3 of the total water resources.

India has rich surface water resources. A large number of dams are constructed to store water resources in the country. Central water commission report estimates that there are 5745 large dams existing in the country. Out of these, 5334 dams are completed and 411 dams are under construction (NRLD, 2019). The large dams played a big role in increasing the water resource potential of the country when available plenty of rainfall. Throughout recent years, Maharashtra holds the first place for the highest number of large dams in the whole country both completed and under construction.

Groundwater is the most important water resource in India. It is a dynamic resource in nature, which is replenished every year. The main source is recharged through rainfall. Rainfall is variably distributed throughout the whole country. However, groundwater recharge and availability are highly influenced by this rainfall. Rainfall contributes to nearly 67 per cent of the total annual replenish able resources in the country (Water and Related Statistics, 2019). The states like Arunachal Pradesh, Chhattisgarh, Himachal Pradesh, Jharkhand, and Kerala contribute 70 per cent of groundwater recharge through rainwater annually (GWYB, 2017-18). India's climatic condition is great diversity and variety. The peculiar climatic nature strongly supports groundwater resources in the country. It means, the availability of groundwater resources is strong in dry seasons and also wet seasons simultaneously, compared to surface water level, as high fluctuated every season (very low in dry seasons and very high in wet seasons). Wells are the main source of groundwater from the ancient period itself. As per the 2011 census, 13.3 per cent of rural and 6.2 per cent of urban households, which total 11 per cent of households, used the well water for their drinking and other purposes. Groundwater is tapped in the form of open wells, bore wells and tube wells.

National Commission for Agriculture assessed in 1976, the total groundwater resources of the country as 67 M.ham and the utilizable groundwater were worked out to be

35 M.ham, out of which 26 M.ham has been considered available for irrigation (GWYB, 1995). In 1979, the groundwater over-exploitation committee, estimate the systematic methodology for the first time and assessed the country's gross groundwater recharge as 47 M.ham and the net recharge as 32 M.ham (GWYB,1995). The national report on groundwater resources of India estimates the total replenish able groundwater resource available is 432 billion cubic meters and the level of development was 32 per cent (GWYB, 1995).

The availability of annual replenished able groundwater resource potential for the entire country is explained below table.

Table 2.10: Ground Water Resource Potential of the Country

Base year	Annual replenish able ground water resources (bcm/year)	Net annual ground water availability (bcm/year)	Annul ground water draft for irrigation,domestic ,industrial uses (bcm/year)	Stage of ground water development
2004	433	399	231	58
2009	431	396	243	61
2011	433	398	245	62
2013	447	411	253	62
2017	432	393	249	63

(**Notes** : Based on GEC 97 the dynamic ground water resources of India have been estimated for the entire country considering 2004,2009,2011,2013 as base year,GEC 97 was revised the 2017 assessment has been carried out using the revised GCE 2015 methodology).

Source: Ground Water Year Book, Various Issues, CGWB (Central Ground Water Board), Government of India.

The groundwater resource of the entire country is recharged above 430 BCM per year. However, groundwater extraction for irrigation and domestic and industrial uses is steadily increasing. The stage of groundwater development increased to 63 per cent in 2017 from 58 per cent in 2004, showing increasing pressure on groundwater resources in the country.

Table 2.11: Top Five Replenish Able Ground Water Resource Countries (Percent Share)

States/ Base year	2010	2013	2015	2019
Uttar Pradesh	76.35	75.25	77.19	69.92
Madhya Pradesh	37.19	33.95	35.04	36.42
Maharashtra	32.96	35.73	33.95	31.64
Bihar	29.19	28.63	29.34	31.41
West Bengal	30.36	30.50	29.25	29.33

Source: Water and Related Statistics, CWC (Central Water Commission), Government of India, 2019.

The table explains the top five states in India contributing to the largest share of replenish able groundwater resources annually. These states were included under the category of 90 per cent of recharged groundwater potential for each year. Uttar Pradesh holds the first rank among the states in replenish able groundwater resources in the country.

Both stages of groundwater development and long-term water level fluctuations based on the assessment units has categorized in the following table.

Table 2.12: Assessment Units in India (Number)

Base year	safe	Semi-critical	critical	Over exploited	saline	total
2004	4078	550	226	839	30	5723
2009	4277	523	169	802	71	5843
2011	4530	697	217	1071	92	6607
2013	4520	681	253	1034	96	6584
2017	4310	972	313	1186	100	6881

Source: Ground Water Year Book, Various Issues, CGWB (Central Ground Water Board), Government of India.

In total assessment units, the major units are included in the safe category. But, recently the number of safe areas is declining. At the same time, the numbers of unsafe areas are increasing over the years. The numbers of over–exploited areas are expanding and it leads to the huge volume of groundwater level declining in recent times. Groundwater is a primary source of water for meeting drinking and all other uses. But the misuse and over-exploitation caused to decline in water tables and water levels annually.

Table 2.13: Ground Water Abstraction Countries (Km^3/year)

Countries	Abstraction
India	251
China	112
USA	112
Pakistan	64
Iran	60
Bangladesh	35
Mexico	29
Saudi Arabia	23
Indonesia	14
Italy	14

Source: A 21st century institutional architecture for India's water reforms, Report by CWC and CGWB, Government of India, 2010

The table explains the top ten groundwater abstracting countries in the world. 72 per cent of the global groundwater abstraction takes place in these ten countries. India holds the first position in groundwater abstraction at the world level. India is abstracting 251 km^3 of groundwater per year.

2.3.4.2 Water Utilization in India

India is abundant in water resources with sufficient rainwater, wide river systems and a good portion of groundwater resources. In total, India receives about 120 CM of rain in a year (Dynamic Groundwater Resources in India, 2017). The average annual precipitation received in India is 4000 km^3, out of which 700 km^3 is immediately lost to the atmosphere, 2150 km^3 soaks into the ground and 1150 km^3 flows as surface runoff (Handbook of Water-related Information, 2017).

India is enriched with plenty of surface water resources. Surface water resources are the most popular and people highly depend on their water needs in traditional India. The water is used in two popular ways, one is directly pumping water from rivers at suitable locations and the other is the construction of dams or barrages on rivers at favorable geological locations to meet all water needs. Table 2.9 explains the average annual water resource potential of the major total 20 river basins is 1999.20 BCM in India. Out of these, the utilizable water resource of the country is assessed at 1123 BCM per year. Only more than half of the surface water resource is utilized in our country per year. Dams were constructed in the country to store rainwater and it's utilized for irrigation and other purposes.

India is the world largest groundwater user in the world. Groundwater is a primary source of drinking water in the country. Over the last three decades, groundwater has emerged as the main source of both irrigation and drinking water activities in India. Influence the variety of climatic conditions and highly polluted surface water sources are causing high demand for safe groundwater resources in the country. Table 2.10 explain the recent estimate of the groundwater potential of India is 432 BCM/per year. Out of the total, over 400 BCM of groundwater is utilized per year in the country. Table 2.10 also demonstrates how annual groundwater extraction has increased over time for all purposes (Domestic, Industrial, and Irrigation). 90 per cent of groundwater is used for agricultural irrigation. Groundwater resource is also utilized in 85 per cent of rural drinking water supply and 45 per cent for urban water supply services (Dynamic Groundwater Resources of India, 2017).Today, the ground water is emerged as the back bone of India's agriculture and provided drinking water security to the country.

Agriculture is a core sector of the Indian economy, which contributes about 20-21 per cent of GDP and generates two-thirds of employment (Water Data Book, 2005).Being an agricultural nation; the state uses the majority of its water resources for irrigation. National Water mission states that, around 80 per cent of water is consumed for agriculture, 13 per cent of water is for industrial usage and 7 per cent of water for the domestic sector in India (Annual Report, 2013-14).

2.3.4.3 Future Water Demand in India

India is the second largest populated country in the world. As per in 2011 census, an estimate shows 121 crores of the population lives in India. The rapid growth of population, increasing food demand, improving living standards of the society, expanding development sector of the economy etc leads to increase in demand for water resources in the country.

Table 2.14: Future Water Requirements in India

India	2010		2025		2050	
	Low	High	Low	High	Low	High
Annual water requirement	496	508	584	627	759	919

Source: Hydrology and water resources information system for India, 2020

The table shows that India has annually required the amount of water for future uses. The table analyses that the water demand is continuously increasing with a high volume of water required in future purposes in the country.

Increasing population and their raising needs with economic development leads to highly expanded development sectors of the economy. The sector–wise demand for large volume of water resources is high in the present and will increase in future. The below table explains the amount of water required for the various sectors for its future development.

Table 2.15: Projected Water Demand for Different Uses in India

Uses	2010			2025			2050		
	Low	High	%	Low	High	%	Low	High	%
Surface water	447	458	65	497	545	65	641	752	64
Irrigation	330	339	48	325	366	43	375	463	39
Domestic	23	24	3	30	36	5	48	65	6
Industries	26	26	4	47	47	6	57	57	5
Ground water	247	252	35	287	298	35	332	428	36
Irrigation	213	218	31	236	245	29	253	344	29
Domestic	19	19	2	25	26	3	42	46	4
Industries	11	11	1	20	20	2	24	24	2
Total water resource	694	710	100	784	843	100	973	1,180	100
Irrigation	543	557	78	561	611	72	628	807	68
Domestic	42	43	6	55	62	7	90	111	9
Industries	37	37	5	67	67	8	81	81	7

Source: "Water and Climate", World Water Development Report 2020, UNDP (United Nations Development Programme), UN.

The table shows the low and high range of demand for water in various sectors. Irrigation is the major water consumer and consumes large quantities of water from both surface and groundwater portions. But in future, the water usage of the irrigation sector will come down to 72 per cent in 2025 and 68 per cent in 2050 respectively. Both surface water and groundwater resources are used to meet domestic water requirements. At the time, domestic water usage will steadily increase by 7 per cent in 2025 and further increase by 9 per cent in 2050. The total water requirement for the industrial sector will increase from 5 per cent in 2010 to 8 per cent in 2025. But the trend will decline by 7 per cent in 2050. A major portion of surface water resources use industrial purposes in India. Future water demand is showing steadily increasing trend, as depicted in the picture.

The overall picture explains the volume of water used for domestic needs is lesser quantity as compared to agriculture and industrial uses. The positive trend of urbanization and expansion of domestic purposes are contributing to rising domestic demand every day. So, domestic water activities and its future demand are steadily increasing in India as well as globally. Then the domestic sector shows high demand for water resources.

SECTION 4

2.4 THE GENERAL CONCEPT OF DRINKING WATER

Water is vital good for drinking and other aspects like domestic activities, food production, commercial activities and industrial development. Drinking water gets the first priority in the allocation for different uses. National water policy strongly emphasizes to give first priority to drinking water. UN Food and Agriculture Organization says that 2-4 litres of drinking water are a necessity required per person for daily life and each person needs 20-50 litres of water per day to ensure their basic needs for drinking, cooking and cleaning (Water and Related Statistics, 2013). Approximately 50 litres of water per person per day are needed to meet most basic domestic needs while keeping public health risks at a low level (WHO, 2017). Water is a common good for all sectors of the economy. Domestic, agriculture, industrial and commercial sectors consumed a major share of water.

Generally, the concept of drinking water is assigned to water provided for human uses and its basic domestic needs (Goncalves and et al, 2019). In the domestic sector, water is used for indoor and outdoor household purposes, which include drinking, cooking, washing, flushing toilets and gardening. These domestic activities are classified into core needs and non-core needs based on the priority of the use of water. Drinking, cooking, washing and bathing are included in the category of core needs and toilet flushing, washing clothes, and water for lawns are included in the non-core needs (Hydrology and Water Resources Information System for India, 2020).

The following table provides simple information on the typical use of water for domestic purposes.

Table 2.16: Typical Use of Water

Items	Percent
Drinking	4
Drinking, Cooking& Other kitchen uses	8
Personal hygienic	29
Washing clothes	10
Toilets flushing	39
House cleaning/gardening	10

Source: Draft general guidelines for water audit and water conservation, 2017

The domestic need for water is crucial, and it's only a small part compared to the use in agricultural and industrial sectors. An increasing population and their changing habit with lifestyle, housing patterns, and hygienic and sanitary habits of local people are putting high pressure on the water in the residential sector. The rapid growth of urbanization with industrialization leads to expanding cities and towns with increasing demand for urban domestic water use.

The union ministry of Work and Housing fixed the basic norms of the human need for domestic activities in both rural and urban areas, as depicted in the following table.

Table 2.17: Minimum Norms for Basic Human Needs (IPCD)

Purpose	Rural	Urban
Drinking water	5	5
Cooking	3	5
Bathing	15	55
Washing of utensils, clothes & household	11	45
Flushing of toilets/sewer	-	30
Total basic water requirement (BWR)	40	140

Source: Hydrology and water resources information system for India, 2020

The table explains the amount of water requirement for domestic purposes in rural and urban areas show huge differences. The high population density of cities and their changing water use habit increases demand for water resources in urban areas. So, the public water supply service is important here.

SECTION 5

2.5 PUBLIC WATER SUPPLY SERVICE

Public water supply refers to water withdrawn by public water suppliers and delivered to users. In simple terms, a water supply system that provides water to at least 25 people or has a minimum of 15 service connections (USGS, 1995).

2.5.1 General Concept of Public Water Supply Service

Safe drinking water is defined as water that does not represent any significant risk to health over a lifetime of consumption (Fogden, 2009). Safe drinking water (potable water) is only taking that can be delivered to the user and is safe for drinking, food preparation, personal hygiene and washing (Bos & et al, 2016). Domestic water supply means infrastructure that provides water to households. The main objective of the domestic water supply system is to provide safe and clean water in adequate quantity at a reasonable cost to every household (General Guidelines for Water Audit and Water Conservation, 2017)

Fundamentally, a water supply system may be described as consisting of three basic compounds. They are the source of supply, the processing or treatment of the water and the distribution of water to the users (Drinking Water and Health, 1982). Firstly, water is collected from appropriate sources either surface or groundwater. Next, apply the proper technologies for treatment (to retain quality) and good storage (to maintain quantity) for current, efficient supply. After this process, the water enters the distribution system. The purpose of the distribution system is to deliver or transport water from the treatment plant to the users with appropriate quality, quantity and pressure.

2.5.2 Public Water Supply Services in World Countries

2.5.2.1 History of Water Supply Services In the World

Modern humans have dwelled on this earth for approximately 200000 years. Approximately 50000 years ago modern man began to inhabit every corner of the world. Some 10000 years ago, when people adopted an agrarian way of life, mankind established permanent settlements (Vuorinen and et al, 2008). Generally, ancient civilizations were always located near ample water sources (rivers, lakes and springs) and highly depended on these sources for their activities. The permanent settlements spread all over the world expanded the population at a faster rate. This type of life made it possible to construct villages, cities and states, which all are highly dependent on water (Vuorinen and et al, 2008). It led to increasingly high demand for limited amounts of water resources and a shortage of water resources globally. In this situation, it is necessary to take appropriate decisions to supply water services all over the world.

Throughout history, as the need for water increased, the appropriate tools were developed and used in society at proper times. The first major innovation of water supply was wells. A 10000-year-old well was discovered in historically permanent human-settled different areas in the world (Juuti, 2007). Since the beginning of civilization, wells were used as main source of drinking water supply. Generally water supply systems receive water from a variety of locations, appropriate treatment, and distribute treated water in different locations through appropriate technology. The first engineered distribution system came in the form of ‘quants’ in 700. Attempt was to distribute water across hillside areas. Ancient Iran first used the quant system for access to water in the mountains (Juuti, 2007). These technologies transferred to different countries under different names. In the17th and 18th centuries made little progress in water supply services at the world level. During the period ROM was using indoor plumbing systems for water supply. In the 18th century, the rapid growth in global population establishment of a private water supply network in London was one of the reasons for rapid increase in population in UK. For this purpose, the new river Company was established and performed in London. The first treated public water supply in the world was installed by engineer James Simpson for the Chelsea water works in London in 1829 (Weinreb and et al, 2007).

Initial and important objective of such a system is to collect water from different sources. Then a water distribution channel is developed to provide water supply to the consumers. Firstly, wood-based piping systems were used the globally, for water supply distribution activities. Generally, the wooden piping system were made from hemlock trees and was over 15 miles long (Joe, 2014). Other channels like cut stone, brick and rough concrete were also used in the same period. Water towers (water tanks constructed at a sufficient height from the earth) appeared popular around in 19th century for water supply. In this period, new materials like cast-iron pipes were used for water distribution purposes widely. Philadelphia was one of the first cities to use cast-iron piping and later it was followed by others (Joe, 2014).

At present, nearly 90 per cent of Americans get water service. New York enjoys to leading public water distribution system in the world during the 19th century, which is built over 40 miles of distribution channels for water services (Joe, 2014). Water quality is steadily getting low over the decades. At the end of the 19th century and the beginning of the 20th century, the main goal was improving water quality and eliminating waterborne diseases. The desalination process appears and is applicable during the late 20th century, which helps in improving water quality. The popularity of the steel material used for water supply pipelines increased in the 20th century. At the beginning of the 21st century, public authorities take a leading role in the provision of water supply services. In this period, a large piped water supply was built, and most homes were connected to those networks, and the network connections extended to agriculture, Industrial and commercial purpose. At present the decentralized authorities actively participate to provide sufficient quantities of water to keep up with growing demand.

2.5.2.2 Evolution of Water Supply Services in World Countries

In beginning of1990s, significant progress has been made in the provision of water supply around the world. In this period, 78 per cent (4.1 billion) of people used water from improved sources, while 64 per cent of the rural population and 95 per cent of the urban population were covered by improved drinking water sources globally. However, 1.1 billion people did not use improved drinking water in the period (WHO, 2006).

In 2000, 62 per cent (3.8 billion people) of people used safely managed water services and 82 per cent (5 billion people) of people used at least basic drinking water services globally. At that time, at least basic water services increased covering 95 per cent of the urban population and 69 per cent of the rural population respectively. This water service is also increased in all eight SDG regions. The greatest increase was recorded in sub-Saharan Africa with 328 million people have gained improved water services since 2000 (WHO, 2019). In 2010, about 56 per cent (5.9 billion) of the global population had access to piped water supply through a house connection or to an improved water source including standpipes, spring supplies and protected wells. However, about 13 per cent (900 million people) did not have access to improved water sources in the period (WHO/UNICEF, 2010). The global population as a whole is on track to meet the MDG (million development goals) drinking water target in the period. However, large disparities exist across the regions and between urban and rural communities in water supply (WHO, 2012).

1n 2015, 71 per cent (5.2 billion) of the global population used safely managed drinking water services. That means 7 out of 10 people used safely managed drinking water services. The global population using at least a basic drinking water service increased by 89 per cent (6.5 billion people) (WHO/UNICEF,2017a).181 countries had achieved coverage of over 75 per cent for at least basic drinking water services in 2015. In total, 263 million people used limited services and 159 million people collect drinking water directly from surface water sources (WHO/UNICEF, 2017a).

In water supply, huge inequalities exist almost every country across the world. In 2015, about 65 per cent of the population of Latin America and the Caribbean had access to safely managed drinking water services. In the year, 96 per cent also used at least a basic water service (WHO/UNICEF, 2017a). The world population was almost 7.6 billion as of June 2017, of which 17 per cent (1.3billion) live in Africa (UNDESA, 2017). But, only 24 per cent of the population of sub-Saharan Africa had access to safe drinking water and it is placed in the lowest safely managed drinking water used regions in the world (WHO/UNICEF, 2017a). Almost half of the people who used drinking water from unprotected sources live in sub-Saharan Africa (WHO/UNICEF, 2017) 4.2 billion (54 per cent) of the world population out of 7.6, live in cities (UNDESA, 2017). This Population growth leads to an increase in the number of slum dwellers in the city. 883 million urban residents are living in slums, worldwide.

89 per cent of the urban population in eastern and south-eastern Asia has access to safely managed drinking water services and 61 per cent of south-eastern Asia urban people have access to safely managed drinking water supply (WHO/UNICEF, 2017b). However, in the Arab region, a 51million people (9 per cent of the total population) lacked basic drinking water service in 2015 (WHO/UNICEF, 2018). In Europe and North American regions, 57 million people do not have piped water at home, and 21 million people still lack access to basic drinking water services. In Latin America and the Caribbean region, 25 million people are without access to basic water services and 222 million are without safely managed drinking water services (WHO/UNICEF, 2017b).

Among the global population, 71 per cent of the population (5.3 billion people) used safely managed water services, 90 per cent (6.8 billion) used at least basic drinking water services, 206 million people used limited services, 435 million used unimproved sources and 144 million still used surface water sources (WHO/UNICEF,2019). Since 2017, piped sources were more common than other improved sources in the world, especially in all SDG regions except for sub-Saharan Africa and central and southern Asia. Globally, the population usage of the piped source increased from 3.5 billion in 2000 to 4.8 billion in 2017. Piped water utilization in all SDG regions are also increasing in the period, which largest increase was recorded in eastern and south-eastern Asia where 572 million people gained access to the piped water supply (WHO/UNICEF, 2019). The global population's usage of the non-piped source also increased from 1.6 billion to 2.2 billion in the period.

The global usage of improved sources of drinking water is high. 71 per cent of the world's population used safely managed water service in 2017; which increased from 61 per cent in 2000. In 2017, the urban and rural population's water supply coverage was 85 per cent and 53 per cent respectively. The global population's usage of at least basic drinking water services is 90 per cent in 2019. It increased from 82 per cent in 2000. During the period, urban population water supply coverage increased from 95 per cent to 97 per cent and rural water supply coverage increased from 69 per cent to 81 per cent, with reduced the rural-urban gap (WHO/UNICEF, 2019). At least basic service is increased in all eight SDG regions with the highest rate recorded in sub-Saharan Africa. The proportion of the global population lacking at least basic drinking water has halved, from 19 per cent in 2000 to 10 per cent in 2017 (WHO/UNICEF,2019). The above analysis explains the result of world-level water supply services that are performing well today.

2.5.3 Public Water Supply Services in India

The provision of water supply is the responsibility of each government. At present in India, water supply services are carried out by integrated government machineries at central, state and local levels.

2.5.3.1 History of Indian Water Supply

During the pre-independence era, in 1944 Bhore committee was the first body to recognize the importance of drinking water supply at the national level (Panickar, 2007). It was followed by madras and other states. After independence, the condition of India was worse with persistent poverty, illiteracy, malnutrition and unemployment. For solving these crucial problems, the state introduced and adopted a strategy of providing the distribution of public goods to the society. This strategy is become more popular when Indira Gandhi introduced the 'Garibihatao' programme (Hasan, 2018). For the first time, everyone got benefits from this successful programme in India. Implementation of this popular public programme helped a lot in the implementation of five-year plans, at that time in India.

The provision of drinking water supply started systematically in India when it introduced five-year plans in 1950. During initial periods, five-year plans were allocating only limited funds with the most shares provided to urban supply. The breaking feature of the Indian water supply has increased since the 1980s, with the introduction of international drinking water decade programme. The commendable progress achieved in the provision of water supply especially in rural supply was from the 6th plan onwards. This plan followed by other plans allocate appropriate fund to both rural and urban supply in India. Traditionally, the Indian water supply followed a supply-driven approach for long periods. In the decentralization period, a new demand-driven approach was developed to replace the centrally owned approach in India. The decentralization approach becomes more popular in present India.

2.5.3.2 Evolution of Water Supply Services In India

According to Indian constitutional provision, drinking water supply is treated as a state subject. So the primary responsibility of drinking water facilities in the country rests with state governments. Good policies, good governance and a good volume of finance are critical in the success of this public water supply services. Being a union of multiple states every state own diverse social, economic and political conditions. Hence water supply approaches and policies change from state to state. So each state is different from the others. Here, the union government of India acts as an intermediary in extending policies, and technological and financial support to each state government for their successful water supply services mechanism.

2.5.3.2.1 Drinking Water Supply and Five Year Plans in India

Safe drinking water provides the quality of life of citizens and is vital for the socio-economic development of the country. So the water supply included in the national agenda during 1st five-year plan. However, the1st plan to 5th plan provides a relatively negligible investment for water supply. From 6th plan onwards plan allocation increased substantially for water supply, which increased steadily afterwards.

Table 2.18: Plan-wise Investment in Water Supply and Sanitation (Rs. In Crore)

Plan	Total public sector plan outlay	Total plan outlay for water supply &sanitation		Plan outlay for urban water supply& sanitation		Plan outlay for rural water supply& sanitation	
		Amount	%of public sector outlay	Amount	%of public sector outlay	Amount	%of public sector outlay
1st plan (1951-56)	3360	49	1.46	43	1.28	6	0.18
2nd plan (1956-61)	6750	72	1.07	44	0.65	28	0.41
3rd plan (1961-66)	8573	105.70	1.23	89.37	1.04	16.33	0.19
Annual plan(1966-69)	6664.97	106.42	1.60	-	-	-	-
4th plan (1969-74)	15902	437	2.75	282	1.77	155	0.97
5th plan (1974-79)	39303.49	1030.68	2.62	549.44	1.40	481.24	1.22
Annual plan(1979-80)	12549.63	430.2	3.43	197.93	1.58	232.29	1.58
6th plan (1980-85)	97500	4047	4.15	1766.68	1.81	2280.32	2.34
7th plan (1985-90)	180000	6522.47	3.62	2965.75	1.65	3556.72	1.98

Annual plan(1990-92)	137033.15	4427.29	3.23	1721.37	1.26	2705.92	1.97
8th plan (1992-97)	434100	16711.03	3.85	5982.28	1.38	10728.79	2.47
9th plan (1997-02)	859200	39538	4.46	18624	2.16	20914	2.43
10th plan (2002-07)	1525639	44206.55	2.89	19758.55	1.30	24448	1.60
11th plan (2007-12)	3644719	120774	3.31	48174	1.32	72600	1.99
12th plan (2012-17)	8050123	255319	3.17	132749	1.64	122570	1.52

(**Note**: 12th plan in projected value. The central allocate funds and funds are provided in the state budget, which progressively larger allocations have been made for water supply in various five year plan)

Source: 12th Five Year Plan 2012-17, Planning commission, Government of India.

During the **1st plan**, the union health ministry announced a national water supply and sanitation programme as part of their health schemes in 1954. The scheme was implemented in states with central assistance for improving urban and rural water supply (India Assessment Report, 2002). The funding pattern was 50 per cent grant-in-aid by the Centre and the other 50 per cent funded by the state government. During this plan, public health engineering organizations were set up at the Centre and several states and provided training facilities. Later each five-year plan's funds were allocated for the development and strengthening of state public health engineering departments. During the **2nd plan**, Rs 50 lakh was allocated for this purpose. In addition, during the **3rd plan**, the central government sanctioned special investigation divisions in 1962 with 100 per cent central assistance for the preliminary survey to identify the problem of water supply in difficult and scarce areas. The union health ministry sanctioned and allocated funds in the same pattern as above for all annual plans.

In 1972-73, country introduced the accelerated rural water supply programme as a part of the special social welfare schemes during the **4th plan**. This central scheme provides 100 per cent assistance to the state for extending its rural water supply. The government of India introduced 20 point programme focused on rural areas in addition to other general development programmes during the **5th plan**. One of the 20-point programmes was, to supply drinking water in problematic villages. Minimum needs programme was also introduced in this plan period. ARWSP scheme was withdrawn in 1974-75. However, the schemes were re-introduced in 1977-78, for improving safe drinking water supply in identified problem villages. The droughts in 1979-80 happened to accurate scarcity of drinking water in many parts of states in India (Economic Review, 1984).In order to address the issue of water scarcity; the sixth plan emphasized the significance of public water supply services and raised awareness on a national and international level.

From the **6th plan** onwards, a shift was evidenced in priority water supply investment from the urban to the rural sector in India. The **7th plan** gives priority in achieving the maximum coverage of water supply in villages. In 1987-88 introduced a national drinking water mission giving high support to rural coverage of water supply. During the **8th plan** new water supply reforms were introduced in India. The plan introduced and implemented a decentralized water supply service mechanism in the country. Here the central government's role in the water supply is restricted. The urban water supply was also not impressive till this plan because of various reasons including inadequate investment in urban water supply. Financial support to urban schemes were extended for implementing accelerated urban water supply programs in 1993-94, to provide water supply coverage in small town areas. The other striking feature of this plan was the involvement of private sector participation in water supply. Mainly involvements of the private sector were in the construction and maintenance of water supply projects. From that plan onwards, private sector involvement is encouraged in water supply sector in the country.

During the **9th plan**, on the base of the 73rd and 74th Amendment act, local governments are empowered to undertake the provision of water supply responsibility to the rural and urban areas. This plan also provides importance to universal coverage of drinking water supply in urban India, in terms of both quantity and quality. In accordance with follow-up minimum criteria and fundamental norms, the **10th Plan** emphasized providing 100 per cent of rural and urban inhabitants with access to safe drinking water. Additionally, this approach protected water resources sustainably and saw water as an economic asset rather than a free good. The peculiar feature of the plan was an improvement of urban water supply in the whole state as introduced by the scheme of JNNURM in 2005-06.

The objective of the **11th plan** was to attain 100 per cent accessibility of urban water supply at the end of that plan. The plan gave emphasize in introducing, designing and constructing multi-purpose reservoirs and storing a sufficient quantity of water for domestic uses in urban areas. For this purpose 40 per cent of plan funds were allocated. 11th plan also emphasizes the private sector participation and private investment in the urban water supply.1t means that public sector lagged behind may be much objective observation in large parts of the world, especially to the poor. The failure led to privatization policies dominating in the 1990s, with undertaking and operations and management of water supply in private companies (World Bank, 2012). The **12th plan** allocates a huge amount of plan outlay for drinking water supply. JNNURM II is launching with a high jump to plan allocation for urban water supply during this plan. This reform is helping to more water released for rapidly growing urban India (Shab, 2013).

2.5.3.2.2 Source of Drinking Water in India

Table 2.19: Major Source of Drinking Water in India

Census	Tap	Well	Hand pump/tube wells	Other Source
1991				
rural	20.6	38.0	34.9	-
urban	65.1	15.9	16.3	-
total	32.3	32.2	30.0	-
2001				
rural	24.3	22.2	48.9	4.5
urban	68.7	7.7	21.4	2.3
total	36.7	18.2	41.2	3.9
2011				
rural	30.8	13.3	51.9	4.0
urban	70.6	6.2	20.8	2.5
total	43.5	11.0	42.0	3.5

Source: Census, Various Report, Office of Registrar General and Census Commissioner of India, Ministry of Home Affairs, Government of India.

In India, urban people mainly depend on tap water for their drinking water purpose. According to the census 2011, 43.5 per cent of urban people use tap water as their main drinking water source and about 42 per cent of people depend on hand pumps and tube wells for their water uses. Only 11 per cent of households depend on well water for their drinking water purposes for the period. This trend shows the increasing number of people demanding public water supply every passing day and depending on well water sources is declining. The table shows the majority of urban people depend on tap water for long periods. Only very few people depend on well water in urban areas and it trend is declining. According to the 1991 census, identify the majority of rural people used well water for their activities. But the trend changed and declined later. In recent times, also more rural people depending tap water for their activities. So the public water supply service is the most important in India.

Table 2.20: Household Having Safe Drinking Water Facilities in India

Census	Rural	Urban	Total
1991	55.5	81.4	62.3
2001	73.2	90.0	77.9
2011	82.7	91.4	85.5

Source: Census, Various Report, Office of Registrar General and Census Commissioner of India, Ministry of Home Affairs, Government of India.

The table explains the trend of public water supply services is increasing in India. Most people are attracted to the safe drinking water service. Tap water and pump/tube well water supply facilities are used for this safe water supply. So, demand for government water supply services is increasing steadily in India.

2.5.3.2.3Water Supply Policies and Programmes in India

In India, high national importance was given for the provision of drinking water supply since independence. After independence, the government of India launched various centrally sponsored schemes and policies for the development of both rural and urban water supply.

In rural India, the first serious attempt on the provision of drinking water supply started, with the introduction of the ARWSP in 1972-73. These schemes were connected to the introduced minimum needs programme in 1974-75. The modification framework of the ARWSP schemes was introduced in 1986 as a part of the national rural drinking water programme. Later ARWSP was changed as a mission approach and adopted the name Rajiv Gandhi National Drinking Water Mission in 1991. From 2004 onwards, all rural drinking water programmes are including under an umbrella of this RGNDWM scheme (Cullet, 2011). In 2005, the Government of India launched the Bharat Nirman programme for the overall development of the rural area, which includes drinking water. In 2019, the government of India started Rs 3.5 trillion to provide all rural households with safe drinking water through the JalJeevan Mission scheme (National Water supply and Sanitation Committee, 2019). This growth trajectory contributes to significant advancements in rural water supply services.

In the beginning stages the urban water supply was not impressive; the table 2.18 is shows that the plan investment in the urban water supply is low in the initial stage. The major problems like inadequate finance, shortage of materials, lack of transport facilities, inefficient management etc are caused by low progress in urban supply. From initial periods itself, the government of India gave great emphasize on the development of rural water supply schemes. Along with that, the central government's major intervention in drinking water in cities and towns started in 1993-94 through accelerated urban water supply programmes. This programme was targeted to supply water in small towns with a population of less than 20000 in the 1991 census. Generally, funding both central and state government in a ratio of 50:50, but in special cases 100 per cent of central fund was ensured. These centrally sponsored schemes bring a new phase in the history of urban water supply services.

India introduced the international drinking water supply and sanitation programme and allocated the huge international financial inflows from the World Bank and various foreign governments. For a long time, World Bank continues to be the primary source of external assistance in both rural and urban supply. The other important sources of assistance are availed from European Economic Community, the Japanese Bank for international cooperation, the Netherlands and the German government (Annual Report, 2017-18). This external support reflected a huge volume of financial inflows and technical extensions developed in the water supply. This leads to a new chapter of drinking water supply progress being achieved in India.

The Central government acts as an intermediary and it mobilizes external assistance for various water supply schemes. It provides direct grant assistance for water supply. This programme also helps to contribute strong internal financial inflows from LIC, HUDCO etc. LIC loan is available to local bodies and state water supply within the amount allocated by the planning commission for each state every year. The loans are available at a concessional rate of interest on the security of the concerned state government guarantee (India assessment report, 2002). HUDCO is a very supporting actor in financial assistance for water supply. It gives priority to financing water supply schemes in small and medium towns. HUDCO loan is used to augment, rehabilitate, extend and introduce new schemes for the development of water-scarce areas (India Assessment Report, 2002). The CPHEEO plays an important role in giving technical sanctions to externally funded agencies and the LIC of India.

The government aims to implement national water policies for planning and development of precious water resources and achieving optimum utilization and avoiding all types of misuse of drinking water. The first national water policy was formulated in 1987. The policy considers the highest priority in provisioning drinking water. It declared the natural resources of water as basic human needs. The policy set general features are development in groundwater and surface water utilization, quality and quantity improvements, and avoiding over-exploitation of water resources in the country (Annual Report,1988-89). Since the 1990s various reforms were implemented in water sector, and an important one is the 73rd and 74th amendment act. This helps to implement a demand-responsive approach to water supply. This reform demands a revised water policy. Then the second national water policy was implemented in 2002.

The policy emphasized private sector participation in water supply delivery. The other important features are first priority in drinking water, encouraged finance, improving the service delivery, integrated water resource management, well-developed information system, people planning and participatory approach, improvement of quality and quantity of water supply and sustainable water resource etc including the second policy (Annual Report, 2002-03). Water resources are essential to human survival. Therefore, the government places a high value on water supply. New adjustments have always been made. Consequently, the national water policy was updated and released in 2012.The policy treated water as economic good. The other features are setting an appropriate service level benchmark, strong community participation management systems; removing the disparities of rural-urban supply and emphasizing water resources management under the national water framework law with in an umbrella of all responsible institutions (Annual Report, 2013-14) including third water policy.

2.5.3.2.4 Reform Initiatives of Drinking Water Supply in India

The provision of drinking water is a major concern of all successive governments in federal India. Since the 1990s different forms of reforms are initiated in the drinking water sector. The 73rd and 74th amendment act 1992 is a strong institutional reform bringing a new phase to the Indian drinking water sector. In these reforms, the state's responsibility of providing water supply was transferred to local bodies. Then local bodies are financially and technically empowered with roles and responsibilities increased with the mandate of the basic civic amenities of water supply. The water supply responsibility was undertaken by Panchayati Raj institutions in rural areas and urban local bodies in urban areas. Here, the role of state government was shifting from service provider to facilitator, which performs in planning, managing and strong financial supporter of the water supply and local government undertakes the responsibility of water service delivery to the communities. The striking feature of the 73rd and 74th act was elaborating the role of involvement of people with empowered local institutions and restricts the role of both the Centre and state as planning, monitoring and partial financial supporter in water service delivery.

The government of India initiated the sector reform process in rural supply when introduced the SWAJALDHARA community programme in December 2002. Most of the rural water supply schemes in India followed a government-oriented centralized approach till 1999. At the end of 1999, rural reform initiatives introduced SWAJALDHARA schemes on a pilot basis. Since 2002, it was operated in 67 districts in the country. The Sector Reform Project was transformed into the Swajaldhara Program in 2003, thus scaling up reforms to a national programme in a people-oriented community-based manner. This new approach involved a high degree of community participation and the user group is mainly involved in the operation and maintenance of the schemes and sharing of project costs (Word bank, 2008).

Following economic liberalization, India began to emulate reforms in the urban water sector in the middle of the 1990s. In 1993-94, the Ministry of urban development introduced the AUWSP as a major initiative of urban water supply, which strong financial supporter of urban schemes. In 2005-06, this scheme merged with urban infrastructure development schemes for small and medium towns (UIDSSMT). On 3rd December 2005 launched the JNNURM, the landmark initiative bringing strong water supply reform in urban areas, especially for urban poor. A large-scale amount of central financial assistance is available to the cities through this massive urban development programme. During 2014-15, the central government launched the flagship programme AMRUT, replacing the JNNURM for urban development and improving water service delivery in cities (water aid, 2018). All these initiatives contribute to achieving remarkable progress in urban water service delivery in the country.

2.5.3.2.5 Water Supply Requirement Norms

The 74th Amendment act gave the responsibility to urban local bodies to deliver urban water supply. The service level benchmarks are providing guidance to the states for improving access and delivery of urban water supply. Different organizations in India suggested service level benchmarks for various services including water supply. In India, for the first time, setting urban service norms and standards was made in 1963 by Zakaria Committee. The committee recommended the per capita water consumption range between 45-270 litres per day depending on city size (NIUA, 2007). City level drinking water consumption patterns change from time to time, as a result of increasing income levels with technological up-gradation. Thus there is a need to change a new range of appropriate norms in the city at different periods. In 1995, The Working Group on Expenditure Norms suggested, the minimum physical standard of urban water service in 100 percent of the population-covered water supply, 70 IPCD of piped water supply and 40 IPCD of public stand post (low-income group) per day (NIUA, 2007).

The World Health Organization recommended the norms of water consumption in an urban area should be 250 IPCD and that public stand posts should be 80 IPCD (Radhakrishnan, 2003). Central Public Health Environment Engineering Organization introduced a range of norms, 150-200 IPCD for urban water supply. Union Ministry of Urban Development and Poverty alleviation suggests water required for the domestic purpose of urban areas is 40 litres in case of supply through public stand posts and 70 IPCD in the case of supply through house service connections. In the case of metropolitan cities having a population is more than 1 million; the domestic water supply would be 150 IPCD (General Guidelines for Water Audit and Water Conservation, 2017)The Ministry of Housing and Urban Affairs has recommended the service level benchmark for urban water supply, is explained in the following table.

Table 2.21: Performance of Service Level Indicators in Water Supply

Sl.No	Indicator	Benchmark
1	Coverage of water supply connections	100%
2	Per capita supply of water in city	135 IPCD
3	Extent of non-revenue water	20%
4	Extent of metering	100%
5	Continuity of water supply	24/7
6	Efficiency of redressed of customer complaint	80%
7	Quality of water supply	100%
8	Cost recovery	100%
9	Efficiency in collection of water charges	90%

Source: Improving urban water supply and sanitation services, Ministry of Urban Development, Government of India, 2012

Generally, the Government of India established the following norms of per capita water supply in urban areas. The government of India proposes that urban water supply norms are based on city size. The basic norms are 150 IPCD for metro cities, 135 IPCD for non-metro towns, 70 IPCD for towns/ cities and 40 IPCD for public standpipes in the city (Status of Urban Water Supply in India, 2018). However, most of the states are establishing their own norms and appropriate classification is used for water supply. The 13th finance commission sanctioned grants to local bodies, based on the above nine water supply indicator performance of local bodies (CPHEEO, 2014).

As per the above norms and the 2011 census, 70.6 per cent of the Indian urban population is covered under water supply. The range of available duration of water is 1 hour to 6 hours in cities and the range of available per capita supply of water is 37 to 298 IPCD in Indian cities.

2.5.3.2.6 Institutional Support to Water Supply

In 1950, the federal constitution of India provide water supply as a state-owned subject. In these provisions, state governments are vested with the right to plan, implement, operate and maintain water supply projects. In a decentralized system, the responsibility of water supply services is transferred to the local level from the state government. However, the successful implementation of the local water supply mechanism depends on strong support from both state and Central Government Corporations and assistance in the form of technical, financial and managerial supervision. The present water supply system in India involved central agencies, state agencies and local government institutions with highly fragmented. Large numbers of institutions are involved both directly and indirectly in the successful implementation of water supply in the country.

In drinking water supply, various ministries are performing at the central and state levels in India. At the central level, the Ministry of Drinking Water and Sanitation is performing rural water supply and the Ministry of Housing and Urban Affairs, Ministry of Urban Development shares responsibility in performing urban water supply. In rural supply, the Department of drinking water supply was formed in 1999 for water supply services to rural India. This department was renamed in 2010, as a department of Drinking Water and Sanitation. The Ministry of this department was formed in 2011, as Ministry of Drinking Water and Sanitation. Now, this ministry is merged with the Ministry of Jal Shakti. The department is responsible for policy formulation, planning, funding and coordinating programmes in rural water supply.

Urban water supply, Ministry of Urban Development is formed in 1952 and it is performing as the main department of urban water supply services in the country till now. In 2004, the Ministry of Housing and Urban Poverty Alleviation Department was separated from the Ministry of Urban Development, and later it merged in 2017 as the Ministry of Housing and Urban Affairs. The Ministry is responsible for urban development with involved in national policy decisions, setting standards and norms and coordinates central ministries, state government and central assisted programmes in urban supply. The other important responsibility is technical and financial assistance to states that provides adequate urban water supply projects. Ministry of Urban Development is responsible for broad policy formulation, setting standards and norms, coordination and support to state water supply programmes, managing international sources of finance and providing total guidance in the urban water supply. The planning commission is the other most supportive institution for water supply, which plans and allocates central and state government funds through five-year plans. In most cases, the state departments like the Public Health Engineering Department, Department of Urban Development and Department of Local Self-government are performing in urban supply Sector.

The above institutions are directly involved in the Indian water supply. For proper and successful implementation of drinking water supply, Cooperation of some other departments is necessary in the country. Central Water Commission, under the Ministry of Water Resources, is responsible for conservation and sustainment of surface water resources, which regulate the overutilization of water resources. Central Ground Water Authority under the same department, is responsible to provide, regulate, misuses, develop, manage and monitoring groundwater levels. National River Conservation Directorate and Central Pollution Control Board under the Ministry of environment forest and climate change help to improve the quality of water resources. These key departments are indirectly involved in the water supply services in India.

The Ministry of Agriculture is involved in planning, formulation, monitoring and reviewing various watershed-based developmental project activities in India (India Assessment Report, 2002). This department is either directly or indirectly involved in water supply services in India.

2.6 CONCLUSION

This chapter focused on the general picture of water resources and their present scenario in the world and Indian context. The chapter draws a picture on the limited availability of freshwater resources on the earth and huge demand for drinking water. The development of main sectors like agriculture, industrial and domestic sectors demands huge water resources. Rapid population growth and a huge amount of sector-wise demand result in the greater importance of safe water resources. The correlation between the population in nations and their consumption patterns is highly mismatching. The development sectors also consumed a major share of water and limited water resource is bringing tight competition among these sectors. The increasing rate of demand and its scarce conditions leads to fundamental decisions regarding water supply and its related services in our society. In the background, the importance of public water supply is to be highlighted. The chapter discusses historical movements, their evolution and the present condition of the drinking water segment of both Indian and global content and proves its public water supply is a cornerstone of human survival and the overall development of the economy. On the other side, the chapter point out the different concepts of water withdrawal and water consumption. The interesting result is India's and other world countries' water consumption is not equal to their withdrawing amount of water for their consumption. A huge amount of water wastage is happening here. This is a big threat to our future life and environment. The chapter gives an overview and real picture of water resources with background information provided to present research work.

Chapter III

WATER SUPPLY SERVICE MECHANISAM IN KERALA

3.1 INTRODUCTION

In this chapter discusses the evolution and present scenario of the state public water supply service mechanism in Kerala with special focus on water supply in an urban context. The provision of water supply is the responsibility of the government in the state. The state government is taking initiative for a safe drinking water supply, where access to water supply is a basic human need and human right. The provision of drinking water supply became popular with the commencement of five-year plans.From the initial stage onwards, water supply was considered a state-owned subject. KWA is the primary drinking water supplier in the state and performing well for a long period. The 73^{rd} and 74^{th} amendments of the Indian constitution mandate the responsibility for drinking water to the local government. In a decentralized system, the local government is actively involved and gives high priority to the public drinking water supply in the state. Today, the provision of water supply services is carried out by the combination of state government and local government with central government assistance in Kerala state.

This chapter is divided into 3 sections. The first section is trying to identify the picture of the importance of water resources in the state.This section begins by outlining theavailability of water resources and their rising trend of sector-by-sector use in the state.Further it tries to explain the future demand of agriculture, industrial and domestic sectors. In freshwater resources, drinking water is the most important one. The second section explains the picture of drinking water availability, its utilization and sector-wise demand in future and also tries to prove that people highly rely on public water supply for day-to-day affairs. In the third section, attempts were made to identify the evolution, growth and present status of public water supply service delivery in Kerala state and give special attention to the role of local government performance of water service delivery in the state after decentralization. This section also explains the share of external-aided projects contribution to the state water supply. This section also includes the role of governance support for the growth of state public water supply delivery in Kerala.

SECTION 1

3.2 PRESENT STATUS OF WATER RESOURCES IN KERALA

The section discusses in detail, picture of available major water resources in the state and their demand and present utilization performance in the state.

3.2.1 General Characteristics of Kerala State

Kerala state covered an area of 38863 km^2, which is bordered by the Lakshadweep Sea on the western side and Tamilnadu and Karnataka states on the eastern side. The length of the state from north to south is 560 km and the average width is 70 km. the state accounts for 1.18 per cent of total India's land area, which covers almost 4.8 per cent of India's total water resources (KGWYB, 2015).

Kerala is blessed with water resources. Water resources in Kerala comprise mainly rainwater, surface water and groundwater, which were demanded for several purposes in the state. Kerala has a monsoon-based water resource system. A high portion of rainwater recharges (stores) surface water and groundwater. Rainwater is the purest form and it may be harvested directly. Domestic, agriculture and industrial sectors are highly dependent on these three main water sources in the state.

3.2.2 Water Resources and its Availability in Kerala

Kerala is one of the highest rainfalls receiving states in India. The state receives southwest monsoon (June –September), northeast monsoon (October-December) and summer rains every year. However, the Southwest monsoon is the most prevalent rainfall contributor in Kerala. It also highly influences the availability of both groundwater and surface water in the state. In Kerala, the average annual rainfall of the state is 3000 mm, where 69 per cent of annual rainfall is received during the southwest monsoon, 16 per cent during North West monsoon and another 15 per cent from summer rains (Economic Review, 2017).

Table 3.1:Rainfall inKerala(MM)

Year	South- West monsoon (June- September)		North-East monsoon (October-November)		Summer Rains (March-May)	
	Actual	Normal	Actual	Normal	Actual	Normal
2010	1932	2142.9	825.7	498.5	359.6	359.6
2011	2215.8	2039.6	450.8	480.7	313.3	359.6
2012	1551.3	2039.6	310.8	480.7	308.5	379.7
2013	2570.3	2039.6	430.7	473	218.9	379.7
2014	2164.9	2039.6	502.2	480.7	364.6	379.7
2015	1514.3	2039.7	610.1	480.7	464.7	379.9
2016	1352.3	2039.7	185	480.7	313	379.9
2017	1857	2039.7	442	480.7	354	379.9
2018	2515.7	2039.7	465.5	480.7	521.8	379.9
2019	2300.2	2038.7	638.3	492.7	169.1	379.9

Source: Ground Water Year Book,CGWB,&Economic Review,State Planning Board,TVM, Government of Kerala.

The picture shows state receives abundant rainwater in the last ten years. However, high variations are among the total rainfall. It can be either excess or deficit. In low land, the average annual rainfall received is 900 MM in the southwest monsoon and 3500 MM in the northeast monsoon. Midland receives total rainfall of 1400 MM in the southwest monsoon and 600 MM in the northeast monsoon. Highland receives 2500 MM in the southwest monsoon and 6000 MM in the northeast monsoon in the same period (Chakrapani, 2014). Rainfall in Kerala has high temporal and spatial variations. These variations lead to both frequent floods and droughts in Kerala. For example, Kerala witnessed drought situations in 1973 and the worst floods situation in 2018.

Generally high-ranges receive more rainfall than midlands and lowlands. Then, the high spatial variations occurred in Kerala. For example, the Western Ghats region of Wayanad district receives higher rainfall than state averages and very low rainfall is received in Attappadi in Palakkad district at the same time (Dinesan, 2016). Plaghat gap highly influences the rainfall deficit in the area compared to other parts of the state. Temporal variations are also very high in the state with differentiation of land size and its holding capacity of water resources.

Kerala is a land of surface water resources. Kerala is rich with 44 rivers, of which 41 west flows and 3 east flowing. Rivers in the western area are speedy flowing to and reach the Arabian Sea in short duration. Three east-flowing rivers join the upper part of the Cauvery River system in Karnataka and Tamilnadu. Based on national norms the Chaliyar, Bharathapuzha, Periyar and Pumba are only medium rivers and the other 40 are minor rivers in Kerala. In total, runoff water of the rivers of the state amounts to about 77900 MCM, of which 70200 MCMfrom Kerala catchments and the remaining 7700 MCMfrom Karnataka and Tamilnadu catchments (Jalanidhi,2011). The total drainage area of the four medium rivers is 8250 sq. km and the remaining 40 minor rivers' total catchment area covers 9489 sq. km(Chakrapani, 2014).

In Kerala, most of the rivers are originating from the foothills. So the Kerala Rivers flow throughout the year. However, most of the rivers are highly dependent on rainfall of which 90 per cent of the river is recharged by monsoon season and the remaining 10 per cent in non-monsoon seasons. The nature of most Kerala rivers is very small with lengths of less than 15 km (Chakarapani, 2014). Kerala's topography is slopped hence; poor retention capacity of soil also increases the speed of rain water flow about 95 per cent of rainfall-runoff through rivers in every monsoon season in the state. This leads to reduced water levels and increased the threat of salinity of the water during the hot seasons.

Kerala is also significant for several freshwater lakes and backwater lagoons. Vembanad Lake (260 sq. km) and Ashtamudi Lake (55 sq. km) are the popular backwater lagoons in the state. Sastamkota Lake is the largest natural freshwater lake in the state. Natural water bodies like tanks, ponds, streams and springs are also dependent on water-related activities in the state. Now 236 springs have been identified by the state (Kerala ENVIS Centre, 2020).

Kerala is blessed with many rivers. So there is a high possibility of artificial barrier construction for holding large amounts of water resources during monsoon seasons. Now, Dam is constructed in many of the rivers in the state to support irrigation development and power generation. This also helps to increase the water potential for domestic and industrial purposes for all nearby places.

Table 3.2: Number of Dams Available in the Country

Country/state	Completed dams	Under construction of dams	Total dams
India	5264	437	5701
Kerala	61	1	62

Source: National Register of Large Dams, CWC (Central Water Commission),Government of India, 2019.

As per the national register of large dams in 2019, a total of 5701 dams exist in the country. Out of 5701 dams, 62 dams are in Kerala. 61 dams have already been completed and one is under construction in Kerala. Major dams in Kerala are explained below table.

Table 3.3: Dams in Kerala under the Category of "Dams of National Importance"

Name & year of completion of dams	Construction under river	Height (m)	Length (m)	Reservoir area (km2)	Gross storage capacity (km3)	Effective storage capacity (km3)	Volume of content of dam (103m3)
Kakki (1966)	Kakki	116.13	336.19	17.51	0.46	0.45	725.00
Idukki (1974)	Periyar	169.00	365.85	59.83	2.00	1.46	467.29
Cheruthoni(1976)	Cheruthoni	138.38	650.75	59.83	2.00	1.46	1699.24
Kulamavu (1977)	Kaliyar	99.97	384.96	59.83	2.00	1.46	453.13
Idamalayar (1985)	Idamalayar	101.60	373.00	28.30	1.09	1.02	880.00

(**Note**: Dams of national importance-dams with height 100 meter and above or gross storage capacity of one billion cubic meters andabove)

Source: National Register of Large Dams, CWC(Central Water Commission), Government of India,2018.

The table gives detailed explanations of the large and famous dams existing in Kerala. Mainly dams were filled with monsoon rains and it is helpful in non-monsoon season for various activities. During the 2018 flood, all major dams were almost filled to maximum capacity with rain water. For example, dams like Idukki (92.5), Kakki (97.3) Idamalayar (97.3) were filled to its maximum storage capacity in that heavy rain (Sudheer andetal, 2019).

Groundwater is another major water source in Kerala. The presence and availability of groundwater recharge depend on the nature of the land and climatic conditions like rainy seasons, summer conditions etc. The availability of groundwater is highly differentiated from place to place. In some areas, the groundwater exists in deep aquifers and other areas; water is stored near the surface. In Kerala, about 88 per cent of the total geographical area is underlined by crystalline rocks devoid of any primary porosity with limited groundwater recharge (Kerala ENVIS Centre, 2020). Groundwater resources are particularly strong especially in summer seasons as compared to the availability of surface water level.

The groundwater estimation committee, estimate the dynamic groundwater resource availability situation in the state in the following table.

Table 3.4: Major Components of Dynamic Ground Water Resources of Kerala (Total)

Base Year	Total Annual Ground Water Recharge (BCM)	Provision for Natural Discharge (BCM)	Net annual Ground Water Availability (BCM)	Existing Gross Ground water Draft for All uses (BCM)	Provision for domestic and industrial requirement supply (BCM)	Net Ground Water Availability for future irrigation development (BCM)	Stage of Ground Water Develop ment (%)
1999	6840.80	611.76	6229.04	2693.38	1411.79	3221.23	43.24
2004	6841.33	611.75	6229.54	2920.20	1411.79	3221.73	46.88
2009	6620.05	591.06	6028.99	2808.95	1705.47	3020.86	47.00
2011	6686.01	660.74	5834.34	2835.54	1705.2	3066.3	47.00
2013	6251.30	599.76	5651.53	2634.91	1549.88	2944.61	46.62
2017	5769.23	557.49	5211.75	2652.77	1571.28	2408.3	51.27

Source: Ground Water Year Book, CGWB (Central Ground Water Board), Government of India.

The availability of groundwater is continuously declining in the state. The groundwater recharge is highly dependent on monsoon and non–monsoon rains, which contribute about 82 per cent of the total annual recharge in Kerala (Economic Review, 2015). The falling trend of monsoons is reducing the water level of aquifer recharge. It reduces the groundwater level.The depth of the groundwater deficit is revealed by the falling trend of net yearly groundwater availability. Groundwater development stage grew from 46.62 percent in 2013 to 51.27 percent in 2017.It demonstrates how the groundwater resources in the state are coming under growing pressure. Central water commission observed groundwater storage in the last ten years and concluded that there is a decrease in the storage capacity of most of the catchments (Integrated Hydrological Data Book, 2012). Now, about 20 per cent of the urban land area is covered by buildings and roads (Dinesan, 2016). This leads to a decrease in the groundwater recharge. The total picture identifies that the groundwater potential of the state is very low.

Table 3.5: Number and Percentage of Ground Water Blocks in Kerala

Base year	Total unit	Safe	Semi-critical	Critical	Over--exploited
2004	151	101(67)	30(20)	15(10)	5(3)
2009	152	131(86)	18(12)	2(1)	1(1)
2011	152	126(83)	28(15)	2(1)	1(1)
2013	152	123(80)	29(17)	2(1)	1(1)
2017	152	119(78)	30(20)	2(1)	1(1)

Source:Ground Water Year Book, CGWB (Central Ground Water Board), Government of India.

The table explains the level of groundwater development in the state. The picture shows the present positions of groundwater development of the safe units are high, while it identified a very low level of decline in groundwater in the state. Over-exploited areas identified a steep decline in groundwater level, but only one spot, ie, Chitturin the Palakkad district, was identified. Critical spots are also very few in the state, namely, the Kasargod block of Kasargod district and the Malamuzha block of Palakkad district(KGWYB, 2018-19). However, the number of safe units declined over the years as well as semi-critical units also increased. This shows the declining trend of groundwater levels in recurring years. Central groundwater board concludes based on their studies, that only 48 per cent of the groundwater resources were exploited recently in Kerala (KGWYB, 2017-18).

Wells (open-dug well, bore well and tube wells) are the major groundwater extraction structure in Kerala. Wells plays a significant role in drinking water availability which is used as the primary source in majority of the households. Now, 65 per cent of rural and 59 per cent of urban households depend on well water in the state (Census 2011). The state has the highest well usage with 250 open wells per sq. km (UN ESCAP, 2004) as the best alternative source of drinking water in the world. Kerala enjoys the highest open well density with 200 wells per sq. km in the coastal region, 150 wells per sq. km in the midland and 70 wells per sq. km in high land (Economic Review, 2013). It shows that Well water is the major source of water in Kerala.

Table 3.6: Depth to Water Level and Distributing Percentage of Wells in Kerala in 2017-18

Months	No.of Wells	Depth to water level(mbgi)		Number and percent of wells showing depth to water level					
				0-2	2-5	5-10	10-20	20-40	>40
April	1396	0.20	56.20	80 (5.73)	394 (28.22)	592 (42)	301 (21.56)	27 (1.93)	2 (0.14)
August	1444	0.02	57.00	386 (27)	459 (32)	470 (33)	114 (8)	14 (1)	1 (0)
November	1449	0.10	49.50	290 (20.01)	479 (33.06)	534 (36.85)	134 (9.25)	10 (0.69)	2 (0.14)
January	1438	0.39	55.70	157 (10.92)	432 (30.4)	625 (43.46)	209 (14.53)	13 (0.90)	2 (0.14)

Source: Ground Water Year Book 2017-18, CGWB (Central Ground Water Board), Government of India.

The table shows several wells and their water level difference in three time periods in the year 2017-18.Iit shows the number of wells and their water levels fluctuated three times a year. Most of the wells are performing in monsoon seasons only. More importantly, the total number of wells are declining and some of them dried up in the summer seasons in Kerala.

Kerala witnessed the flood situation yet it took any fruitful step to improve the recharge of groundwater resources in Kerala. This is because the short duration of rainwater cannot influence the groundwater level. However, the rise in well water level accounted for 41.45 per cent (Shaji et al, 2019). But, it influence in changing the water levels on a few wells and for others is no change is happening in this short span of time, at all. In 2018, the central groundwater development department conducted a study report that said that 81 per cent of dug wells show a rise in water level and 19 per cent of wells show a decline in water levels in Kerala (KGWYB, 2017-18).

Kerala is enjoying plenty of rainwater and surface water resources with limited groundwater development. Rainwater is the prime water source in the state. The state depends on river water for its major share of water demands. Fluctuating level ofriver water leads to fluctuating levels of groundwater tables. The deficiency of rainfall badly affects the total water potential of the state. Due to deficiency in rainfall, water levels are low and easily dried up in the summer seasons. Heavy pollution due to land misuse, deforestation with soil erosion, sand mining, untreated sewage, waste dumping, pesticides and fertilizer utilization from agricultural operations, has highly contaminated water resources in Kerala. It leads to a limited level of groundwater recharge potential and badly affects river health. Increasing levels of polluted groundwater and surface water also contribute to low per capita water availability in the state.

3.2.3 Present Water Use Scenario in Kerala

Kerala accounts for only 1 per cent of the total area of India; it contains about 3 per cent of the country’s population (Chakarapani, 2014). Now Kerala's population is 33.38 million persons. The population density of the state is about 859 people per sq. km (Census, 2011). The increasing growth of population and expansion of economic sectors leads to increasing water use demand in the state.

The freshwater use of the state in 1901 was about 1000 million litres, which has increased to about 5500 million litres in recent year (Padmalal, 2019). In Kerala, a total of 44 rivers which together an annual yield is 70323 mcm, of which only 42700 mcm (60 per cent)is an annual utilizable yield in the state (Dinesan,2019). The state groundwater department calculates the groundwater recharge as 8134 sq. mm3 and its withdrawal is estimated as 980 mm3 in annually (Kerala ENVIS Centre,2020). The available rainwater is estimated at 72000 MCM, where it utilizes only 40000 MCM. Here, the state is utilizing 2.5 per cent of available rainfall (10^{th} Five-Year Plan, 2007).

The agriculture sector is the single most water consumer and it accounts for more than 70 per cent of global demand and 90 per cent of demand in India. Kerala also has high percentage of the water utilized for this sector. The industries like food processing industries, paper industries, textile industries, and cement and fertilizer industries are the most water consuming industries in Kerala. The domestic sector is one of the major water users, in highly populated states. Table 3.4 depicted the picture of agriculture, industrial and domestic sectors highly depend on groundwater resources. But the trend of groundwater for uses of these sectors is reduced. However, groundwater is the principle source of water for domestic uses with more than 80 per cent of rural and 50 per cent of urban populations depending on their activities (KDWSR, 2015). This is also fulfilling 50 per cent of irrigation needs in the state

3.2.4 Future Water Demand in Kerala

In Kerala, the total projected water demand is 49700 MCM, of which 30000 MCM(60.63 percent) is estimated for agricultural purposes and 7500 MCM(15.09 percent) is estimated for domestic uses (12^{th} Five-Year Plan,2017).In estimated total surface water requirement is 48600 MCM for 2021, which various in uses like irrigation for 28900 MCM (59.5Percent) and both domestic and industrial uses for 7500 MCM(15.4 percent) in the state (Dinesan,2019). But estimated future availability of surface water is only 42000 MCM in the state. The rough estimate of the projected demand for groundwater in total requirement is 4970 crore CUM. Out of the total, 3000 crores CUM required for agriculture and 750 crores CUM is required for domestic purposes (Jalanidhi,2015). The future groundwater resource availability is estimated at 7048 MCM in Kerala. This picture shows the total water demand is in excess of the total water supply in the state.

The national commission on integrated water resources development (NCIWRD) has estimated water requirements for future states and is presenting the below table.

Table 3.7: Net Water Requirement for Future Periods in Kerala

Year	Water Requirement(km^3)	
	Low	High
2010	7.6	7.8
2025	10.4	11.3
2050	19.4	23.8

Source: Draft General Guidelines for Water Audit & Conservation, 2017.

The table shows water demand is steadily increasing day to day. The growing population and increasing needs highly demand water resources in future. The major reasons like the impact of climate change, low and stable water availability rate, and continuous decline in per capita water availability lead to a lot of pressure on available water resources in the state.

The above picture explains demand for the water resources is increasing every day. But, at the same time, the quantity of water supplied is decreasing alarmingly. So it creates huge demand–supply gap. This difference is widening every time and it highly influences in the reduction of low level of per capita availability of the state. Kerala is the lowest water availability per capita state in the country which again shows a declining trend in recent periods (Economic Review, 2015). Here is a better solutions is to implement Government owned public water supply service.

SECTION 2

3.3 PRESENT STATUS OF THE DRINKING WATER SEGMENT IN KERALA

Drinking water is a gift of nature. It is the prime input to sustain the life and development of the economy. Water is the basic necessity of all creatures on Earth and life depends on water. But nobody owns this precious resource. However, the ownership of the water resides with the state as the public resource, which is used for entitlement for individuals, communities and society.

3.3.1 Drinking Water Demand in Kerala

Now, the state government needs 100 LPCD, and 150 LPCD water for meeting the drinking water demands of rural and urban areas respectively. But since 2005, Municipal &corporation areas are alone demanding targeted, 200 LPCD. The total water requirement in municipal and corporate areas in the state is 697 million litres per day in 2010, which increased from 645 million litres per day in 2005(12th Five-Year Plan, 2017). It shows the drinking water demand in urban areas is increasing.

3.3.2 Drinking Water Availability in Kerala

In general view, location-based source of water availability are sufficient in Kerala. This is illustrated in the following table.

Table 3.8: Location Based Drinking Water Availability of Kerala (Percent)

Source wise availability	2001			2011		
	Rural	Urban	Total	Rural	Urban	Total
Within the premises	69.1	78.9	71.6	72.9	83.3	77.7
Near the premises	17.4	13.6	16.5	16.3	11.5	14.1
Away the premises	13.5	7.4	12.0	10.8	5.2	8.2

Source:Census Report, Office of Registrar General and Census Commissioner of India, Ministry of Home Affairs, Government of India.

In Kerala, 78 percent of people had access to drinking water on their own premises. It means that the vast majority of people rely on water sources that are located within the complexes for their residential needs. In 2011, just 14percent of persons were dependent on the area around the premises, down from 16.5 percent in 2001. In 2001, 13 percent of people relied on sources of water that were outside their homes. It decreased, and in 2011 just 8.2 percent of houses used outside-premises water. The picture shows most of the households are demand and prefer to use safe public water supply services in the state. The following table explains the drinking water availability of state in past five years in 2018 to 2022.

Table 3.9: DistrictWise Drinking Water Availability in Kerala

District	Existing LPCD		
	2018	2019,2020,2021	2022
Thiruvananthapuram	127	147.96	160
Kollam	40(rural)120(urban)	72.82	63
Pathanamthitta	150.89	142.13	116
Alappuzha	52(rural)90(urban)	92.57	69
Kottayam	67.53	66.17	57
Idukki	35(rural)	51.75	63
Ernakulanm	75(rural)100(urban)	188.18	188
Thrissur	48(rural)103(urban)	72.63	70
Palakkad	50(rural)121(urban)	51.14	69
Malappuram	60	32.56	38
Kozikode	40-110	81.18	64
Wayanad	40(rural)70(urban)	55.94	47
Kannur	88.5	61.05	62
Kasargod	61.5	18.19	22
Total	81.61	84.76	83

(**Note**:the existing LPCD is average LPCD computed based on production capacity in the district by existing schemes and as per census 2011).

Source: Economic Review, State Planning Board, TVM,Government of Kerala.

In 2018, the average per capita availability of pipe water was 81.61 litres per day. It increased to 84.76 litres per day in 2021. It shows that more households gotaccessibility to state-owned public water supply services in Kerala. However, the average per capita availability of piped water is reduced by 83 litres per day in 2022. The availability of drinking water level of each district shows high degree of variation during the same year. The availability of water levels in each district also highly varied when we compare these two different periods.

3.3.3 Drinking Water Utilization in Kerala

People in Kerala mainly depend on well water, tap water (piped water supply), hand pumps and other surface water resources like rivers, canals, lakes, ponds, tanks, and springs etc. for their drinking water purpose. But the majority of the people use both pipe water supply or/ and well water in Kerala. Generally, every household in rural areas uses well water. Urban households also sometimes maintain wells in their compounds.

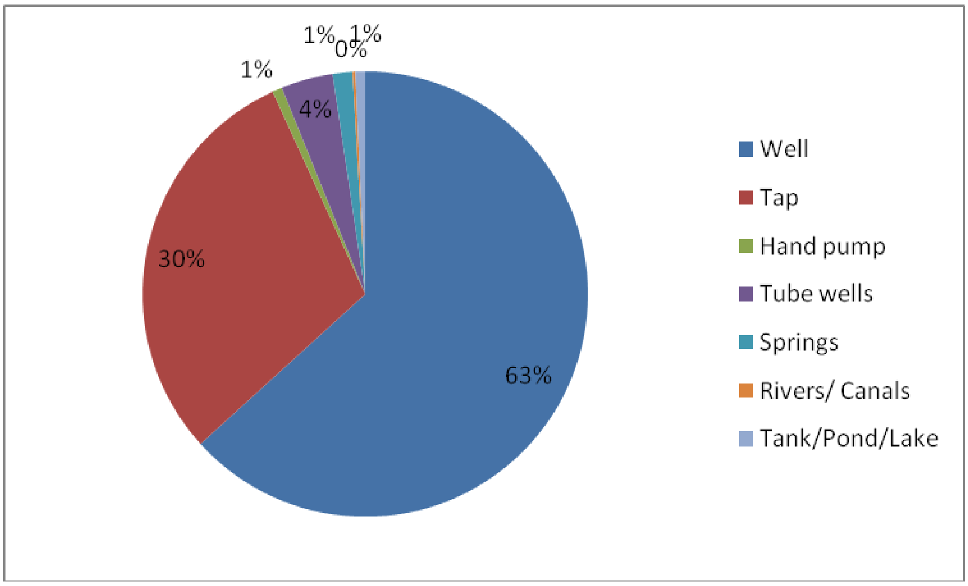
Table 3.10: MainSource of Drinking Water in Kerala (Percent)

Source of drinking water	2001			2011		
	Rural	Urban	Total	Rural	Urban	Total
Tap	13.9	39.9	20.4	24.5	34.9	29.3
Well	77.2	56.0	71.9	64.8	58.9	62.0
Hand pump/tube wells	3.0	3.0	3.0	3.9	4.6	4.2
Other source of water	5.9	1.2	4.8	6.9	1.7	4.4

Source:Census Report, Office of Registrar General and Census Commissioner of India, Ministry of Home Affairs, Government of India.

In Kerala, most of the people are depended on well water for their domestic purposes. But recent trend of well water usage is declined to 62 percent in 2011 from 71.9 percent in 2001. At same the time, there is an increasing trend of households depending on piped water supply with an increase to 29.3 percentfrom 20.4 percent. This opposite trend gives the importance of provision of potable water supply services in the state. It means, most of the people demanded safe drinking water supply. The interesting point is that, share of rural people dependence on piped water supply services is increasing and share of urban peoples well water usages is increasing today. However, the percentage share of urban household's depending on public water services is higher than rural households. This is because majority of the rural people are highly depending on well water as well as surface water sources in their drinking water activities.

Figure 3.1:Main Drinking Water Source of Usage by Households



Source:Census Report, Office of Registrar General and Census Commissioner of India, Ministry of Home Affairs, Government of India.

The diagram depicts the present household's drinking water utilization pattern in Kerala. It shows both rural and urban households' total water usage is steadily increasing in the state.

Table 3.11: Safe Drinking Water Facilities in Kerala(Percent)

census	Rural	Urban	Total
1981	6.3	31.7	12.2
1991	12.2	38.7	18.9
2001	16.9	42.8	23.4
2011	28.3	39.4	33.5

(**Note**: safe drinking water facilities include tap, hand pump, and tube well)

Source: Census Report, Office of Registrar General and Census Commissioner of India, Ministry of Home Affairs, Government of India.

The table explains safe drinking water availability ofthe households in Kerala. The trend of safe drinking water availability is steadily increasing and presently 33.5 percent of household has access to safe drinking water in the state. At the time, water utilization trend of both rural and urban household also increasing. But large size of urban households depends on safe water facilities for drinking and their domestic's activities as compared to rural households. This trend identify to increasing households demand on public water supply services in the state.

SECTION 3

3.4 WATER SUPPLY SERVICE MECHANISM IN KERALA

Water service provision is the provision of potable water supply. Water supply is the state subject and hence the Kerala government holds the responsibility for provisioning of water supply. Three main agencies, KWA, KRWSA and local bodies are performing in the field of water supply services in the state.

3.4.1 History of Water Supply Services In Kerala

Kerala state came into existence on 1st November 1956 on a linguistic basis. Government-level water supply programmeswere initiated and implemented at the time of the formation of the state. However, the historical documents saythat the provision of drinking water supply, especially water supply in cities of Kerala began before the formation of the state. The first organized water supply scheme was started in the Thiruvananthapuram district and was named the Trivandrum water supply scheme; the scheme was launched in 1933, in Karama River and was designed to cover an area of 11.22 square miles in town which benefited 1.35 lakh of the city population. The total capital cost of this scheme was Rs57 lakh (Suprabha, 2016).

Secondly, an in1934 Ernakulum water supply scheme was implemented in the Periyar River. It was a small scheme that provided water supply to the Ernakulum town only, at an estimated total cost of Rs 152 lakh. This was followed by the Alleppy water supply scheme, which was commissioned in 1939, in the Travancore region. Later in 1953, the Kozhikode water supply scheme was implemented in the Malabar region. The total capital cost of the scheme was 3.50 lakh. The picture shows that implementing water supply schemes were minor and on a small scale during that period.

The area of provision of potable water supply services in Kerala became as serious a concern even during the five-year plans. Firstly, the water supply progress was already made in the implementation of the above urban water supply schemes in the state. These total schemes were covering about 6 lakhs of the urban population in Kerala (Suprabha, 2016).

In 1954, the government of India announced the national water supply programme and made provisions to assist the states in the implementation of their urban and rural water supply schemes. The state governments were asked to set up their public health engineering departments to build up a system. Following this, PHED was formed in 1956. This department was functioned well in water supply services in the state till KWA replaced PHED.

3.4.2 Growth Trend of Water Supply Services in Kerala

The Social service sector plays for the welfare of the people. Water supply is one of the basic social needs. Water supply service is under state control and the majority of household highly depends on the government for a wide range of this service. Public services are the responsibility of each government. A huge investment is necessary for successful implementation of these services. The constitutional provision enables both, the Centre and state,both has to perform a crucial role in planning, managing and financing water supply in the state. So the government takes a primary initiative for the growth and development of public water supply and for providing fund through five-year plans and budget allocation.

3.4.2.1 Water Supply and Five Year Plans in Kerala

In our state, the story of the public water supply mechanism begins with a five-year plan onwards, except for the above mentioned small and local based schemes. The social service sector includes the water supply; which plays very importance as safe water is one of the very basic needs of the society. So every five-year plan gives importance to the drinking water supply in the state. The following table shows the state government's share of plan outlay for water supply and sanitation in every planning period. The first five-year plan has no role in water supply services in the state.

Table 3.12: Plan Outlay on Water Supply & Sanitation under Different Five Year Plans in Kerala (Rsin Lakh)

Plan period	Total plan outlay	Outlay on social services	Percentage share of outlay on social service to total plan outlay	Outlay on water supply &sanitation	Percentage share of outlay on water supply &sanitation to outlay on social services
First five year plan (1951-56)	-	-	-	-	-
Second five year plan (1956-61)	8700	2494	28.67	200	8.02
Third five year plan (1961-66)	17000	3826	22.51	480	12.55
Annual plan(1966-69)	14437	2543	17.61	-	-
Fourth five year plan(1969-74)	25840	5863	22.69	1225	20.89
Fifth five year plan(1974-79)	56890	12159	21.37	3642	29.95
Annual plan(1978-80)	42870	23619	55.09	-	-
Sixth five year plan(1980-85)	155040	29359	18.94	7905	26.93
Seventh five year plan(1985-90)	210000	40975	19.51	10890	26.58
Annual plan(1990-92)	143520	28260	19.69	-	-
Eight five year plan(1992-97)	546000	107718	19.73	39190	36.38
Ninth five year plan(1997-02)	1610000	286374	17.79	103200	36.04
Tenth five year plan(2002-07)	2400000	436045	18.17	115900	26.58
Eleventh five year plan(2007-12)	4042200	969214	23.98	250303	25.83
Twelfth five year plan(2012-17)	10200000	3320700	32.56	465600	14.02

Source: Five year plan draft outlines,State Planning Board, TVM,Government of Kerala.

A first glance at the table shows a totally low share of plan outlay on water supply and sanitation. However, the total plan outlay is increasing with every plan period. But the percentage share of social service outlay shows upswings and downswings in all plans. Out of the total plan outlay on the social service sector, the share of water supply and sanitation was also showing upswings and downswings. Plan outlay on water supply began to increase during 4^{th} plan onwards. The government of India's fund allocations and minimum needs programme have been a top priority in the 5^{th} plan, leading to anincrease in the plan outlay. 2^{nd} to 5^{th} plan outlay proposed to implement rural water supply schemes. The planned programme was diverted to rural areas from urban during the 6^{th} plan onwards. To achieve the target set for the international water decade programme, the state government gives high priority to drinking water and also increased the plan outlay during the 6^{th}, 7^{th}, 8^{th} and 9^{th} plans. But in the 10^{th}, 11^{th} and 12^{th} plan outlay shows is continuous declined.

3.4.2.2 Urban Water Supply and Five Year Plan

In Kerala, the public water supply mechanism started from the **Second five-year plan** onwards. In 1956, the state public health engineering department was implemented and started water supply service at the state level. The department was responsible for planning, designing, implementing and managing water-related activities in the whole state. But the agency mainly concentrated on urban water supply services and neglected rural water supply. During this plan, the five water supply schemes were implemented and supplied water to Thrissur, Ernakulum, Kollam, Kottayam and Palakkad towns only. However, the urban water supply work progress was very low in that period. National Water Supply and Sanitation Committee (1961) pointed out that Kerala has a very low rank in respect of urban water supply at the end of the second plan. At the time, only 24 per cent of the urban population got adequate water supply with 18 per cent having inadequate supply and 58 per cent with no water supply (Second Plan Document, 1961).

Beginning of large size of water supply schemes in urban areas started during the **Third five-year plan** onwards. The plan proposed a total provision of Rs 909 lakhs in these urban schemes with a targeted of 900 thousand of the population. The **Fourth five-year plan** gives importance to the provision of water supply services in the state. Here commendable progress was achieved, especially in the urban water supply. This is because of institutional financing from the likes LIC. These related spillover schemes were taken up and completed during this plan period and also implemented new schemes. The plan provides 921 lacks for extended urban water supply.

In the **Fifth Plan,** approximately65 per cent of the urban populations benefited from water supply facilities in the state and extended water supply in more towns. The **Sixth plan** declared the international decade for the drinking water supply programme. The objective of the programmewas 100 per cent coverage of urban areas under the water supply schemes. This helped inacquiring World Bank huge assistance and support in implementing water supply schemes. The total outlay for urban water supply schemes in the plan was Rs 4702 lakh. Based on the international decade, the drinking water programme followed and the **seventh five-year plan** placed great support on the development of water supply services. This plan provides an outlay of Rs 3128 lakhs for urban water supply extension to the state (Plan Outlay and Expenditure Kerala, 2010).

During the **Eight Plan,** a new democratic initiative happened in Kerala. The decentralization began to get involved in the activities of local government institutions and people in the society, more vigorously. This also helped to develop the huge financial implementation of municipalities and corporations and more water supply projects were explored. This was helpful to about 5.07 lakh houses to get piped water supply connections and 32 lakh of people benefited from water supply service in the plan. The plan faces great stress when more population and areas were covered underwater service.

The **Ninth Plan** concentrated on universal coverage of drinking water supply in adequate quantity and better quality on a sustainable basis in both rural and urban areas. The plan also proposed to increase the LPCD consumption level to 150 LPCD from 70 LPCD in the urban water supply in Kerala. In the plan, 35-40 per cent of the total plan (development) funds would be devolved to the local government for its performance in the state.

The **Tenth five-year plan** provides an outlay of Rs 2430 lakhs for urban water supply services with importance in providing rehabilitation work like replacement of pipelines, pumps and motors, improvement to the treatment plants, electrical installations activities etc.(Plan outlay and expenditure Kerala,2008)Coverage was an important agenda during this plan. The period benefited an additional 50 lakh of the population with a 200LPCD supply of water. In the plan period, the government of India introduced a flagship programme on JNNRUM, which had a great influence on urban water supply. The functional and financial positions of ULBs become highly effective in the plan.

The **Eleventh plan** redefined the picture of water use in the state in an effective, productive and technological manner. The plan is mainly concentrated to achieve quality and sustainable water resources, especially in urban areas. The plan proposed a 25 per cent plan outlay used for water supply sewerage development of the state.

The **Twelfth plan** gives importance to the availability of households drinking water supply and in implementing different schemes in the state. The plan proposed to increase the household's piped water supply quantity norms of 70LPCD from the existing 40 LPCD in the state. The plan highlights the area of improvement in the water quality and quantity, service equity and financial sustainability to the urban poor.

The approach to the **Thirteenth five-year** plan is to ensure drinking water supply to the entire population, give special focus on drinking water supply for scarce urban areas, pay special attention to protecting wells and take appropriate measures to diminish distributional loss (Economic Review, 2017). The plan focuses on 100 per cent of the population coverage of water supply with a target of the norms of 100 LPCD for rural areas and 150 LPCD for urban areas. The plan should focus on the landmark policy shift from a supply-driven centralized approach to a demand-driven –community-led approach and redefines the role of local bodies, maintaining the sustainability of such schemes.

The five-year plans provide a solid financial foundation for the expansion of public water supply services in the state as well as strong background support for implementing various water supply schemes.

3.4.2.3 StateBudget Allocation for Public Water Supply

Generally central, state and local governments devote a major part of their budget to attaining public services. The state government provided funds in the state budgets. The following table explains the state government budget allocation for public water supply and sanitation in the state.

Table 3.13: State Budget for Water Supply (Rs in lakh)

Year	Total social service	Water supply and sanitation	% in water supply &sanitation in total social service	Water supply	% of water supply in water supply & sanitation
2000-01	457500	16315	3.57	15423	94.53
2001-02	473520	13187	2.78	12393	93.98
2002-03	512170	19527	3.81	17818	91.25
2003-04	536743	23030	4.29	21111	91.67
2004-05	596929	26277	4.40	24336	92.61
2005-06	602930	22463	3.73	20395	90.79
2006-07	659450	24152	3.66	21719	89.93

2007-08	792441	21077	2.66	19328	91.70
2008-09	936284	27478	2.93	25583	93.10
2009-10	1083078	55700	5.14	48509	87.09
2010-11	1259003	50223	3.99	44974	89.55
2011-12	1681874	47386	2.82	42050	88.74
2012-13	1943938	62703	3.23	56838	90.65
2013-14	2159700	64211	2.97	59005	91.89
2014-15	2459337	74912	3.04	69271	92.47
2015-16	2863832	105269	3.68	98550	93.62
2016-17	3505740	114482	3.27	104706	91.46
2017-18	3832833	112322	2.93	99923	88.96
2018-19	4144909	149373	3.60	118192	79.13

Source: RBI, Hand book of statistics on state government finance, Government of India& Kerala budget, Ministry of Finance, Government of Kerala

The above 18 year's budget analysis explains state budget allocations for social services.It shows an increasing trend over the years. But the share of budget outlay on water supply and sanitation are very low and average 3.5 per cent only in all years. This trend share also shows upswing and downswing from year to year. Out of the total state budget allocation for both water supply and sanitation, the major share allocates for water supply services. Average of above 90 per cent of budget funds are utilized for water supply in all years. However, the trend share of water supply is also upswing and downswing year to year with recent shows it declining.

The State government's financial support through five-year plans and budget allocation is very supportive in the successful implementation of public water supply services in the state.

3.4.3 Drinking Water Supply System in Kerala

Kerala's drinking water system can be broadly divided into three types. The first one is the schemes owned and operated by the state government via, KWA and local government. The second one is water supply through externally aided projects by different organizations like JBIC, ADB and World Bank. The third one is, family managed drinking water supply in which individual families constructing their wells on their compound and managing the water supply resources by themselves (12th Five-Year Plan Document, 2012).

KWA is the primary drinking water supplier in the state and performs a well-established network for the distribution of drinking water. KWA established by the government of Kerala on 1 April 1984 replacing PHED.KWA was formed under the Kerala water supply and wastewater ordinance 1984. The ordinance was replaced by the Kerala water supply and sewerage act of 1986. In the background, KWA established as an autonomous body for the development and regulation of water supply and wastewater collection and disposal in the whole state (Administrative Report, 2018-19). KWA performs in water supply, for design, preparation, implementation, promotion, operation, maintenance and financing of water supply schemes and extending the protected water supply coverage in the state. It is performing as the largest drinking water supplier and it covers 94 per cent of the total piped water supply in Kerala.

KWA is a nodal agency for implementing water supply schemes in the state. KWA implemented water supply schemes for efficient water supply with the assistance of the central government. Domestic water supply is a fundamental requirement for human life. In natural cases, limited safe water is used as a priority for drinking and domestic uses. Generally, water supply schemes are designed and implemented for use of domestic purposes.

3.4.3.1 Water Supply Schemes Operations in Kerala

Drinking water supply schemes were initiated in the state before the official formation of the state. But it were more popularized and structurally implemented at the time of five-year plans. Each Water supply scheme aims to ensure 100 per cent access to drinking water for the beneficiaries. These initiatives help a major portion of people by benefiting from water availability and protecting them from water shortage issues.Kerala's water supply schemes are divided into rural and urban schemes.

Table 3.14: Operations of Water Supply Schemes by KWA (in Percent)

Year	Rural	Urban	Total
1970-75	112.57	1.03	80.98
1975-80	11.13	6.37	10.94
1980-85	10.68	0.75	10.38
1985-90	-1.34	-0.74	-1.33
1990-95	-1.86	-0.77	-1.83
1995-00	2.46	3.84	2.65
2000-05	-0.28	4.74	-0.13
2005-10	2.52	1.13	2.47
2010-15	-12.71	-8.85	-12.49
2015-20	-5.76	19.5	1.37
2020-22	-9.09	-6.52	1.832

Source: Economic Review, State Planning Board,TVM, Government of Kerala.

The analysis table explains the compound annual growth rate of 50 yearlong of water supply schemes by the KWA.Keralawitnessed substantial progress in water supply services from 1970sonwards. This progress was achieved also with the help of institutional financing like LIC of India. LIC provides liberal credit supply from that time for water supply.In 1972-73, ARWSP (Accelerated Rural Water Supply Programme) programme was introduced to provide funds and technical assistance to rural water supply with great support and contributed commendable progress to the rural water supply in the period. This trend changed in mid of the 1970s and the concentration was shifted to urban water supply services.

In the 1980s, the international drinking water supply and sanitation decade programme was launched, which aims to provide the target of 100 per cent coverage of water supply services. This scheme was supported to help accumulating substantial loan inflow from external agencies like World Bank (IBRD) and bilateral agencies and multi-lateral agencies etc. Open good schemes in rural areas were also popular in the period. In 1983, the state faced unexpected drought conditions. But the situation was effectively handled by improvements made in the existing water supply schemes. The efforts benefited about 40 lacks of people (Economic Review, 1984). The implementation of PHED in 1984 was also helpful in the formulation of large schemes with bilateral and World Bank assistance. All these led to the progress of water supply schemes in1980s. But in mid of the 1980s, the trend reversed and the growth trend of water supply schemes become negative. This is because of the low state plan fund.

In the mid of 1990s, Kerala witnessed a new decentralized democratic movement. This movement is helping to the improvement of water supply services since 1995, particularly in urban areas. Implementation of the centrally sponsored AUWSP in March 1994 helped to bring commendable progress in urban water supply growth. It helps to extend financial and technical support to urban supply schemes in the state. The table analyses the point that the major share of water supply service growth, contributed to rural areas earlier and this trend changed after decentralization in Kerala. The concentration piped water supply services rural areas were shiftedto urban areas after decentralization.

The table analyzes the overall performance of water supply schemes which are very low in Kerala. Generally observation is that the huge cost involved in water supply scheme's operation and maintenance is the main reason behind this. The planned fund is the major source of finance for the implementation of the water supply schemes in the state. But, the utilization pattern of the plan fund is very low in the sector. Hence, the implementation of the schemes as such are delayed (Economic Review, 2017). Seasonality in water availability is also an important reason for the problem of water supply.

2018 flood also contributed to the low and negative progress of water supply services in Kerala. After the flood, it was reported that 108 urban and 372 rural schemes under KWA were damaged and an estimated 58 percent reduction in KWA s daily production. It affected approximately 50 percent to 60 percent of piped water users (20 percent of the state population) in Kerala (Economic Review, 2018). However, the recent year shows the positive growth movement of total water supply services and the high growth of urban water supply services in Kerala. This is because the recently implemented new projects under KIIFB, AMRUT, NABARD, and the state plan helped to push extending finance and water supply services.

Huge capital investment is needed for the implementation of the water supply schemes. Finance for the water supply schemes has mobilized in the form of domestic funds (Grants, Loans, Own funds), national funds (Grants, Loans) and international funds (Grants, Loans). To extend the state water supply, KWA was implementing various schemes with loan assistance from various funding agencies like LIC, HUDCO, NABARD, JICA, SAARK etc. In addition to centrally sponsored schemes like ARWSP, TECHNOLOGY MISSION, RGNDWM, AUWSP, JNNURM, UIDSSMT, UWSS special package scheme and state fund schemes are performing well in the state.

3.4.3.2 Financial Performance of Water Supply Services

In Kerala, at the time of independence, local bodies metthe share of finance needed for the implementation of water supply schemes.Firstly state government met by entire expenditure of water supply schemes. Then, on the completion of those schemes 50 per cent of the cost was treated as a loan to provide local bodies and 50 per cent was granted in aid fromcentral assistance. But now local bodies are not responsible to meet the capital expenditure for water schemes (Approach Paper of 13th Five-Year Plan, 2017).

In the beginning, state fund played the dominant source for investing in water supply services in the state. The state government is the owner of the total water supply mechanism. However central government played an important role in the form of grants, loans and technical assistance to water supply services. Now, Central and state governments are following equal funding patterns in water supply schemes in the state. Considerable progress was achieved in water supply when institutional financing like LIC started to fund the water supply schemes. The LIC-assisted water supply schemes started in the state in 1967-68.

3.4.3.2. a) Internal Assistance For Water Supply

Table 3.15: Major Internal Financial Sources for Water Supply

Year	LIC			Government of India
	Rural	Urban	Total	
1968-69	0	44	44	-
1969-70	0	8	8	-
1970-71	50	253.4	303.4	-
1971-72	0	407.98	407.98	-
1972-73	70	394.2	464.2	-
1973-74	0	476.6	476.6	-
1974-75	107.37	455.8	563.17	-
1975-76	0	189	189	-
1976-77	37.27	435.39	472.66	-
1977-78	0	38	38	102
1978-79	570.50	514.77	1085.27	277.14
1979-80	415.22	582.82	998.04	324.06
1980-81	0	116	116	323.38
1981-82	86.7	67	153.7	576.16
1982-83	190	110	300	695.96
1983-84	241.05	30	271.05	1728.94
1984-85	147	280	427	1502.01

Source: Kerala Water Authority, Flow of Finance to Various Issues, Jalabhaven,TVM,Government of Kerala

Rs 44 lakh LIC loan was released for the first time allocated in 1968-69 for urban water supply schemes. In the 1970s and the first half of the1980s, the LIC of India acted as a major donor for water supply in the state and it provided liberal loan assistance to water supply with a low-interest rate. This helped to achievecommendable progress in the water supply services in Kerala. Initially, LIC was paying more credit to urban supply schemes, where demandwater supply was high. But after in the 1980s, the tendency changed and more LIC loans were credited to rural supply in the state. The liberal credit policy of the LIC is giving a big push to the water supply system in Kerala.

The government of India's major intervention in water supply started when ARWSP was launched in 1972-73 for assistance to rural water supply. The government started to fund grants for the implementation of water supply schemes in 1977-78, through ARWSP schemes. Government of India It was providing Rs 102 Lakhs in the initial stage. Later, this trend of fund flows increased over the years.

3.4.3.2. b) External Assistance For Water Supply

In the background of the international drinking water programin the 1980s, the government of Kerala receives support from outside financial sources for water supply. This program help the to state receive substantial loan assistance from different funding agencies since mid of the 1980s. The popular funding agencies are the multi-lateral agency like World Bank (IBRD), and bilateral agencies like the Netherlands government, the Danish government, Japan etc. LIC of India also performs as a major financial supporter to both rural and urban water supply in the period. Income from the sale of water also started to contribute a major share of the financial growth of water supply services in the period. From beginning of the 1990s onwards, government of Kerala is raising its provision of plan and non-plan funds.

Table 3.16: Major External and Other Financial Sources for Water Supply

Year	External source			LIC funds			Revenue from water	Govt of India fund	State government fund
	World bank	Netherland	Danida	Rural	Urban	Total			
1985-86	-	781.3	-	156.87	403	559.87	1512.75	1085	-
1986-87	8.4	263.23	140	315.38	304.62	620	1400.37	1213	-
1987-88	217.7	739.45	371	803.1	57.9	861	1657.61	1398.32	-
1988-89	473.9	142.39	315	140	807	947	1699.36	920.75	-
1989-90	435.33	136.11	163	12	988	1000	2109.72	944	-
1990-91	0	543.06	170	1122.59	224.41	1347	2197.29	1076	-
1991-92	1527	227.03	300	629.33	370.67	1000	2221.44	1191	9462.94
1992-93	601.55	380.62	120	888.81	687.19	1576	3066.08	1217	10864.7
1993-94	1454.1	760.68	748	856.31	949.69	1806	3890.90	2127	12568.03
1994-95	0	496.41	500	-	-	-	4386.45	2819	12563.24

Source: 1) Kerala Water Authority, Flow of Finance to Various Issues, Jalabhaven, TVM & Economic Review, State Planning Board,TVM,Government of Kerala.

The World Bank is the primary multi-lateral agency and continues to provide above 10 years for external assistance in the water sector. In the beginning, the World Bank assisted 17 rural and 4 urban water supply schemes. At the end of the 1980s, World Bank assisted 7 urban schemes and it benefited 16.06 lakhs of the population toaccess water supply. The Netherlands government started its credit flow in 1985-86 to assist the state government with 3 water supply schemes.

At the beginning of the 1990s Netherlands government assisted 8 water supply schemes and which benefited the water supply to 17.2 lacks of the population. The government of Kerala received assistance from the Danish government for the first time in 1986-87 for 5 water supply schemes. At the beginning of the 1990s, the Danish government assisted 3 water supply schemes and it benefited 7.39 lakh of the population in the state. These external funding institutions are well performing and acting as major donors of the water supply services in mid of the 1990s in Kerala.

LIC of India is performing well and its credit flow is increasing over the period. Also, the Government of India's financial assistance is showing an increasing trend. This is because, in 1986, ARWSP programs changed to a mission approach with increased financial and technical assistance to rural water services. This mission approach was renamed as Rajiv Gandhi National Drinking Water Mission in 1991-92. Aim of this mission is to provide adequate safe water for domestic purposes to every rural household. This helps to increase the rural supply coverage.

3.4.3.2 c) Multiple Financial Sources for Water Supply

The government of Kerala utilizes the major source of funds as its plan and non-plan fund, revenue collected from the supply of water, various grants from the government of India and loans from LIC of India, HUDCO and local bodies fund for the implementation of water supply schemes after decentralization. These initiatives help to extend the financial and technical support to the state government. The 74th amendment related to the local government actively involved both financial and technical support to the state government for water service. This is reflected in increasing fund flows and participation by local government, national and international agencies to state water supply. HUDCO is also very active in supporting the sector.

Table 3.17: Multiple Financial Sources of Water Supply

Year	Revenue from water	State government fund (plan + non plan fund)	Loan from LIC/HUDCO	Govt of India fund	Deposit from local bodies	Others
1995-96	4821.59	14074.88	3088	2469	-	-
1996-97	5814	14537	2560	2414	-	-
1997-98	6697	20256	4055	4071	-	-
1998-99	6954	17788	3953	4942	-	-
1999-00	9180	20694	3621	3668	-	-
2000-01	11679	16240	2777	3846	-	304
2001-02	12150	15885	100	5565	-	299
2002-03	10580	16586	5029	6204	-	302
2003-04	11512	15862	1000	4341	375	375
2004-05	11523	17247	300	5885	385	385
2005-06	14937	25499	4431	6170	395	395
2006-07	13839.09	32642	3046.13	6527	829	1113
2007-08	16954	80729	2836	8972	951	-
2008-09	23890	56520.6	-	12474	1225.81	-
2009-10	29261.84	83453.66	660.48	15447.08	598.37	7041.86
2010-11	31898.47	57524.8	689.75	14876.64	678.46	579
2011-12	32003.15	65977.9	77.52	12446.43	1260	1922.16
2012-13	32839.74	80419.79	77.77	24903.58	5531.37	3217.14
2013-14	38711.82	71365.9	-	21204.01	9174.40	600
2014-15	40297.23	51750.07	683.65	11512.03	9595.81	1100
2015-16	45911.00	79089.93	213.50	5702.99	-	800

Source: Economic Review, State Planning Board, TVM, Government of Kerala.

Generally, the table observes that fund flows of revenue from the sale of water, grants from the government of India and local government deposit shares are increasing for long periods and contributing major financial source for protecting water supply services. The state government’s plan and the non-plan fund is also the major source of finance, but the fund flow is showing upswing and downswing at all periods. The influence of the institutional financing like LIC and HUDCO credit flow is decreasing after decentralization.

Revenue from the sale of water depends on the water rate. The government of Kerala is revising the existing slabs frequently and then increasing the income from distributing water. The government of India's financial support is also increasing. It started in 1993-94 when AUWSP was launched in urban areas. It helps to improve the financial support to state government and local bodies to provide water supply facilities in towns. The government of India launched JNNURM in 2005 for direct investment in infrastructure development and improving service delivery to the whole city, especially for the urban poor. Another programmeUIDSSMT was launched for 100 per cent water supply accessibility to the entire urban population at the end of 2012. After decentralization, local governments is highly involved in water supply services and areearning high income.

The above financial assistance by both state and central government is contributing to establish a large number of water supply schemes and extended drinking water supply coverage in the whole state.

3.4.3.3 Population Covered by Water Supply Schemes

In Kerala, water supply service was popular since 4th five-year plan. At the end of the 4th plan1.40 million urban and 5.00 million rural populations are covered by water supply schemes respectively in Kerala. At the beginning of the 1970s, 9 districts namely, Thiruvananthapuram, Kollam, Alappuzha, Kottayam, Ernakulum, Thrissur, Palakkad, Kozhikode, and Kannur were only involved and enjoyed water supply services in the state. The service was extended to Malappuram district in 1973. In 1975, extended water supply services in the Idukki district.

At the time, water supply schemes were implemented in almost all municipal towns in Kerala. That is, in the mid-1970s protected water supply services incovered 19 towns and it wasincreasto 31 towns by the end of the 1970s. Here, substantial progress has been achieved in urban water supply services in Kerala. At beginning1980s the water supply services was extended to 33 towns and it benefited 70 per cent of urban populations. During that period,implementiondrinking water supply and sanitation programmewere mostly attained with external funding through international water supply schemes. Also, LIC of India became a major financial contributor in urban water schemes. These lead to the extended implementation of urban water supply schemes and extended the piped urban water supply coverage. In the mid of 1980s, the water supply services were extended and implemented in whole (14 districts) districts in Kerala. At the end of the 1980s, the urban water supply coverage increased in 35 towns in the state and benefited 32 lacks of urban people. Through the concerted efforts during the last 40 years about 35 per cent of the rural population and 70 per cent of the urban population came under protected water supply in Kerala (Economic Review, 1990).

Table 3.18: Population Coverage of KWA Water Supply Schemes (in Percent)

Year	Rural	Urban	Total
1990-95	5.77	2.26	4.47
1995-00	3.53	1.43	2.82
2000-05	3.65	3.18	3.50
2005-10	2.24	0.52	1.70
2010-15	-11.12	-12.15	-11.42
2015-20	10.20	-11.19	4.52
2020-22	1.24	0.43	1.61

Source: Economic Review, State Planning Board, TVM, Government of Kerala

The table explains the compound annual growth trend of population coverage of piped water supply services in both rural and urban areas after the 1990s.In the mid-1990s, water service extended to a total of 106 towns and 90 per cent of the population, coveringthe three city regions of Thiruvananthapuram, Kozhikode and Kochi. Generally, the trend in the growth of water supply is low and declining in nature and it became negative recently. The 1990s shows, low growth of water supply services in both rural and urban areas. The second half of the 1990s also worsened the situation further.

To extend financial support to the state government, while implementing AUWSP in 1993-94 in decentralized Kerala depends on improving the water supply and which leads to extending the water supply coverage, particularly in urban areas. But this trend began to decline and it became negative after 2005. This is because decrease in the implementation of water supply schemes in the period, where almost all schemes suffer for long periods and most of them cost over runes. The major source of excess cost is met by low plan funds in the state. In Kerala, the flood also damaged water supply systems and it reduced the availability and accessibility of water service to the population, particularly in urban areas. Thatis why, more schemes are implemented in urban areas, recently.

Table 3.19: Percentage Share of Population Covered By KWA Water Supply Schemes

Year	Rural Population	Urban Population	Total Population
1989-90	-	-	-
1994-95	42	67	NA
1999-00	51	69	NA
2004-05	62.24	82.59	67.52
2009-10	68.55	84.8	72.17
2014-15	60.17	26.32	44.2
2018-19	52.10	70.33	56.38
2019-20	54.11	75.60	58.42
2020-21	59.48	79.28	63.98
2012-22	62.15	79.62	66.26

Source: Economic Review, State Planning Board, TVM, Government of Kerala.

The table explains the picture of the overall population covered by piped water supply in Kerala. This shows more than half of the population depends on the state water supply. The remaining populations depend on other sources such as rainwater harvesting, groundwater sources like open wells, drug wells etc. And surface water sources like ponds, lakes, natural streams etc. People mainly depend on well for their drinking water purpose, especially in rural areas. So this state water supply is highly demanded by urban peoples and a major share benefited them.

The above analysis clearlyexplained the growth progress of water supply services in the state. KWA is implementing various water supply schemes with the close collaboration of central government financial assistance. Thisgood financial support is contributing to the progress inwater supply schemes. Then water supply schemes are extended to whole areas and a major half portion of the total population is covered by public water supply in the state.

3.4.4 Present Condition of Water Supply Services in the State

Generally, the Kerala state water supply service provisions involved are the following:

1. State government through KWA may plan and implement water supply schemes in both rural and urban areas and manage the water distributing network forwhole Kerala.

2. Local government may plan and implement small water supply schemes in both rural and urban areas out of their resources (plan fund). However, KWA must have a major involvement in this aspect.

3. Central and state-sponsored external aided water supply schemes implemented through KWA or local government. (DWSS report, 2018)

Today, the three main agencies KWA, KRWSA and local bodies are performing to provide water services in the state. These three agencies are involved in planning, implementing, distributing and managing total water supply services in the whole state.

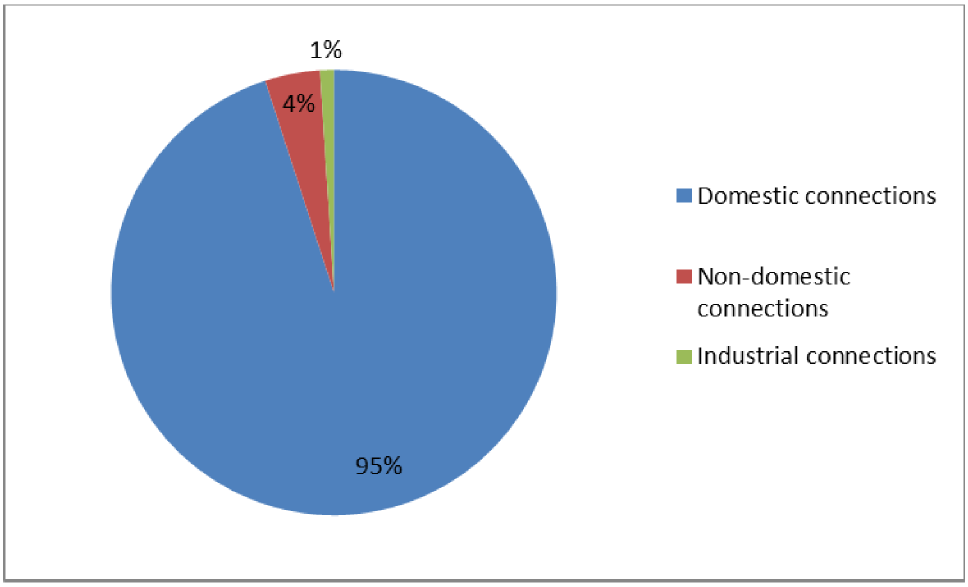
Today, KWA operates 928 water supply schemes, benefiting a population of 2.36 crore (Economic Review, 2021). The average per capita availability of piped water is 84.76 litres per day. 27 schemes were commissioned for water supply services in the year. Now 63.98 per cent of the total population is covered, of which 59.48 per cent is in the rural population and 79.28 per cent is in an urban population in piped water supply in the state

(Economic Review, 2021). New water supply projects were sanctioned under KIIFB and AMRUT for covering water supply to uncovered areas. The other schemes like JJM, NABARD, NRDWP, state plan etc. are implemented with the help of central and state government assistance and are bringing remarkable progress in rural and urban water supply sectors in the state in recent years.

3.4.4.1 Water Supply Connections

Generally, KWA provides water service connections to the beneficiaries for fulfilling their 1) domestic activities like drinking, cooking, washing, bathing and sanitation purpose etc. 2)non-domestic activities like cleaning, cultivation etc.3) small-scale industrial purposes etc.

Figure 3.2: Total Water Connections



Source:Economic Review, State Planning Board, TVM, Government of Kerala.

In total connections, public water is being utilized for domestic purposes by large sections of the people. Out of KWA's total service connections a large number if connections are meant for the domestic sector. The share of Non-domestic connections is very low and industrial connections very negligible. The domestic sector is the dominant sector to access water connections and it depends on the trend of service connections increasing in the state.

Generally, KWA distributes water through house service connections and street taps. Today, KWA maintained 33.71 lakh house connections and 2 lakh public taps in Kerala (Economic Review,2021)

3.4.4.1. a) House Service Connections in Kerala

Table 3.20: Water Supply House Service Connections in Kerala (in Percent)

year	Domestic connections	Non-domestic connections	Industrial connections	Total connections
1995-00	4.75	-	-	-
2000-05	6.26	2.07	-11.80	26.48
2005-10	5.21	5.81	2.42	5.25
2010-15	7.19	3.80	6.63	6.99
2015-20	6.86	8.56	8.19	6.98
2020-22	19.18	8.58	0.04	18.95

Source: Economic Review, State Planning Board,TVM, Government of Kerala.

The table explains KWA has implemented the water supply service connection to various sectors. The average annual growth trend shows that the growth of all service connections is increasing. In the mid of 1990s, KWA implemented domestic services only. KWA is extending its water services to non-domestic and industrial activities since 2000 only. This reflected the high growth of total water service connection in 2000-05.

3.4.4.1. b) Street tap connections in Kerala

Traditionally street tap connections are popular in the state. But recent years show a decreasingtrend Street taps supply connections.

Table 3.21: Street Tap Connections in Kerala(in percent)

Year	Rural	Urban	Total
1995-00	-	-	5.15
2000-05	4.55	-0.95	4.71
2005-10	2.91	0.67	2.45
2010-15	-0.67	1.97	-0.09
2015-20	-1.49	0.89	-0.86
2020-22	-4.47	-5.04	-4.60

Source: Economic Review, State Planning Board, TVM, Government of Kerala

The table explains the average annual growth trend of street tap connections in Kerala. In the initial stage, the major share of street tap connections has been implemented in rural areas compared to urban areas. In the mid-1990s the total street tap connections is 5.15. The growth trend of street tap connections is declining and recently it became negative. Firstly, the major street tap connections have been demanded by rural people. Later, this trend has changed over the year. In recent times more connections are demanded by urban people.

The interesting point is that there is a co-existing relationship between both house service connections and street tap connections in the state water supply. It means an increasing trend of house service connections leads to decreasing trend of street tap connections. Presently the beneficiaries are more in demand of its house service connections in place of traditional street tap connections.

3.4.4.2 Income from Water Connections(Water rates)

One of the major sources of income for KWA comes from the water rate. Water rate helps to control water misuse and protect the scarce resource in a better way. Only the Kerala state followed the 100 per cent of metered water connections in India and followed the block tariff structure. The state government is implementing the existing slab rate for charging water rate and equitable access to water for all at a fair price.

In Kerala, the first step of implementing water charges was, to introduce a provisional invoice card (Pic) system at Thiruvananthapuram in 1988(Economic Review, 2002). The Kerala government implemented the first and new tariff structure for the entire state in 1991. The minimum charge was Rs 10 per KL up to 10000 litres per month. Secondly, the water tariff was revised after a long period in 1999. No revision of tariff occurred in the next ten years. The later tariff was revised in 2008. After the revision in 2008, the tariff was revised only six years back in 2014. Now, the existing new tariff rate is revised in 2016.

Table 3.22: Income from Water Schemes

Year	Rural Schemes	Urban Schemes	Total Schemes
1999-03	8.67	11.93	10.73
2003-07	4.91	6.92	6.20
2007-11	42.60	30.55	34.73
2011-15	-10.26	3.29	-3.22
2015-19	11.93	10.79	11.26

Source: Economic Review, State Planning Board, TVM, Government of Kerala

The table explains how the updated tariff rate, which is based on water revenue, has increased annually on a compound basis. At first, water rate was quite low, and the state only received negligibleincome from water. Following the modification of the tariff in 1999, the state earns more income from street tap connections and water supply service connections (domestic, non-domestic, and industrial). Later, as the entire cost of water delivery (production costs, operations and maintenance costs) which have been rising over time as well as the lack of yearly tariff adjustments and the length of time between revisions, the income level has been dropping. The considerable growth in revenue from the water supply in 2008 had a significant impact on updated tariff rates.

In this modification, the state gave BPL families special consideration and was also free to offer a concession. People who used upto 10,000 litres of watereach month were not charged. Additionally, existing connection fees were lowered by 50% (Economic Review, 2008). The water charge's revenue has been significantly reduced and is negative since 2010. This is due to the fact that fewer water supply plans are implemented, particularly in rural areas, and fewer street tap connections are made overall throughout the state. In both 2014 and 2016, revised tariffs increased water revenue from recent water service customers.

3.4.5 LOCAL GOVERNMENT AND WATER SUPPLY

In Kerala, the 73rd and 74th constitutional amendments act in 1994 brought a new era of the decentralized democratic governance system. Kerala is one of the leading states in implementing decentralized reforms. Under decentralized initiatives adopted and followed by Kerala, the local government assumes greater responsibility of managing and delivery of public water supply services. The state government applies decentralized public service delivery approach for the water supply services since 1996 (DWSS Report, 2018). The approach explains that the state government's responsibility for the total water supply is transferred to the local government level. But a small part of water supply schemes were transferred to the local level in the state. On this occasion, the local government is starting to provide water services to residents in the state.

Local government’s involvement in water supply services is in two ways. One is, the local government directly undertakes and manages the water supply schemes and secondly, the water supply schemes are undertaken and managed with the partnership of KWA. This second water supply service system is popular in the state. State water policy 2008 strongly stated that state government shall be shared with the appropriate local government for implementing, managing and maintaining small and medium water supply in the state (State Water Policy, 2008).

Based on the panchayati raj act 1994, in 1998 the government of Kerala decided that KWA should hand over 1050 small water supply schemes to Panchayaths. Then panchayaths undertake total responsibility to implement, operate, maintain, manage and meet all expenses from their funds for these water supply schemes. Then, later all other small schemes were transferred to the local level and KWA concentrated on large schemes.In 2005, KWA handed over small water delivery schemes to the local level in accordance with a 1998 government directive.

Table 3.23: KWA Water Supply Schemes Transferred to Rural Local bodies

Year	Transferred Scheme		Total Schemes	Benefited Population
	KWA transfer 1050 schemes	Other than 1050 schemes		
2005-06	199	172	371	962725
2006-07	199	172	371	962725
2007-08	199	172	371	962725
2008-09	229	223	452	1049070
2009-10	229	223	452	1049070
2010-11	229	223	452	1049070
2011-12	229	223	452	1049070
2012-13	229	223	452	1049070
2013-14	238	239	477	1080560
2014-15	238	239	477	1080560
2015-16	238	239	477	1080560
2016-17	238	239	477	1080560
2017-18	270	315	493	1104176
2018-19	238	243	481	1085560
2019-20	252	249	501	1101160
2020-21	252	315	576	1336362
2021-22	313	385	698	1101160

Source: Economic Review, State Planning Board, TVM, Government of Kerala

The table shows an increasing number of rural water supply schemes transferred to panchayaths and it benefited more rural people over the years. The Kerala flood in 2018 badly affected water supply schemes and operations. Flood also reduce the number of transferred schemes and reduce the number of beneficiaries in the state. The growth progress of the schemes is negligible and only a few schemes have been transferred to local bodies from KWA at present. This is because most of the water supply services are implemented and operated by KWA in the present situation.

In decentralized initiatives in 1999, rural Kerala witnessed a landmark policy shift from a centralized government water supply-driven approach to a decentralized community-led demand-driven approach by providing a greater role for community participation. This policy change brings a new phase of the water supply service mechanism in rural Kerala. Here, established a new relationship between local government and user groups in the implementation of water supply schemes with high participatory involvement of communities. The major implementing agencies KRWSA and local government are ensuring community participation in rural supply schemes by sharing the financial cost. In this approach, the local community takes responsibility for the operation and management of total water supply schemes. The participatory approach is most demandable and popular today. This is because the schemes are fulfilling their local beneficiaries' demands. It means the schemes are focused on specific regions and specific issues and the importance of the community's choices whileperforming in remote rural locations.

Under the municipal act of 1994, municipalities and corporations gotthe legal right to implement, operate and control water supply schemes in urban areas. Section 315 of this act mentions the powers of the Municipal Corporation Concerning Water Supply. Based on this act, state-owned small water supply schemes are transferred to urban local bodies. However; urban local bodies did not make any considerable progress in water supply service in the state. Most of the municipalities or corporations in Kerala depend on the KWA water supply. Local bodies only play a little role to manage and operate this water supply. So KWA plays a vital role inwater supply in the decentralization period also.

On the other side, an important feature of Kerala decentralization is the state government earmarked one–third of its development fund transferred to the local level government for developmental activities. The fund is allocated from the state budget to local government as grants. The finance commission recommended two types of grants, namely basic grants and performance grants are transferred to local levels.

Table 3.24:Grand Transferred to Local Bodies 2015-20(Rs inCrore)

Grants(Kerala)	Rural Local bodies	Urban Local bodies
Basic grant	3615.85	2931.48
Performance grant	401.76	732.87

Source: 14^{th} finance commission, Ministry of Finance, TVM, Government of Kerala.

A substantial share of the grant was received by both rural and urban local bodies in Kerala. The major advantage of this plan grants is the high freedom of local government to use the fund for their developmentalprogrammes. It also helps local bodies generate their financial resources and enjoy stable sources of revenue. It followed many other measures to support the financial health of local government in the state. Generally, this grant is helping to support the strength of delivery of basic services which include water supply.

Amongst all, the local bodies are enjoying a greater degree offiscal autonomy and functions, although the specific fiscal and functional powers are helping positively improve its public service delivery. Then, thedecentralization reforms help to improve the role and increase the waterservice delivery at local levels in the state. In this situation, the urbanlocal government is performing well in water service delivery within its limitedrole in Kerala. The best example is Trissur Corporation's performance of watersupply and its related services.

3.4.6 Water Supply through External Aided Projects

The major external aided agencies like World Bank, JBIC and ADB etc. are also contributing to the public water supply in Kerala state. The state government is implementing water supply schemes with the assistance of these major external agencies.

3.4.6.1 JBIC (Japan Bank of International Co-operation) aided water supply

JBIC currently known as JICA, approved for loan assistance to five water supply schemes in 1996 and it startedgiving loan assistance in September 2003. The total project's estimated cost is Rs1787.45 crore for the implementation of less than five water supply projects. Later the project cost was revised to Rs 2987.40 crore. The duration of theJICA schemes were from 2003 to 2015 and the fund was closed July 2015. Thenfurther expenditure was undertaken in the state plan. The amount of Rs 150crore was allocated for finishing the balance work of the project. The project covered two urban regions and three rural regions. The details are explainedbelow in the table

Table 3.25: JBICaided State Water Supply

Scheme	Treated water plant capacity(mld)	Expected Total population benefited on completion(in lakh)	Benefited area
Trivandrum	74	10.7	Thiruvanathapuram& adjoining 3 Panchayaths
Meenad	71	5.26	Paravoor Municipality & 13 Panchayaths
Cherthala	107	6.53	Cherthala Municipality & 18 Panchayaths
Kozhikode	174	13.03	Kozhikode city &16 Panchayaths
Pattuvam	90	5.3	ThaliparambaMuncipality and 11 Panchayaths

Source: 13th plan approach paper,State Planning Board, TVM,Government of Kerala.

The total production capacity of this project was 516 MLD and it benefited 41 lacks of population for water supply in five districts Thiruvananthapuram, Kollam, Alappuzha, Kozhikode and Kannur.

3.4.6.2 World Bank Assisted Jalanidhi project

At the state level, KRWSA was established in 2000 for the special purpose of implementing the World Bank assisted Jalanidhi project in rural Kerala. This project sought to enhance rural residents' access to high-quality services.Gramapanchayath has a major role in implementing this community-based water supply. jalandhi projects implemented jalanidhi 1 from 2001-08 and jalanidhi 2 from 2011-19 in two phases.

Table 3.26: Phase 1: Water Supply Service Implemented by KRWSA (from 2001-2008)

Year	Scheme	Domestic Connections	Benefited Populations
2001-02	67	-	30168
2002-03	280	41859	-
2003-04	815	56114	-
2004-05	1208	57447	311058
2005-06	2088	110125	752050
2006-07	3159	140185	838477
2007-08	3647	163219	975834
2008-09	3703	168336	1003843
2009-10	3705	169465	1003843

Source: Economic Review, State Planning Board, TVM, Government of Kerala

In the beginning the project were introduced in the four districts Thrissur, Malappuram, Palakkad and Kozhikode. Firstly, the project covered 99 selectedGramapanchayath and completed 67 small water supply schemes benefiting 30168 people for the above four districts. Till the year of 2004-05, the project covered only four districts and implemented 1208 schemes for the supply of water. Since 2006, KRWSA water services is extended and scaled up to cover additional nine districts except Alappuzha. At the end of 2006, the project was spread over 92 Gramapanchayaths in the first four districts and 18 Gramapanchayath in the remaining 9 districts. The first phase implemented 3689 small water supply schemes and 16 large schemes, which benefited 10.03 lakh populations. In the total period, KRWSA is providing 1.7 lakh domestic connections with 175 non-domestic connections and 747 streets tap connections.

Table 3.27: Phase 2: Water Supply Service Implemented by KRWSA (from 2011-2019)

Year	Schemes	Domestic Connections	Benefited populations
2010-11	3710	188221	1109483
2011-12	3710	188221	1109483
2012-13	3710	188221	1109483
2013-14	3859	195928	1163586
2014-15	4150	212106	1163586
2015-16	4772	258439	1365239
2016-17	5072	286649	1489995
2017-18	5506	362019	1598540
2018-19	5877	451818	1756755

Source: Economic Review, State Planning Board, TVM, Government of Kerala.

The 2nd phase of the project is implementing 5877 water supply schemes which benefited 17.5 lakh of rural people. The project has also achieved water supply services in 200 Gramapanchyath in Kerala. Domestic connections of the project increased and it benefited 4.5 lakh of rural households. But non domestic connection and street tap connections are same number as 175 and 747 respectively in the 2ndphase. Here it is important to note that 12 percent of the jalandhi schemes are using its main sources as rain water. This initiative promotes Kerala government activities of rain water harvesting in an efficient way with highly save major water resources in Kerala. In 2018 flood damaged 583 jalanidhi schemes in Kerala (rebuild Kerala initiatives, 2019) and its recovering process is in progress. Jalandhi water supply project is a highly successful community managed rural drinking water supply scheme in Kerala.

3.4.6.3 ADB assisted Tsunami rehabilitation programme (TRP)

ADB provided assistance for restoration of water supply for tsunami affected schemes. Recentlyit provided Rs7087.57 lakhs for 115 schemes in tsunami affected areas covering in Kasaragod, Kannur, Malappuram, Kozhikode, Trissur, Ernakulum, Alappuzha, Kollam and Thiruvananthapuram district in Kerala.

The above analysis shows that decentralized delivery of water service in Kerala state is characterized in hybrid model of delivery. The model explains that the state level agencies like KWA and KRWSA, local government institutions and beneficiary groups together play an important role in the provision of public water supply services in the state. So, the Kerala state used multi service delivery approach in its water supply delivery mechanism and is performing well.

3.5 GOVERNANCE SUPPORT FOR PUBLIC WATER SUPPLY SERVICES IN KERALA

It is a crucial responsibility of government institutions to deliver public services that a society requires to maintain and improve their welfare. The smooth functioning of the water supply service is needed for a good administrative organization with its structured and systematic approach, regulated policy guidelines and various programmes, strong financial system and stakeholder’s participation. Building a governance system is an unavoidable factor for the growth and development of public water supply in the state. Government support is helping to achieve water security, fair allocation and avoiding disputes, regulate mis-utilisation and conserve resources in a good manner.

The prime duty of the state government is to ensure the drinking water supply and its related services in the state. For the smooth functioning of public water supply is support in water acts, water-related policies and programmes are needed. It helps the development of the water supply and regulates utilization and conserves this natural gift. Generally, funds are shared by the central, state and other contributors together.

3.5.1 Water Supply Programmes and Policies in Kerala

The table shows a brief account of the evaluation of water-related policies, and various programmes, various institutions in encouraging and supportin our state water supply growth and development.

Table 3.28: Evaluation of Policies, Programmes and Institutional Support to State Water Supply

Year	Programmes/policies	Main features
1954	National Water Supply and SanitationProgramme(NWSSP)	Central Ministry of Health introduces this programme to assist states in the execution of urban and rural water supply schemes. This gave the priority to operate in water-scarce areas
1956	Launched Public Health Engineering Department (PHED)	Water supply and sanitation work for whole state
1961	National Water Supply and Sanitation Committee (NWSSC)	Aimed at improving the coverage of adequate &safe drinking water to rural population. The agency is performing with technical and financial assistance from the UNICEF.
1972-73	Accelerated Rural Water Supply Programme (ARWSP)	The government of India supports assistance for rural water supply. It is aim at ensuring the minimum availability of 40 litres of water per capita per day to all rural people
1974	Prevent & Control Water Pollution Act	The act gives power to water boards to set standards and regulations for the prevention and control of pollution.
1974-75	Minimum Needs Programme(MNP)	Providing safe water as a basic minimum need with supply drinking water to problem villages.
1981	International D-rinking Water Supply & Sanitation Decade Programme	The target has set by 100 per cent water supply coverage in both rural and urban areas.Loan assistance from world bank and foreign governments
1984	Introduced Kerala Water Supply and Waste Water Ordinance Kerala Water Authority(KWA)	The ordinance based implementing KWA Replaced PHED. Major water supplier in the state. Sole agency for execution and maintenance of water supply schemes and distributing drinking water to the state. Main supporting actor to local government for successful water supply.
1986	Kerala Water Supply and Sewerage Act Technology Mission National Rural Drinking Water	It replaced the water supply and wastewater ordinance 1984.Establishment of KWA an autonomous authority for the development and regulation of water supply and wastewater collection and disposal in the state. It provides power to authorise to state water supply To financial and technical assistance to rural water supply. (ARWSP changed as mission

	Mission	approach) To provide every rural person with available safe drinking water on sustainable basis
1987	First National Water Policy	Planning and development of water resources throughout the country. The priority is the allocation of water for drinking. Other functions are to promote and protect ground and surface water resources, implement proper organizational structure, appropriate water rate fixed.
1991	Rajiv Gandhi National Drinking Water Mission (RGNDWM)	To extend the safe drinking water coverage of rural areas in the whole state. It is an umbrella programme for all rural schemes.
1992	State Water Policy	In line with the national water policy document of 1987, the Government of Kerala announced its first Water policy. To emphasize management of the state water resource and the need to conserve major sources of rainwater in the state.
1993-94	Accelerated Urban Water Supply Programme (AUWSP)	To provide safe and adequate drinking water supply in census towns having populationless than 20000.
1994	The 73rd&74th Amendment	The constitutional amendment makes provision for drinking water supply to assign the responsibility of local government. Implemented Kerala panchyathi raj act in rural water supply and Kerala municipality act in urban water supply
1999	Policy Change in Rural Water Sector Introduced Water Conservation Community Projects	People-oriented, decentralized, demand-driven community-based programmereplaced Government oriented, centralized, supply-driven programme in rural water supply. As the initiatives, the important schemes Jalandhi(2000), Swajaldhara (2002), Jeevadhara (2004),Giridhara (2006) are implementing for Kerala as community participation. The schemes are Harithakeralammission (2016), Jalashree (2010), Jalasouhrudhavidhyalam, Jalasamridhiprogramme, Mazhapolima(2008), Varsha, Jaljeevan mission, Rain water harvesting projects implemented with community participation.
2000	Kerala Rural Water and Sanitation Agency(KRWSA)	Implemented to world bank aided Jalanidhi drinking water project in rural areas.
2002	Second National Water Policy	The revised policy emphasizes an Integrated participatory water resource management system, Greater emphasis on water quality, the Importance develop and practising water conservation methods, Integrated & coordinated development of both surface and groundwater

		resources etc.
2004	Kerala Municipality Building Rules 1999(amended in 2004)	These building rules incorporate provisions for rooftop rainwater harvesting. In the programme, the government launched an awareness and implementation of rainwater harvesting in public buildings, institutions and households.
2005	Urban Infrastructure Development Scheme for Small &Medium Towns (UIDSSMT) Jawaharlal Nehru National Urban Renewal Mission (JNNURM) Bharat Nirman	Improvement of urban infrastructure including water supply in small towns and cities. Improving and providing affordable water supply service to urban poor. The objective is to make water available on 24x7 bases to everyone in cities. It is a rural infrastructure development programme. To existing schemes with increasing coverage of safe water in rural areas.
2008	State Water Policy	It provides the highest priority to domestic use of water, helps to highly transparent water governance and is accepted by the public as large, Efficient water management and conservation, Priority to drinking water assuring water quality etc.
2009	National Rural Drinking Water Programme (NRDWP)	It is a modified ARWSP programme. The Programme formulates guiding policy, sets standards and provides funds and technical assistance to the state's rural water supply. The goal of the programme is to provide every rural person with adequate safe water for drinking and other basic domestic needs on a sustainable basis.
2012	Third National Water Policy	The revised policy emphasizes the need for national water framework law, the policy treated water as an economic good (safe drinking water achieving food security), the importance of benchmarks for water service, emphasized to public-private partnership model with Community participation & Adaption and used most modern appropriate technologies.
2014-15	Atal Mission for Rejuvenation and Urban Transformation(AMRUT)	The central government launched the flagship programme AMRUT and replaced the JNNURM for urban development including water supply.
2019	Jal Jeevan mission	Safe and adequate water through individual household tap connections in all rural Kerala. It aims to give tap water to all households by 2024.

Source: Five year plan documents&Economic Review, State Planning Board, TVM, Government of Kerala.

In Kerala, the municipality acts 1994 empowered urban local government institutions and gives power to perform special features and functions within their boundaries. This act was based onvarious acts like the municipal structures act, municipal system act, municipal finance management act, municipal property rules act and municipal laws etc. building up a strong legal foundation of municipalities/municipal corporations in the Kerala state.

Table 3.29: Important Municipal Acts

Municipal Acts	Features
Municipal Structures Act	It provides for an appropriate division of functions and powers, regulate internal systems, structure and office bears of municipality and make provision of appropriate electoral systems of local level
Municipal System Act	It helps to establish standards and minimum standards for matters assigned to municipalities. Section 4(2) of the act, councils must use municipal resources in the best interests of local communities.
Municipal Finance Management Act	To secure sustainable management of the financial affairs of municipalities by establishing standards and requirements.
Municipal Property Rules Act	It regulates the power of a municipality to value and rate immovable properties located within the boundaries of municipalities.
Municipal by Laws	It regulates the affairs of the services the municipality provides in its areas of jurisdiction.it is the legal foundation for effective service delivery by municipalities.

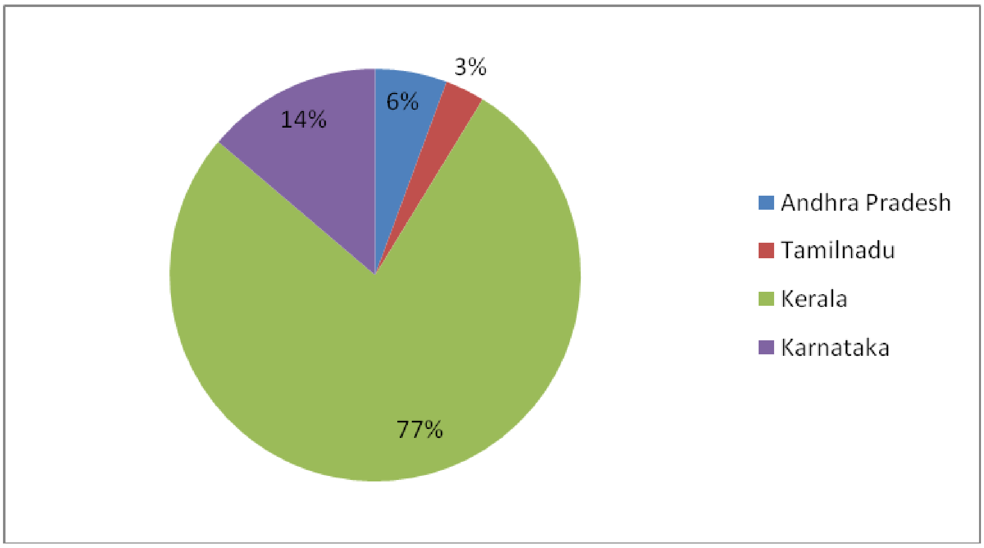
Source: Department of Town and Country planning,localself-government Department,Government ofKerala.

These municipal acts enable Municipal Corporation to build strong guidelinesfor city development. It helps inimplementing the provision of delivery of public services in a better manner.

3.5.2 Water Quality

Safe drinking water is a basic necessity for healthy communities. But major drinking water sources in state are contaminated by bacterial and chemical contents. Ministry of drinking water and sanitation reported, Kerala has highest chemical and bacterial contamination in drinking water among 28 tested states in the country (Economic Review, 2012). Kerala is also high in chemical and bacterial contamination in south Indian states. It is depicted in the following figure.

Figure 3.3: Water Quality of South Indian State in 2013(Percent of Contamination)



Source: Economic Review, State Planning Board, TVM, Government of Kerala

State Environment Report (2005) said that state rivers have been highly polluted, in the study based on quality testing related toPeriyar and Chaliyar Rivers in Kerala. The study has found Industrial and chemical waste from factories, sewerage water and various dumping waste being the major threat to rives in Kerala (KSCSTE, 2009). Radhakrishnan andetal(1996) study shows that their study took the total sample of well water in coastal Kerala and found it‘coliform positive’. Thestudy finds unscientific sanitation practices and pesticides & fertilizer usage in agriculture are the reason for bacterial contaminations.

In the general case, people depend on their unprotected well water. Also in urban areas is a lack of access to adequate water supply in living informal settlements in Kerala. Large number of urban poor lived in slums or unhealthy settlements. These conditions cause the majority of drinking water highly polluted in the state. In Kerala, both ground and surface water sources continuously reported high levels of contaminations. Rivers are the major sources of KWA water supply schemes. KRWSA-implemented Jalanidhi projects are highly dependent on rural well-water sources. So maintenance of water quality is a big challengein water supply services.

Table 3.30: District Wise Detail of Quality Affected Drinking Water in Kerala, 2011

District	Total source tested	Tested found contaminated	Percentage of contamination
Thiruvananthapuram	1472	1356	92.12
Kollam	1447	933	64.48
Pathanamthitta	1126	913	81.08
Alappuzha	809	437	54.01
Kottayam	1153	980	85.00
Idukki	3578	1901	53.13
Ernakulum	3560	2035	57.6
Trissur	1938	1334	68.83
Palakkad	1907	1841	96.54
Malappuram	1782	1013	56.85
Kozhikode	1701	1130	66.43
Wayanad	1701	1479	86.95
Kannur	2051	1733	84.5
kasargod	2473	2232	90.25
Total	26698	19317	72.35

Source: Report from Drinking Water and Sanitation,Ministry of Rural Development,Government of India.

The table explains that state still face serious problems with water quality. Water quality test result shows above 50 per cent of tested water sources have contaminated in all districts. High level of contamination are recorded in the districts like Palakkad, Thiruvananthapuram, Kasargodetc in the state. Districts like Idukki, Alappuzha, Malappuram and Ernakulum recorded the category of low-level contaminations as compared to other districts in Kerala. So the state is seriously affected with water quality problems from contaminated water sources and worsening conditions to drinking water.

Table 3.31: Quality Programmes Implemented by Government

Year	Name of the programme	objective	Achievement
1986	National Drinking Water Mission(NDWN)	To meet and solve rural drinking water related quality issues	Up to 20 per cent of the ARWSP funds are to be earmarked for new projects designed to address water quality issues.
1999	Kerala Rural Water Supply And Environmental Sanitation Project	Improve the quality of rural water supply and environmental sanitation	KRWSA implemented jalanidhi project with support to world bank
2005	Bharat Nirman	Safe source of drinking water in every habitation	Centrally sponsored scheme of ARWSP which funded on

		by 2009 in rural areas	a 50 percent.
2006	National Rural Drinking Water Quality Monitoring And Surveillance Program	Strengthen the community participation in the drinking water sector for sustainability	5 people in each Gramapanchayat are to be trained to carry out regular surveillance of drinking water sources for which 100 per cent financial assistance including a water texting kit provided
2008	Environmental monitoring programme on water quality	To create data base on water quality and to use the derived information for practical applications in the management of water resources and their effective utilization	The programme initiated by KSCTE & implemented by CWRSDM in the state
2017	Establishment of Mobile Testing Laboratory for the Quality Assurance of Water Resource	Raise the awareness of the communities with respect to protection of source of water.	Mobile laboratory is doing Services of 120 panchyaths, 15 municipalities and 3 corporations. More than 3000 samples were tested using this facility.
2018	Jivamritan project	Over 100,000 villages in Kerala, spread across14 districts have begun to receive clean drinking water	127 water filtration units have installed in this project.

Source: Five year plan document &Economic Review, State Planning Board, TVM, Government of Kerala

Here, the Government has implemented various programmes for improving water quality. These programmes and the various popular water quality treatments like purification, chlorination and fluoridation help to reduce the contamination level and avail safe water service to society. These also help to reduce the causes of all types of water-related diseases and protect community health with the social upliftment of society. Achieving and maintaining both adequate quantity and better quality in water supply services is a great achievement of the government's public water supply system. Now the Kerala government set off this journey for implementing new water supply schemes with various water quality improvement activities and programmes.

3.5.3 Institutional Support to State Water Supply

In the state, various institutions are workingfor ensuring successful implementation of water supply. The institutions help on implementing plans, policies, and schemes and executing them in water supply services. In state water supply, some major institutions are directly involved and other institutions are very supportive tothese major institutions for implementing successful water supply.

At the state level, water resource departments are the superior institutions for total control of the water supply services in the state. The department is mandated to formulate water policies, implement rules and regulations for the benefit of the people, fix appropriate water rates, maintain finished projects and supervise the drinking water supply in the state. At the administrative level minister of water resources is headed by the department. KWA and KRWSA are under this department. The other line departments like the groundwater department, irrigation department etc is also located under this department.

KWA is the main water supplier in both rural and urban areas in the state. It was established under the Kerala water supply &sewerage act 1986. It is the main agency responsible for implementing, developing and regulating water supply services and wastewater collection and disposal in the whole state. The other major functions are:

1. Preparation, execution, Promotion, maintenance and financing of the schemes for the supply of water and disposal of wastewater
2. Planning for the state's water supply and sewerage requirements
3. Preparation of state plans for water supply and wastewater collection and disposal on the direction of the government
4. Establishment of state standards for water supply and wastewater services, and
5. Making provisions for the supply of wholesome water and efficient sewerage services to the people in the state. (KWA Administrative Report 2018-19)

KWA is also a main supporting actor to local government for implementing to schemes and financial assistance to their water supply activities. In most cases, deposit work (labour, infrastructure facilities, mechanics and materials) of local government water supply has done by KWA.KRWSA was established under the state government in 2000 for rural water supply services with community ownership and cost-sharing. In this community participation approach, the beneficiary groups are more actively participating in the operations and maintenance of water works.

Local self-government departments are another important department for supplying water services at the local level. This department has the power to issue various orders or circulars for the local government institutions and also provides technical assistance to local governments. At the administrative level local self-government is headed by the local self-departments. Directorate of Urban Affairs and Town and Country Planning Departments for urban and Panchayath Directorate and Commissionerate of Rural Development in rural are the major allied departments supporting local self-government departments for water supply.

Under the panchyath raj act 1994, panchyath get responsible for implementing and maintaining water supply services in their respective areas. But, it is interesting that all panchayats utilize the KWA water supply schemes and the panchyath takes a supporting role in the provision of water supply. Mainly operation and maintenance activities of the water supply are done by panchyath coexisting with of beneficiaries support. Now KWA takes more multi-GP schemes which covered large areas compared to single GP schemes and it requires high financial support.In accordance with the Municipal Act of 1994, assist in coordinating water supply services for urban local bodies in their respective regions. As usual, corporations and municipalities also use the KWA water supply.The city government merely plays a supporting role in KWA's water services.

Under the local government level, a large number of drinking water schemes are taken by both rural and urban local governments with high support to beneficiaries. In mid-1999, a structural transformation model, a community-led water supply model wasimplemented with an active role of beneficiary groups. Then beneficiaries take a major role in operations, maintenance and financial activities in local water supply in their stipulated areas.

3.6 CONCLUSION

The chapter is examining the picture of state public water supply service delivery in urban context. Water supply is the state subject and hence the responsibility for provisioning water supply is vested with Kerala government. Kerala is blessed with plenty of water resource and characterized high population growths with expanding development sectors are demanding high volume of water resource in the state. At present, the state is following multi service delivery approach in implementing public water supply service. The three main agencies KWA, KRWSA and local bodies are workingto providing water services in the whole state. KWA is the primary drinking water supplier and provides provisionsfor water service in the state at long time. Kerala is also enjoys a leading position,when it comes to the implementation of decentralization reforms. The 73rd and 74th amendment act declares water supply asone of the obligatory function of local body. In decentralized Kerala, local governments play greater responsibility in delivering of water service. However, most of the water supply services are planned and implemented by the local bodies through KWA assistance. Both urban local bodies like corporation/municipality and KWA are performing together in urban water supply. In the state, the local bodies have full freedom to provide the services of water supply in their limit with administrative and financial support from state and central government. But in most cases, local bodiesare dependingon KWA for water service and it they are only managing operation and maintenance portion in urban supply. In this situation, Trissur Corporation took a special responsibility and successfully implemented water supply schemes in a long run. The chapter also provesthat governance support is a necessary factor for implementation strong and successful water service delivery performance in our state.

Chapter IV

EFFECTIVENESS OF LOCAL GOVERNMENT WATER SUPPLY SERVICES

4.1INTRODUCTION

This chapter aims to discuss the depth of effectiveness of Thrissur Corporation's water service delivery and its mechanism. The chapter is divided into two sections. The first section discusses the evolution and present scenario of the Thrissur Corporation's role in water service delivery and the special attention given by the corporation to ensure the demand–supply performance forbetter water service delivery. To begin with this section gives a brief description of the study area with discussed and adescription of Thrissur district and a detailed explanation of Thrissur Municipal Corporation. Secondly, it tries to analysesthe evolution and present performance of Thrissur Corporation's water supply service mechanism. In the second section, attempts were made to identify the special measures taken byThrissur Corporations to its better its performance in water service delivery and to find out to what extent they wereeffective. For analyzing depth of effectiveness, it is important to measure customer satisfaction. For this, indicators like Availability, Accessibility, Affordability, Water quality and Water management is considered in the study. The study finds that local government water supply is effective. For the purpose, the chapter intends to compare the effectiveness of the water service delivery mechanisms used byKWA and the Corporation. This part is focused on a detailed analysis of the primarily collected data set from selected sample areas in the Thrissur Corporation boundary.

SECTION 1

4.2 PROFILE OF THE STUDY AREA

4.2.1 Profile of Thrissur district

Thrissur district has situated in the central part of Kerala state. The area of the district is 3032 sq. km and it constitutes 7.8 percent of the total area of the state. It ranks 5th among the district in area (District Census Handbook, 2011). The name Thrissur is derived from the Malayalam word 'Thrissivaperur'.Thrissur district is popularly known as the 'Cultural capital of Kerala'. The date of formation of the Thrissur district is on 1st July 1949. Thrissur is bounded by Malappuram and Palakkad on the north, Palakkad and Coimbatore district of Tamilnadu on the east, Ernakulum and Idukki district on the south and the Arabian Sea on the west.

Thrissur district has a total population of 3,121,200 as per 2011census. Out of this total population, 1,480,763 are males and 1,640,437 are females. The average sex ratio of

Thrissur district is 1108. The district constitutes 7.8 per cent of the total geographical area of the state and it accommodates 9.34 per cent of the total population. As per the 2011 census, out of the total population, 67.2 per cent of people live in urban areas and 32.8 per cent of people lives in rural areas. In total, 2096406 people live in urban areas of which males are 992460 and females are 1103946. The Schedule Caste (SC) and Schedule Tribe (ST) constitute 10.4 per cent and 0.3 per cent of the total population in Thrissur district respectively. The total literacy rate of Thrissur district is 95.08 per cent. Out of total literates, 96.8 per cent are male literate and 93.56 per cent are female literate.

Table 4.1: Administrative Set-up of Thrissur District

1	Number of Taluks	7
2	Number of Revenue Villages	255
3	Number of Corporations	1
4	Number of Corporation Wards	55
5	Numbr of Muncipalities	7
6	Number of Municipality Ward	233
7	Number of District Panchyath	1
8	Number of District Panchyath wards	29
9	Number of Block Panchyath	16
10	Number of Block Panchyath wards	213
11	Number of GramaPanchyath	86
12	Number of GramaPanchyath wards	1501
13	Number of Assembly Constituencies	13
14	Number of Assembly Parliaments	2

Source: Panchyat level statistics, Trissur district, Department of Economics and Statistics,Thiruvananthapuram, Government of Kerala,2011.

Thrissur district has 255 villages in 7 taluks. The taluks are Thrissur, Chalakkudy, Mukundapuram, Kodungallur, Chavakkad, Kunnamkulam and Thalappally. The district has one corporation named Trissur and 7 municipalities are Chalakudy, Irinjalakkuda, Kodungallur, Guruvayoor, Chavakkad, Kunnamkulam and Wadakkancherry in urban areas. The present study chooses the core sample area as the Trissur corporation area of the Thrissur district. Thrissur corporation area belongs to Thrissurtaluk. There are 55 corporation wards.

4.2.2 Profile of Thrissur Corporation

Thrissur city functioned as a Municipality since 1921 under the Cochin municipal regulation actin 1932, the new municipal corporation building was constructed in Thrissur. Thrissur Municipality came into existence on 1st July 1942. Later in 2000, it was upgraded by the Kerala government to a municipal corporation, by merging the adjoining Ayyanthole, Ollukkara, Koorkanchery, Ollur and Vilvattompanchayats and parts of Nadathra and Kolazhypanchayats.

Thrissur Municipal Corporation came into existence on 2nd October 2000 with total area of 101.42-kilo meters of Thrissur city limits through five zones Ayyanthole, Vilvattom, Ollukkara, Ollur and Koorkanchery (Official Website of Thrissur Corporation, 2020). It is the fourth largest city in the state of Kerala based on area and Population. As per the census report 2011, the total population of Thrissur Corporation was 315,957 consisting of 152,296 males and 163661 females. The population density of the city is 3115 persons per km^2. The total number of 759210 families residing in Trissur Corporation city limits. The Corporation also comprises two legislative assemblies in Thrissur and Ollur assembly constituencies. The Corporation has its headquarters in Thrissur City. Property tax is the main source of revenue for Thrissur Corporation (Thrissur Corporation Budget, 2014).

The Thrissur Municipal Corporation is the civic body that governs the Thrissur city. It is the second-largest city corporation in the state of Kerala. For administrative purposes, the city is divided into 55 wards. Of which, 26 wards are reserved for women, 4 wards for scheduled caste and the rest for the general. The administration of the Thrissur Corporation vests in the council. The corporation council is composed of a total of 55 elected ward members from their respective wards. The term of office of the council is five years. The mayor (elected from among the councilors) chairs the council meeting and is responsible for overall supervision and control of administrative functions of the municipal corporation. The deputy mayor is the chairman of the finance standing committee and also presides over the council meeting in the absence of the mayor.

The Thrissur Municipal Corporation through the council has all the powers, authority and responsibilities of the government, to enable it to function as an institution of self-government, in respect of the matters entrusted to it. The council, constitute a standing committee for exercising its powers, discharging such duties or performing such functions, as is provided by the Kerala municipalities act. The secretary of the Thrissur Municipal Corporation is an officer appointed by the government.

Thrissur Corporation is the only local body in Kerala which act as a distributor of water supply in the city. The Corporation is responsible for civic infrastructure and administration with direct control of water distribution and also electricity supply in Thrissur

City. The Thrissur Municipal Corporation continuously supplies basic amenities like water in the old municipal area (32 wards) for a long period.

4.3PERFORMANCE OF THRISSUR CORPORATION'S WATER SERVICE MECHANISM

Thrissur Corporation is the only urban local body in Kerala which directly undertake the task of water supply distribution in the city. The sole responsibility for water supply and its related services in the old municipal area is vested solely in Corporation.

4.3.1 History of Thrissur Corporation's Water Service Connections

On 30/09/1956 dated,anagreement to executeThrissur city water works between the government and Thrissur Municipality was signed. The Municipality has requested and the government have agreed to undertake the construction and maintenance of the Thrissur water supply scheme at an estimated cost of Rs59.5 lakhs with the Municipality has agreed to bear 50 per cent of the cost and as the government agreed to meet the remaining 50 per cent of the cost by way of grant and by advancing a loan to the municipality. The water supply and allied services in the Thrissur Municipality commencedin 1962 as per the government order 24/01/1962. The Municipality shall be responsible for all the works connected with the water supply distribution system in the town area. For the purpose atreatment plant was to be constructed in Peechi dam.

Unfortunately, the water supply and sewerage services are vested in all local bodies stand transferred to Kerala Water Authorities based on the Kerala Water Supply and Sewerage Act 1986(act 14 of 1986). Then, the long-period vesting of the water supply and sewerage systems in ten local bodies like Cochin, Calicut, Kollam, Kottayam, Alleppey, Aluva, Thrissur, Palghat, Perumbavooer and Pala municipalities as expired on 31.3.1989 as per the government order 11.10.1986. Therefore, the water supply and sewerage by terms, together with the rights, liabilities, and obligation there on, vested in their local bodies stand transferred to and vested in the Kerala water authority with effect from 1/4/1989.

To retransfer the municipal water supply in Thrissur city, a significant revolution among city residents began in the Thrissur district. This matter was seriously discussed in Thrissur municipality council on 8th February 1993 atthe council meeting and requested the government to re-transfer the water supply scheme to the municipality. Based on the discussion, the government declared to re-transfer the scheme to the municipality. Then, the water supply and allied services in the Thrissur Municipality which were vested in and transferred to the Kerala Water Authority was re-vested and retransferred to Thrissur municipality with effect from 14/05/1993, subject to the condition that the municipality shall remit all outstanding dues to Kerala Water Authority and take over the entire water supply scheme right from the intake, treatment, storage and distribution. The government also hands over the old scheme capacity (14.5) of the treatment plant to Thrissur Municipality for city water supply on 3/06/1993.

However, in the presence of Kerala Water Authority officers, Corporation officers and the government minister discussions were held on 15/11/1993 on the continuation of the water supply distribution in Thrissur city limit. In the discussion it was decided that the responsibility of treatment and its purifying water to transport from the Peechi plant to city tanks was re-assigned to the Kerala water authority. Here, the municipality shall be responsible only for the works connected with the water supply distribution system in the town from the city storage tanks.

In 2000, the Thrissur Municipality was upgraded to the level of a Municipal Corporation by merging five zones Ayyanthole, Vilvattom, Ollukkara, Ollur and Koorkanchery. For administrative purposes, the total Thrissur Corporation area is divided into 55 wards. Out of the total of 55 wards, 32 wards wereincluded from old municipal areas and the other 23 wards are included from adjoining panchayath areas. The Thrissur Municipality was a continuation of supplying water only within the old municipal area, and the distribution of water in the adjoin panchayath area was being done by the Kerala Water Authority. Both Corporation officers and Kerala Water Authority officers participate in the meeting held on 3/12/2002 and decide that Kerala Water Authority agreed to provide 20 MLD of water out of 50 MLD of water produced by the Peechi plant to the Thrissur Corporation for distribution in their old municipal area. The meeting also decided to calculate the maintenance charge of total water production and the corporation should pay 40 per cent of it to the Kerala Water Authority.

However, the Corporation council meeting held on 23/08/2017 discussed in detail ThrissurCorporation's water supply systems and its operational activities within their city limit. In the council meeting, it was decided that Thrissur Corporation would take over the entire water supply scheme right from the intake, treatment, storage and distribution in the old municipal area. Then the Corporation would take over the full operation of the water supply handed over to the Kerala Water Authority based on the government order of 17/05/1993.

4.3.2 Growth Trend of Water Service Connections by Thrissur Corporation

The Thrissur Municipal Corporation has been taking over the efficient supply of drinking water since 1962 as a model for any other municipality in Kerala. Generally, the Municipality is allowing water connections in both domestic and non-domestic areas. Domestic connection is used for household's domestic purposes of drinking, cooking, washing, bathing and other personal and home hygiene activities. Non-domestic connections generally include other activities excluded from domestic purposes. In the beginning,the Corporation included flat water connections in the domestic section but it was included in the non-domestic category, later. Water connections for hotels are included in the non-domestic category as it is a business enterprise. Casual connection is the connection for the building construction and allied activities for a limited period. The temporary connections are including the non-domestic category.

Number of water service connections of Thrissur Corporations show an increasing trend since 1993 (Thrissur Corporation Service Directory, 2020) and it's expanding since 2000. Generally, the trend shows total water service connections are increasing over the periods till the nineties.

Table 4.2: Total Water Service Connections of Old Municipal Area of Trissur Corporation (Percent)

Year	Domestic connections	Non-domestic connections	Total connections
1990-95	0.32	15.63	0.44
1996-00	1.6	27.27	2.06
2001-05	1.18	17.7	2.14
2006-10	1.6	4.98	1.91
2011-15	0.51	6.55	1.21
2016-20	-2.59	2.7	-1.78

Source: Thrissur Corporation Service Directory,ThrissurCorporation,Government of Kerala, 1990-20.

The table explains that the compound annual growth trend of 30 years of water service connections and it was increasing over the years except recently. Both domestic and non-domestic connections are increasing. Large numbers of non-domestic connections are introduced and itis contributing to high growth in the 1990s. Generally, both non-domestic and casual connections are included in the non-domestic category.

In the year 2000, Thrissur Municipality was upgraded to Municipal Corporation. The Corporation introduced a new slab rate in 2004. As a result, the growth tendency of both domestic and non-domestic water connections, shown since the middle of 20thcentury is decreasing. Again in 2017, the Corporation increased the water rate and introduced a new system of spot billing based on meter readings. As a result, the growth trend of non-domestic connections is reducing and domestic connections are becoming negative. The growth trend of total water connection becomes negative. This is because of the increasing number of water connections are disconnected especially in domestic category, since 2017. It means increasing the rate of water charge leads to the increasing trend of disconnecting, and this will lead to illegal and unnecessary water connections.

4.3.3 Present Condition of Thrissur Corporation's Water Service Connection

Presently, the Thrissur Corporation's water supply system is spread over about 625 km in the old municipal area. In the system, the water is supplied by a 14.5 MLD treatment plant at Peechi reservoir and the treated water is pumped through a 600 mm pipeline to four tanks installed in the Thekkinkad ground. Now, the Corporation uses 19 MLD of water for distribution to their old municipal area. In 3rd March 2022, the Municipal Corporation launched the water efficiency Thrissur project as part of the Amruth schemes to modernize all public water supply within old municipal areas with the most modern systems to provide the best possible service to the public. The primary object of the schemes is to provide drinking water in a timely and efficient manner.

Table 4.3: Water Service Connection and Public Tap in Old Municipal Area of Thrissur Corporation

Ward Number	Domestic connection	Non-domestic connection	Total connections
1	517	3	520
2	438	12	450
3	525	15	540
4	593	8	601
5	284	80	364
6	453	25	478
7	382	23	405
8	390	69	459

9	515	123	638
10	405	455	860
11	296	170	466
12	328	120	448
13	441	151	592
14	389	45	434
15	424	6	430
16	420	11	431
17	461	46	507
18	453	78	531
19	285	82	367
20	504	97	601
21	553	91	644
22	409	9	418
23	618	21	639
24	718	27	745
25	499	611	1110
26	575	221	796
27	482	47	529
28	675	160	835
29	477	123	600
30	567	52	619
31	445	58	503
32	428	23	451
Total	14949	3062	18011

Source: Thrissur Corporation Service Book,ThrissurCorporation,Government of Kerala,2020

Official records of the Corporation ward-wise total number of water service connections and its public tap connections are explained in the table. At present, a total of 14949 domestic connections and 3062 non-domestic connections are included in the old municipal area of Thrissur Corporation. Generally, domestic connections are used only for domestic purposes and non-domestic connections are used for non-domestic purposes like vegetable farming, gardening, and vehicleservice etc. in the Corporation area

Table 4.4: Corporation Wards –Wise Life Connection and Public Tap Connections

Ward Number	Life connection of water service (Total)	Public tap connection
1	502	5
2	283	3
3	506	11
4	528	8
5	335	18
6	489	8
7	397	4
8	449	8

9	584	6
10	574	4
11	504	12
12	452	7
13	600	5
14	458	4
15	398	31
16	420	20
17	450	15
18	472	10
19	284	11
20	505	13
21	493	48
22	360	35
23	422	6
24	107	3
25	694	3
26	663	8
27	542	7
28	749	13
29	616	7
30	583	7
31	462	11
32	463	14
Total	15344	365

Source: Thrissur Corporation Service Book,Thrissur Corporation, Government of Kerala, 2020

Present number of active connections is drawn in the table. Out of the total of 18011 water connections, approximately 15344 water connections are active in the present stage and the other 2600 water connections are considered to be dead (inactive) connections in the corporation area. At present Thrissur Corporation has about 365 public taps within its limits. The large numbers of tap connections are included in three Corporation wards Kanattukara East, Kanattukara West, and Aranattukara East. This is because these wards are concentrated in big colonies.

Today, the Corporation supplies 19 MLD of water for their old municipal area. The supplied water is available 24/7 hours per day in the corporation area. However, usually, the forced supply is available 6-8 hours per day in the area. Generally, the corporation supplies water in the from five in the morning to 1 pm everyday. Every summer, the Corporationmanages adequate water supply, allowing it to use additional resources, such as tanker supplies, to alleviate water shortages in water-scarce areas. A good quality water supply is also available through the corporation. But the water supplied in

Thrissuriscoloured. This is because the corporation uses the product of ‘alkayi’ for treated water. When purified water flows through a rusty pipe, it reacts with the rust to make it coloured. When this water is texted, it is clear that there are no health problems. Corporation-fitted washout valves are placed to solve qualitative water problems. These valves are opened and cleaned. Then the accumulated mud goes away and the water becomes clear. The corporation also provides 24 hours public tap supply for every household in both non-summer and summer seasons, free of cost.

4.3.4 Demand forThrissur Corporation Water Supply

Table 4.5: Corporation-Ward wise Demand for Water per Month (Liters)

Ward number	Demand for water per month (Average)	Ward number	Demand for water per month (Average)
1	20503	18	55730
2	15589	19	30464
3	15278	20	48998
4	24876	21	29027
5	80321	22	14942
6	27607	23	19312
7	34140	24	36410
8	38941	25	112123
9	60965	26	62058
10	56065	27	44594
11	27141	28	72510
12	85822	29	60288
13	55804	30	47430
14	18410	31	31119
15	14107	32	21361
16	22902	Total	13,00,243
17	25432		

Source: Thrissur Corporation Service Book, Thrissur Corporation, Government of Kerala, 2020

The table explains tothat average demand for domesticwater per month in each ward of old municipal area in the year 2020.At presently, the households in old municipal wards are demanding approximately a total of 13 lakh liter water per month.Also, the beneficiaries in old municipal wards are demanding supply water for their major non-domestic purposes as listed in below tables.

Table 4.6: Water Utilization of Flats in Old Municipal Area

Water Consumption (Liter per month)	Flat (Number)
25,000	56
< 50,000	39
< 1,00,000	68
< 2,00,000	35
< 5,00,000	29
> 5,00,000	12

Source: Thrissur Corporation Service Book,Thrissur Corporation, Government of Kerala, 2020

Now, there are-a total of 230 flats in old municipal areas. The different types and sizes of flats are using different amounts of water per month. The table shows the highest number of 68 flats consuming the range an average of 50,000-1, 00,000 litre of water per month. The large size of 12 flats is use an average, 5, 00,000 liters of water per month. Generally, the corporation uses a 15 mm width of pipeline for water supply toflats.

Table 4.7: Water Utilization of Hotels in Old Municipal Area

Water Consumption (Liter per month)	Hotel (Number)
<15,000	41
<25,000	28
<50,000	11
<1,00,000	3
>1,00,000	11

Source: Thrissur Corporation Service Book,Thrissur Corporation, Government of Kerala, 2020

Today, the big and small sizes of 143 hotels are therein the old city limits. The table explains the highest number of 41 hotels have used less than 15000 litres of water per month. The large size of 11 hotels has used more than 100000 litres of water per month. So the corporation's public water supply is in high demanded every year.

4.3.5Income and Expenditure of Water Serviceby Thrissur Corporation

4.3.5.1 Income of Water Service

Water charge is the main source of income from the corporation's water service. A water charge is a charge that is calculated by looking at the average consumption of water used over a given period and by consuming the existing running meter. At present, the corporation calculate monthly water bills based on the consumer's meter reading as per the spot bill system. The meter reading is done at the rate fixed by the municipal council at stipulated time and charge water rate in the spot bill system.

From the time of introduction itself, the corporation charged water at a very low rate. In the beginning, the corporation charged only Rs 5 per litre for domestic connections and Rs 10 per litre for non-domestic connections. Later, a slab system was introduced in the billing system. The corporation changed the slab of water rate a few times over the long period of years. Till 2017, the corporation follows the system of slab-based water rates for the water usage of consumers. But this system creates the problem of mismatch between water consumption and income from water bills. In 2017, the corporation decided to increase the water rate and replaced the slab rate with new system of spot bill method based on meter readings.

Table 4.8: Water Charge of Domestic Category (as on 1/4/17)

Liter/Month	Corporation Water Charge	KWA Water Charge
5000	13	22
6000	13	26
7000	13	30
8000	13	34
9000	13	38
10000	13	42
11000	15	47
12000	15	52
13000	23	57
14000	23	62
15000	23	67
16000	23	98
17000	23	104
18000	23	110
19000	116	116

Source: Thrissur Corporation Service Book,Thrissur Corporation, Government of Kerala, 2020

In 2017, the Corporation has decided to increase the water rate. As per the decision dated 30/3/2017 the Corporation decided, those who consume up to 10000 litres of drinking water per month will be charged Rs 13, 12000 litres up to Rs 15 and18000 litres up to Rs 23 and above 18000 litres consumptions are charged the same rate as fixed by the Kerala Water Authority for their domestic water consumption. The Corporation charged the same rate fixed by the Kerala Water Authority for all levels of consumption in the non-domestic category.

The Corporation gives benefits to BPL families in water supplying only half amount of the total individual connection charge. Also, the Corporation permits water usage of below 10000 litres of the connections to be free for BPL families. The Corporation also gives free water connections and its supply to SC colonies in their area. The Water Supply and Sewage Act 1986 based Corporation charge fines or penalties from their beneficiaries for failing to pay the water rate at the correct time. Based on this act, the Corporation charge fines or penalty of Rs 10 for domestic connection and Rs 20 for non-domestic connection in the water supply.

Table 4.9: Income from Water Bill

Year	Income from Water bill (Rs in lakh)
2010-11	10,463,284
2011-12	12,468,265
2012-13	15,463,785
2013-14	16,564,324
2014-15	18,564,320
2015-16	20,856,347
2016-17	22,447,959
2017-18	16,477107
2018-19	33,858,069
2019-20	35,545,867

Source: Thrissur corporation budget document,Thrissur Corporation, Government of Kerala, 2010-20.

The table explains the trendsin Corporation's main source of income in its water service. Generally, the trend shows increasing. But in 2017-18, the trend shows declining. This is because the Corporation decided of increasing water charge in the year. This action results in an increasing number of disconnections of unnecessary and illegal water connections in the Corporation area. This helps to eliminate the misuse of water services and increase the efficiency of total water connections and also to increase the amount of income from water service.

4.3.5.2 Expenditure of Water Service

The Corporation spends a big volume of amount for house connections, public tap connections and other non-domestic connections to the supply water. Today the Corporation spent approximately Rs 20 lakh on ward-wise water supply services per year. The Corporation now utilizes 19 MLD of water for its water supply. The Kerala Water Authority produces and supplies this quantity of water. Since 2017, the Corporation has paid the Kerala Water Authority Rs 32,400 per month to purchase this amount of water. Initially, The

Corporation spent Rs 2 lakh payable to water charge to Kerala Water Authority per month. The amount is increasing and the Corporation is payableupto to Rs 4 lakh per month since 2003. Again the amount is increasing and the Corporation paysRs 6 per month since 2004. Since 2014, the Corporation is spent Rs34.20 lakh as water charges to Kerala Water Authority regularly. But the amount is declining since 2017 as the result of reduction in the number of illegal connections and misuse of water service connections etc.

The ownership of the total public tap connection in the whole Corporation area is under the responsibility of Thrissur Municipal Corporation. Tap water connections are always free. So, the total costs of the tap water connection are under the sole responsibility of the Municipal Corporation. KWA has no role in the tap water supply in the state. Till 2014, the Corporation payedRs 5256 per tap monthly to KWA as a water bill. The expenditure on public tap connections is increasing. Today, the corporation spent Rs 7834 on one public tap connection per month. This is because the slum populations highly demanded public tap connections from year to year.

Corporations also spend huge amounts for their maintenance work of water supply.

Table 4.10: Expenditure of Corporations Own Maintenance Work

Year	Zone	Amount (per month)
2010-11	1-16 wards 17-32 wards	30000 20000
2011-12	1-16 wards 17-32 wards	33000 23000
2012-13	1-16 wards 17-32 wards	35000 26000
2013-14	1-16 wards 17-32 wards	37000 28000
2014-15	1-16 wards 17-32 wards	40000 30000
2015-16	1-16 wards 17-32 wards	42000 32000
2016-17	1-16 wards 17-32 wards	45000 35000
2017-18	1-16 wards 17-32 wards	35000 28000
2018-19	1-16 wards 17-32 wards	40000 35000
2019-20	1-16 wards 17-32 wards	43000 37000

Source: Thrissur Corporation account book,Thrissur Corporation, Government of Kerala, 2010-20.

The Corporation calculates and spends the amount for maintenance work in the zone base. The first zone includes 1 to 16 wards and the second zone includes 17 to 32 wards. The trend cost of corporation's maintenance work is increasing. However, the amount of maintenance cost was low in 2017-18. This is because of decrease in the number of unnecessary water connections in the period. Generally, the maintenance cost is high in three months, ie, March, April and May in a year. This is because the Water level is low in the summer months and its related corporation's cleaning, replacing and fitting of pipelines are increasing these times. The other reasons like maintaining quantity and quality of adequate supply, finding out alternatives for sufficient water supply etc are increasing cost of water supply by Corporations in summer months. Thus, total expenditure on Corporation's water supply increases during summer months..

4.3.6 Future Perspective of Thrissur Corporation for Water Supply

In order to meet the future demands of an expanding population with a high demand for water supply, the Corporation chose to implement a new treatment plant with a capacity of 20MLD (200 lakh litres) of water.The corporation is taking initiatives to purify waterwhile collectionitselfin collecting mud and sludge from the dam's lowest level.To develop a new technique for collecting water from the surface level known as a "Floating Intake Programme," is implement to solve the problem of change in color. The Corporation also implemented the programme 'Network Control Project', which will be divided into 8 zones to ensure full-time water availability in upper areas of the city. The Corporation has decided to replace the old pipelines and constructednew tanks for good water supply and solve the problem of low pressure of water supply. The Amurth drinking water project of 91 crore is being implemented as part of the above new programmes in the Trissur Corporation area.

The above explanations make it clear that the Corporation supplied both adequate quantity and quality of water for their beneficiaries. Generally, the Corporation supplie 19 MLD of water against a demand of 18 MLD of water (Corporation Service Book, 2020). So, the quantity of water demanded is almost balancing with the quantity of water supplied by the Corporation. But, the demand for water consumption is increasing day by day. For satisfying ever increasing demand, the Corporation will be designing and implementing a new treatment plant and modern transmission pipes to handle maximum day demand. Generally, the Corporation issupplying piping water from 5 am to 1 pm per day at a high force rate. It isdecided to improve 24 hours of force supply per day. The Corporation maintainsgood supply and management in summer seasons with the use of tanker water supply. The Corporation also takes actionfor increasing water rate with spot bill method based on meter readings in 2017. This movement is helping to reduce the number of illegal and unnecessary water connections in corporation limits.

4.3.7 Water Service Connection and Public tap in Adjoining Panchyath area of Thrissur Corporation

The Thrissur Corporation area includes both the old municipal area and the adjoining Panchyath area. Out of the total of 55 wards, 32 wards are included from the old municipal area and the other 23 wards include from adjoining panchayath. Kerala Water Authority is undertaking the responsibility of water supply services in adjoining panchyath areas of the Corporation.

Table 4.11: Total Number of Water Service Connections and Public tap Connections in Adjoining Panchyath area

Division	Domestic connections	Non-domestic connections	Total connections	Public tap
Ayyanthole	7935	264	8199	683
Ollukkara	2850	28	2878	402
Koorkanchery	5937	53	5990	556
Nadathra	2220	64	2284	203
Vilvattom	3984	45	4029	306
Total	22926	454	23380	2150

Source: Thrissur Kerala Water Authority Service Book, Kerala Water Authority,Government of Kerala, 2020.

The table figures out the total number of water service connection and public tap connection in the above mentioned 23 wards in 2020. These water service connections are generally undertaken by Kerala Water Authority. Kerala Water Authority includes the flat water connection in domestic category as against of Corporation. Water supply through public tap of adjoining panchyath area is also the responsibility of Kerala Water Authority. However, total public tap connection of the total Corporation areas including adjoin panchyath areas are under the control of Trissur Corporation. Implementation and its maintenance are under the sole responsibility of corporation. Public water supply is freeto all beneficiaries. So, the Corporation regularly pay fixed rate of amount to Kerala Water Authority for their supply of water through in public tap connections.

SECTION 2

In the first section,it is statedThrissur Corporation is well performing in its water service delivery. They perform effective water supply to its beneficiaries. . The Corporation can achieve good result in satisfying special objectives with minimizing problems and solving them in accordance with consumer satisfaction. Here it is important to identify the present stage of Thrissur Corporation's performance level of its water service delivery. For the purpose of analysis, the depth of effectiveness of water service delivery mechanism of Thrissur Corporation is presented in this section. Analysis is based onthe primary data collected from a set of selected sample areas from Thrissur Corporation boundary.

For begin to the analysis, firstly discuss general description of sample area and general characteristic of sample households in the Corporation boundary.

4.4General Information of Sample Area and Sample Size

Table 4.12: Study Area and Sample size

Study Area	Sample Size
Corporation	220
KWA	133
Total	353

Source: Author Calculation

The present study was conducted at the Thrissur Corporation boundary. The total sample units have been collected from both Corporation and KWA water supply areas in six wards. Multi-stage random sampling technique is used for this selection. The samples have been selected in proportion to the number of water connections in six Corporation wards. For the purpose of the probability proportional to size sampling method is used. The total sample households of the study were 353. Out of the total, 220 samples have been drawn from the Corporation's water supply areas and 133 samples have been drawn from Trissur divisional Kerala Water Authority's water supply areas in the Trissur Corporation.

4.4.1 General characteristic of sample households

The section gives a detailed analysis of both socio-economiccharacteristic and some special housing characteristics of the samplehouseholds.

Table 4.13: Socio-Economic Characteristics of Sample Respondents

Variables	Description	Percent
Gender	Male female	35.7 64.3
Religion	Hindu Christian Muslim	53 43 4
Social group	General OBC OEC SC	25.8 53 9.3 11.9
Type of ration card	White Blue red Yellow	15.3 65.2 12.5 7.0
Source of energy	KSEB KSEB+ Solar	92.6 7.4

Source: Primary Data

The table analyzed the socio-economic character of the sample households in Trissur Corporation. It is clear from the gender profile of the sample that the majority of the respondents are females. It means that women are the primary stakeholders in daily household activities and managing domestic water supply instead of men. Religion-wise classification of respondents reveals that the major religious groups of the corporation areas are Hindus and Christians. Hindus (53 per cent) dominate over other groups in the sample area. In the social group classification, 53 per cent of respondents belonged to the OBC category and it dominates overother social groups. 25.8 per cent of sample households are general category.

The document of the Ration card is a symbol of an individual's economic status in society. It is clear that the majority of sample households are blue card beneficiaries. Only 7 per cent of the sample households are Antyodaya-AnnaYojana beneficiaries (most economically back wad section of the society). Above 80 per cent of sample households are included in the APL category. The source of energy is one of the factor is determining water consumption in the sample households. KSEB is the main source in the sample area.7.4 per cent of sample households used the additional source of solar power supply.

Income is the most important variable determining the socioeconomic status of an individual. Household income is an important variable determining the level of water consumption and influences demand for water supply. Income also has a direct influence on willingness to pay. Based on the sample household's average monthly income, the following table categorizes them into three income groups for easy analysis

Table 4.14: Monthly Income

Income Categorization	Percent
Lower income	15.9
Middle income	71.4
Higher income	12.7

(**Note**: monthly income is calculated by adding monthly income of all members in a family)

Source: Primary Data

In the study, 15.9 per cent of the respondents have a monthly income of less than Rs10000 per month.71.4 per cent of them are middle-income class, with an income ranging between Rs 10000 to 25000 per month.12.7 per cent of respondents have an income aboveRs 25000 per month. Both corporation and KWA households' income and water consumption are positively correlated. Generalassumption is that higher-income household will have a higher willingness to pay and vice-versa.

Table4.15: Housing Characteristics of Sample Respondents

Variables	Description	Percent
Natural of locality	Apartment Quarters Housing colony	19.5 1.7 78.8
Type of dwelling unit	Pucca house Semi-pucca house Kutch house Semi-kutch house	74.5 17.3 6.5 1.7
ownership	Own Rent	92.6 7.4

Source: Primary Data

Nature of locality is the important variable needed for analyzing the availability of water supply and also influence water demand.78.8 percent of the sample households are settled housing colonies in the study. Type of dwelling unit is an important variable determining the water usage of sample households. Majority (74.5) of respondent lives in Pucca houses and other small percentage of sample households still leave in other type of houses in study area. Out of total respondents, 92.6 percent lives in Own houses and 7.4 percentage lives in rented houses. Total households living in rented houses, they are paying average rent of Rs 6807.7 per month.

Table 4.16: Size of Homestead

Size (Cent)	Percent
0-5	30.3
5-10	46.7
10-15	15.3
15-20	6.8
20-25	0.9

Source: Primary Data

The size of the respondents' residences is a significant background factor that affects the demand for water supply and the degree of water usage. The majority of sample households hold a small size of homestead. About half of the households hold a range of land area between sizes of 5 to 10 cents. This trend shows the general characteristic of the city-level holding of land area by city population.

Table4.17: Floor Area of Houses

Size of Floor (sq.ft)	Percent
0-500	9.9
500-1000	55.2
1000-1500	20.7
1500-2000	10.2
2000-2500	4.0

Source: Primary Data

The demand for water supply is influenced by house size as well. Homes in the size range of 500 to 1000 square feet or more make up more than half of the sample in urban areas. Water demand directly relates to the size of the house.

Table 4.18: Family Size

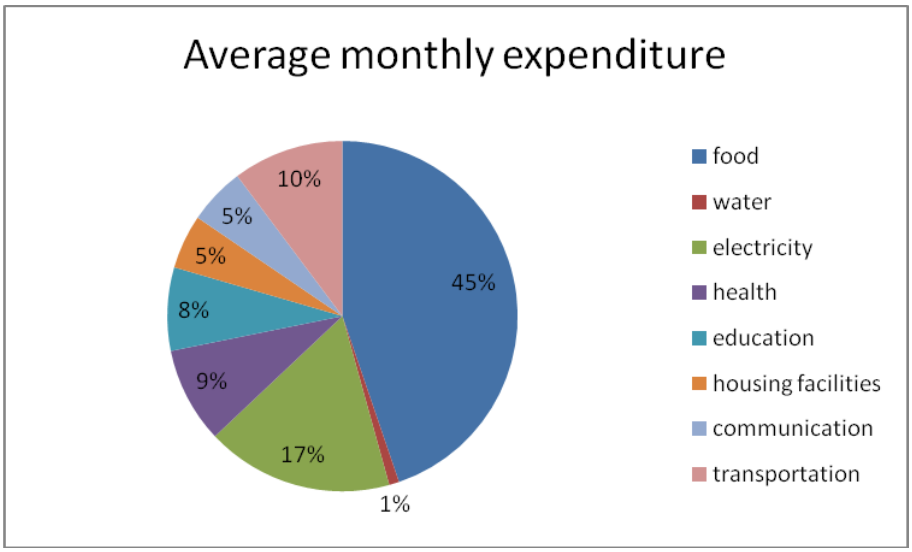
Family Size	Percent
Two	10
Three	23.2
Four	42.2
Five	16.7
Six	6.5
Seven	1.4

Source: Primary Data

The size of the family is representing the total number of family members living under a roof. A major portion of the sample was included in the category of four-member families and followed by three-member families. This trend shows most families are nuclear in urban areas. Family size is a strong background variable that determines the water usage and demand for water supply. Water consumption is depending on the number of family members. Family size and demand for water supply are positively correlated. An increase in the number of family members leads to an increase in water usage leads to increasing demand for water supply.

4.4.2 Monthly Household Expenditure of Basic Necessities

Figure 4.3: Average Monthly Expenditure of Sample Area



Source: Primary Data

The pie diagram explains the average monthly household expenditure pattern of basic necessities to the sample respondent. Sample households spend large amounts on food expenditure. It is followed by electricity and transportation expenditures. The sample household spends the least amount on monthly water supply. A sample household spent an average of Rs 92.84 for their monthly water supply. So almost all sample households are easily affordable to pay water charges in their water supply. Then all beneficiaries are benefited from this public water supply.

Generally, the consumption habit of an individual is depending on their income levels and their expenditure pattern. Household income level increase leads to an increase in the household's basic expenditure. The total basic expenditure increases lead to an increase in household water consumption in the sample area.

Table 4.19: Simple Correlation

Variables		Income	Total expenditure of basic necessitates	Water consumption
Income	Pearson correlation Sig(2-tailed) N	1 353	.711 .00 353	.523 .00 353
Total expenditure of basic necessitates	Pearson correlation Sig(2-tailed) N	.711 .00 353	1 353	.245 .00 353
Water consumption	Pearson correlation Sig(2-tailed) N	.523 .00 353	.245 .00 353	1 353

Source: Computed from Primary Data

The analysis table explains that three variables, monthly income, expenditure and water consumption are positively correlated. Income and basic expenditure are highly positively correlated. At the time, income and household water consumption are showing a moderate positive correlation. Also, the household total expenditure of basic necessities and expenditure of water supply are showing a very low positive correlation.

As a household's income increases, the trend of basic expenditure positively increases. The trend of household water consumption is also increasing. Here, Monthly income strongly influences household's basic expenditure and water expenditure and its related water consumption influences in at a medium level in the sample area. An increasing amount of household income is contributing to a strong positive direction of total basic expenditure. But the increasing trend of water expenditure is influencing at avery low level, in increasing the total basic expenditure of households in the sample area. It means the household's water expenditure is comparatively low compared to other basic expenditures. A family benefits from a high income level since their basic spending increases their basic consumption level. This leads to an increase in household water consumption and it helps to increase demand for water supply.

4.4.3 General Water Sources in Sample Areas

The primary source of water supply among sample households was piped water supply. Both Trissur Corporation and Kerala Water Authority, Trissur(TKWA) are supply drinking water in the sample area. In 2000, the Trissur Municipality was upgraded to the level of Municipal Corporation with adjoining panchayath areas. Out of the total of 55 wards, 32 wards are included fromold municipal areas and the other 23 wards are included fromadjoining panchayath areas. Trissur Corporation has supplied water in the old municipal area and TKWA (Thrissur Kerala Water Authority) has supplied water in adjoining panchayath areas including the corporation. Most of the samples in both connections are taking water connections in 2000-2005.

4.4.3.1 Main Source of Connection

The main source of water in the sample area is both public water supply and well water. Generally, piped water distribution consists of two types of beneficiaries. The first type of beneficiaries depends on metered water house connection and the other part of beneficiaries depends on public tap, through which water supply is free of cost. The urban people of small colonies and slums are depending on public taps as their main source of water. The present study is selecting the total number of the sample population depending on the house connection to public water supply.

Table 4.20: Main Source of Connection in Sample Area

Seasons	Corporation	KWA
	Household connection	Household connection
Non-summer	100	100
Summer	100	100

Source: Primary Data

In Corporation connections, the total respondents are depending on public water supply in both seasons. 52.5 per cent of corporation households prefer this connection as a resultof low water bill expenditure and 33.5 percentprefer it for proximity and 10 percent prefer it for no better alternative reasons and 4 per cent for other various reasons. Corporation sample areas are situated in the core town area.

In the KWA connection, the total number of respondents is depending on the public connection in both seasons. Intotal connections, 49.7 per cent of KWA households prefer this connection as the reason for proximity and 24.5 percent prefer no better alternatives and17.8percent prefer low water bill expenditure and 8 per cent for other various reasons. KWA sample areas are situated peripherally from the town area.

4.4.3.2 Supplementary Source of Connections

The supplementary sources are added to improve it or complete it in original sources. It means the supplementary sources are providing extra support to the deficiency situation of the primary sources.

The main supplementary source of water among the sample areas are well water and purchased water. Below half of the total sample respondents used both well water and purchased water as supplementary sources in the sample area. They used well water as a main supplementary source.However, a small percentage of people also use various sources of purchased water as a backup option.

Table 4.21: Supplementary Source of Connection in Sample Areas

season	Corporation						KWA					
	Corporation connection		Well water		Purchase water		KWA connection		Well water		purchase water	
	house	tanker	Own well	Well neighbouring	bottle	can	house	tanker	Own well	Well neighbouring	bottle	can
Non-summer	51.2	-	25.3	8.6	0.9	14	67.6	-	8.3	5.3	1.5	17.3
summer	35.7	3.2	31.7	8.1	0.9	20.4	54.8	4.5	11.3	5.3	3.0	21.1

Source: Primary Data

In corporation connection, above half of sample households are depending on public supply in non-summer seasons and other small percentages of respondents depend on supplementary sources. This trend changes in summer seasons and more respondents depends own wells and purchased can water for their water requirements.

In KWA connections, most number of the households depends onpublic water supply in both seasons and other small percentage of respondents depends on supplementary sources. In summer seasons, slight level reduce the number of public connection and increase the number well water and purchase water users in this area.

Only the small percentage of respondents depended on own well in non-summer in both connection areas. These percent declines in summer as the result of reduce or dry the well water level in both connection areas.

In summer, the both authorities are maintaining tanker water supply for high water shortage areas in the city. 3.2 percent of Corporation and 4.5 percent of KWA sample households are depending tanker supply in summer seasons. Out of total respondents in both corporation and KWA connections, majority are not paying extra amount for water supply. That is, they are getting water free of cost from own well, neighbors well and authorities tanker supply. Only a small percentage of households spent extra money on buying purchased water for their water requirements.

4.5 CONSUMER BEHAVIOR OF WATER CONSUMPTION, STORAGE, AND MANAGEMENT OF SAMPLE AREA

Drinking water is water intended for human consumption for drinking and other domestic purposes. Water is required for existence of life and their various activities of human being. However, the public water delivered and used for households in an important aspect of domestic purposes. Most of the residents of corporation receive public water for domestic consumption only. In this situation, it is important to understand the general behavior of consumers demand for this public water supply.

4.5.1 Water Consumption

Domestic water use includes indoor and outdoor uses at residences, and generally used to consume water for domestic purposes like drinking, cooking, bathing, washing, cleaning and sanitation purpose etc.Analysis of data in below table shows average quantity of water consumed by sample households for their various domestic purposes per a day.

Table 4.22: Average Quantity of Water Consumed per a Day

Quantity of Water (Liter)	Non-summer	Summer
500-1000	11.6	5.1
1000-1500	38.5	16.4
1500-2000	40.5	42.5
2000-2500	8.2	26.6
2500-3000	1.1	9.3
Total	100	100

Source: Primary Data

The table shows the majority of the sample respondents consumed a range of 1500-2000 litre of public water per day in their life. Followed by 38.5 per cent of the respondents also consumed a range of 1000-1500 litre of public water per day. In the general case, the water use habit of the consumer is increasing in the summer season as compared to non-summer. The table analyzed sample households' water use patterns increased in summer months like March, April and May. Majorities have consumed the range between 1500-2500 litreof public water per day in summer months. Also, 9.3 per cent of households consume at a range of 2500-3000 litre of public water per day in summer months. The trend shows consumption habits of households are increasing day byday.

4.5.1.1 Determinants of the Consumption - Multiple Regression Analysis

In the study, Household consumption (quantity of water consumed per day in non-summer) is determined by the important socio-economic variable like monthly income, size of family, size of homestead, and source of energy. Generally, the household consumption level strongly influences the demand for water supply. The above variables strongly influence the water consumption of sample households in the study. The multiple regressions help to identify the importance of the independent variable in how itinfluence and predict the dependent variable in the model.

Linear multiple regression is a statistical technique of modeling to explain the relationship between the dependent variable like the quantity of water consumption and independent variables like monthly income, size of family, size of homestead, and source of energy. The model is expressed in following

$$\mathbf{Y=\alpha+\beta_1X_1+\beta_2X_2+\beta_3X_3+\beta_4 D_1 +U}$$

Where,

Y - Quantity of water consumed per day in non-summer

α -Constant term

β_1, β_2…..β_4 -Regression coefficient

X_1- Monthly income

X_2- Number of family members

X_3- Size of homestead

D_1- Source of energy

U- Random error term

In the model, the independent variable like monthly income is expressed in Rupees, the size of the family is expressed as in number of family members and the size of the homestead is expressed as in square feet. A dummy variable is expressing a way of incorporating qualitative information into regression analysis. In the model, the Source of energy is expressed as a dummy variable and value of one is representing KSEB connection and value zero is representing other energy sources like Solar.

A regression model which contains the independent variables representing a mixture of both quantitative and qualitative variables is popularly known as the UNCOVA(Analysis of Covariance) model. In the model, the variables like monthly income, family size, size of homestead etc. represent quantitative variables and the source of energy is representing qualitative nature. Generally, a model is made to statistically 'equate' groups toadd to one or more variables which may differ across groups. In the model, one dummy variable is added with other quantitative variables. So the model is also known as the UNCOVA model.

The explanatory power of the model is expressed in terms of R2 (coefficient of determination). In the above model, the value of R2 is 0.325. It implies that 32.5 per cent of the variations of water consumption are influenced by variables like monthly income, family size, and size of homestead and source of energy in the model. The range of R2 value is expressed as 0.3 to 0.5 is the moderate effect (Srinivasan, 2020). So, the model shows the satisfactory (average) level of goodness of fit.

Table 4.23: Multiple Regression Analysis- Model Specification

Independent Variables	Coefficient Value	t Value	p Value
Monthly income	0.109	1.817	0.030
size of family	0.005	2.092	0.025
Size of homestead	0.177	3.041	0.003
source of energy	-0.080	-1.354	0.017

Source: Computed From Primary Data

Individual influences of the variable considered in the regression model on consumption were measured by the individual beta coefficient value, t value and its significant level. The table explains ρ value is less than 0.05, which is significant. So the independent variable like monthly income, size of family, size of the homestead and source of energy is statistically significant. It means changes in these independent variables are correlated with household water consumption. F value also shows significance. So, the group of independent variables has shown a statistically significant relationship between household water consumption.

The table explains the beta coefficient value of monthly Income, family size and size of the homestead positively influencing water consumption. The independent variable like the Source of energy is negatively correlated with household water consumption. It means increasing the amount of electricity charge leads to reducing the water consumption level of households. The electricity charge is normally high in the sample area.

Generally, the above said independent variables are connected. So, it is important to check multi- collinearity problem in the model.

Table 4.24: Multiple Regression Analysis -Variance Inflation Factor

Independent Variables	VIF
Monthly income	1.124
Size of family	1.143
Size of homestead	1.087
Source of energy	1.032

Source: Computed From Primary Data

The table explains the variance inflation factor. The result of the collinearity check reveals that there is very low collinearity between the independent variables of the model. The minimum possible value of VIF is 1.0 and values greater than 10.0 may indicate a collinearity problem. So, the model satisfies the basic assumption of 'no perfect multi-collinearity in the study.

City population growth is demanding an increasing trend of water consumption. The sample area is situated at the core of the city. So the trend of water consumption is increasing. Here also investigating the other important variables like water storage and water management by sample households. These two variables which strongly influence household consumption patterns in the area.

4.5.2 Water storage

Water is required for various purposes and is available in the tap for shorter periods. Sothe storage of water becomes essential in sample areas. In this study, the total sample respondents positively use storage facilities for a store of supplied drinking water.

Table 4.25: Store of Drinking Water at Home

Storage Facilities	Percent
Roof tank	87.7
Underground level tank	2.0

Container & others	10.3
Total	100

Source: Primary Data

The table shows the type of water storage facilities available to households in the sample area. Most of the sample beneficiaries possess overhead tanks to store water. Above, half of the respondents (57.5) have a tank capacity of 1000 litres. 20.7 per cent of the respondents have a tank capacity of 500 litres.10.5 per cent of the respondents have a tank capacity of above 1500 litres and the rest 11.3 per cent of the respondents have a tank capacity of less than 500 litres in the study. Water hoarding is good for urban consumers in the study area. This good storage practice helps in the availability of regular and adequate drinking water in this area.

4.5.3 Water Management

Reducing the amount of water user's consumption for their particular needs, such as domestic and non-domestic requirements, is known as demand-side water management.Generally, public water supply is only used for domestic purposes in the sample area. The Proper utilization of water in our homes can save precious water resources. In the sample area, most number of the sample respondents are considering water saving and the majority of them (75.7) practice water-saving measures in their homes.

Generally, the sample households are practicing the common method for reducing misuse of water consumption as depicted in the following table. The methods help to increase the efficiency of water utilization in the sample area.

Table 4.26: Method of Water Saving Measures Practicing in Home

Water Saving Measures	Percent
Use recycled water	28.3
Use Water saving automatic tap	10.4
Reduce the frequency of bathing/washing	4.4
Use automatic water control appliances	17.2
Drip irrigation	15.4
Total	75.7

Source: Primary Data

Out of the total, most of the sample household's observesthat this above-practiced water-saving measure should help to reduce the wastage of water resources. Most of the sample households use recycled water for vegetable garden irrigation purposes in the town area. Drip irrigation is also popular in the sample area. Most number of the sample households in town areas used modern water-saving appliances for their water consumption. The water-saving practices of the city dwellers in the study area have a favourable impact on each of them.

Water conservation is the practice of using water efficiently to reduce unnecessary water usage and protect available water resources in our boundaries. In the study, the sample households are practicing the methods of water conservation is homestead water management, rainwater harvesting and well recharging etc for conserving their water resource. Homestead water management means constructing tanks, protecting small ponds and any other type of water bodies maintained in our boundary for water conservation practices. The field survey observed that only small percentages (25.2) of the sample household arepracticing water conservation measures for their boundary.

Table 4.27: Method of Water Conservation Measures Practicing in Home

Method of Conservation	Percent
Rain water harvesting	14.8
Well-recharging	7.3
Homestead water management	3.1
Total	25.2

Source: Primary Data

An interesting point the table reveals is that, almost all sample respondents are aware of all general methods of water conservation. But, those who practice measures is very low. Out of the total respondents, only a few per cent are practicing water conservation measures successfully. The survey observed that the majority of the respondents believe that water should be saved at any cost.

The above picture shows that public water supply is more demanded by the sample households in their day-to-day life. At the time, the other side shows the tendency of most of the sample households in using storage facilities and store water resources in the sample area. The sample households give importance to water-saving measures and practice those measures properly. The sample households are also practicing in water conservation and give importance to homestead water management practices in the sample area. This information is also emphasizing the need of analyzing the present study.

So, the need to analyses Thrissur Corporation's water service delivery mechanism is important here. It needs to analyses the depth of effectiveness of water supply delivery by the corporation, as the condition of the sample household gives more importance to storage facilities and high dependence to store water.

4.6 EFFECTIVENESS OF LOCAL GOVERNMENT WATER SUPPLY

In the study, the concept of effectiveness is considered to measure the overall performance of water service delivery by the corporation. As mentioned earlier,the study is trying to measure what extent the corporation can achieve its objectives and policy goals in water service delivery functions. To measure the concept of effectiveness selection of appropriate indicators like availability, accessibility, affordability, water quality and water management in the study.

Water is recognized as a ‘human right ‘by the united nations general assembly on 28 July 2010. The article ‘universal declaration of human rights ‘states that “everyone has the right to life” since there can be no life without water to sustain it. So water must be considered a human right. According to the United Nations, water right entitles ‘everyone to have the right to sufficient, continuous, safe, acceptable, physically accessible and affordable water for personal and domestic use.On the other hand, the WHO views the need for a sufficient and secure water supply as the most important health requirement. WHO sustainable development goals target 6.1 calls for universal and equitable access to safe and affordable drinking water. According to the WHO concept ‘safely managed to drink water services’ means drinking water from an improved water source that is located on-premises, available when needed and free from contamination. Water management is managing the optimum use of water resources under defined water policies and regulations. Proper management of a municipal water system is essential to sustain cities and support the water security of society. Management also needs to be improved to ensure water provision and quality. The WHO consider thatimproved water supply and better management of water resource can boost counties' economic growth and can contribute greatly in poverty reduction.

The above information explains that sufficient and continuous availability, equitable accessibility, safe quality with affordable price and proper management is necessary for a good supply. These incorporating variables are very important to determine the effectiveness of the water supply. So, the present study selects these five variables for measuring the depth of effectiveness of the water supply. The good supply indicators are clearly explained below.

4.6.1 Availability

Water availability is the quantity of water available for usage by human beings. Availability of public supply meansthat every respondent gets sufficient quantity with continuous supply intheir everyday life. In the study, the concept of availability is considered to measure the time of water available to in-force piping supply.

Table 4.28: Availability of Water Supply

Days\season	Corporation		KWA	
	Non-summer	Summer	Non-summer	Summer
Daily	88.2	80.5	79.9	60.6
Alternative days	9.8	12.8	19.5	29.0
Two days	2.0	6.7	2.3	7.1
Three days	-	-	-	3.3
Total	100	100	100	100

Source: Primary Data

In Corporation connection, the availability of public water reveals that the majority of households get water every day in both seasons. However, the number of households is reduced in the summer season as compared to the benefit of daily water supply in the non-summer season. At the time, 11.8 per cent of sample households do not get a daily water supply in the non-summer season. Out of this total, 9.8 per cent of sample households get water on alternative days and another small percentage has access to water supply only in two days gap. This trend changed and declined in the summer season. In summer, 19.5 per cent of sample households are not getting a daily water supply. In this season also, only 6.7 per cent of household's gets good supply in two days gap.

In the KWA connection, 79.9 per cent of respondents get water on a daily basis. Only little percentage of sample households responded, said that they get adequate water supply on two days gap in non-summer.20.3 per cent of households are not getting daily water supply in non-summer season. This trend is increasing and 39.4 per cent of households are not getting a daily water supply in summer. In summer, 3.3 per cent of households gets water supply only in three days gap. In the sample area, most of the households depend on well water. Well water source is not potable in all seasons, but they still use them as there is no better alternative source.

Table 4.29: Adequate Quantity of Water Supply

Quantity\Season	Corporation		KWA	
	Non-summer	Summer	Non-summer	Summer
Always sufficient	78.2	63.6	72.2	58.9
Somewhat sufficient	21.8	33.2	27.8	36.6
Not sufficient	-	3.2	-	4.5
Total	100	100	100	100

Source: Primary Data

The efficiency of the water supply system is considering the availability of an adequate quantity of water to beneficiaries. In corporation connection, 78.2 per cent of respondents get sufficient water and others get somewhat sufficient water in non-summer. This trend changed in the summer season. In the summer, 3.2 per cent of sample households are not getting sufficient water. They feel a deficiency of water supply in the season. However, above half of respondents get always sufficient water and 33.2 per cent get somewhat sufficient water in the season.

In the KWA connection, 72.2 per cent of respondents get sufficient water in non-summer. This trend has declined and 58.9 per cent get sufficient water in the summer season. 4.5 per cent of respondents face deficiency in water supply as a result ofwater shortage in the summer season.36.6 per cent of households replied that they often get sufficient water in the summer season.

Table 4.30: Availability Index in Non-Summer

Variables	Mean Value	
	Corporation	KWA
Daily get water supply in non-summer	1.49	1.20
Number of days per week water supplied in non-summer	3.64	1.80
Adequate quantity of water supply in non-summer	1.42	1.35
Total Availability of water supply in non-summer	6.55	4.35

Source: Computed From Primary Data

The analysis table explains the mean difference of both Corporation and KWA connections and it shows the mean value is higher in Corporation connections. The Corporation is followed more regularity of water supply and existing sufficient water in both seasons as compared to KWA connections. This is because of the Corporation connection holders strongly demanded for regular public water supply and they are situated in core area of the city. At the time, the KWA connection holders are situated in peripheral areas of the city and they possess strong accessibility to supplementary source like well water. Demand is always influencesto the supply side and Corporation is giving more importance to satisfy this demand. So, the supplied quantity of water and supply time (days) followed by both Corporation and KWA are in different pattern in the sample area. The household survey reveals that water is available for average 3.64 days a week in Corporation connection and average 1.80 days a week in KWA connection.

Table 4.31: Availability Index in Summer Season

Variables	Mean Value	
	Corporation	**KWA**
Daily get water supply in summer	1.59	1.20
Number of days per week water supplied in summer	3.22	1.23
Adequate quantity of water supply in summer	1.70	1.60
Total Availability of water supply in summer	6.51	4.03

Source: Computed From Primary Data

In summer season, both corporation and KWA also follow sufficient and regular supply as well as non-summer season.However, according to both Corporation and KWA connection holders, the regularity and quantity of delivered piping water is lower during the summer than throughout the rest of the year. But the supplementary sources like tanker supply contribute to good supply in the sample area.

For statistical proof, independent t sample texts were used to identify the significant difference between the availability of public water for both corporations and KWA connections.

Table 4.32: Availability of Water Supply - Independent Sample t Text

Institutions	Mean Value	Mean Difference	t-Statistic	d.f	p value	Significant Value
Corporation	1.4511	0.34658	2.746	351	0.006	0.05
KWA	1.1045					

Source: Computed From Primary Data

The table explains P value is 0.006, which is less than significant value 0.05. Hence the null hypothesis (H0) is rejected at 5 percentage level of significance. It means, the differences between the above two mean values are statistically significant. So the availability of water supply from both Corporation and KWA are different. Most number of the respondents reported sufficient daily water supply is possible from Corporation and the number is much lower for KWA, where respondent reported having daily water supply.

4.6.2Accessibility

Access to water is a human right.The definition of a household with access to a piped water supply is one that has that supply available for drinking. All sample households are depending on house water connections in the study. Then, households in sample areas have easy access to a source of public water supply. Accessibility is measure to check whether sufficient, safe and good pressure of water accessible to everyone without discrimination. The total sample household that has access to drinking water throughout a day, but the force supply is available only in limited hours per day in the sample area. In the study, accessibility indicates that average hours available force water supply in the city.

Table 4.33: Accessibility of Water Supply in Hours per Day

Hours per day	Corporation		KWA	
	Non-summer	Summer	Non-summer	Summer
4	-	5.9	-	16.5
5	11.4	34.1	31.6	31.6
6	26.8	29.5	28.6	24.1
7	34.5	25.0	24.8	24.3
8	27.3	5.5	15.0	3.5
Total	100	100	100	100

Source: Primary Data

Generally, the duration of the average water supply is inthe range between 4-8 hours daily in sample areas at a force rate. In Corporation connection, the total respondent said that water supply is available between 4-8 hours daily in non-summer. In summer, 5.9 per cent of households said that they get a force water supply per day for 4 hours only. At the time 5.5 per cent of respondents replied that they get a regular force supply of water for 8 hours per day in the summer season.In summer, the Corporation is trying to bring regularity and equality of water supply to its beneficiaries.

In the KWA connection, also total sample households get water available between 4-8 hours daily in non-summer at a force rate. 16.5 per cent of households said that they are getting forced water supply for 4 hours per day in summer. At the time, 3.5 per cent of respondents said that they get regular forced water supply for 8 hours per day in the summer season. In summer, the KWA water supply has been rationed and most of the supply is irregular.

Table 4.34: Pressure of Water Connections

Water Pressure\Season	Corporation		KWA	
	Non-summer	Summer	Non-summer	Summer
Very good	26.4	10.3	13.5	8.3
Good	56.4	57.5	54.9	41.8
Average	17.3	28.6	31.6	39.1
Low	-	3.6	-	10.8
Total	100	100	100	100

Source: Primary Data

Piping water supply is available for throughout a day in sample area. But, the pressure of water supply is irregular. Generally, the force water supply is available in limited hours per day in sample areas. In Corporation connection, most of the respondents said that pressure of connection is almost good in non-summer. While 10.3 percent said that very good and 17.3 percentages said that average. More than half of respondents said that pressure of connection is also good in summer. Only 3.6 percentages of respondents said that pressure of water supply is low in summer.

In KWA connection, above half of total respondents said that pressure of connection is good, while 13.5 percent said that very good. The other half said that water pressure is average. Water pressure of KWA's water supply is almost good in non-summer. But this trend changes in summer season.10.8 percentage of respondents said that pressure of water supply is low in summer season. Only the small percentage of respondents said that water pressure is very good in summer. Here the sample respondents demand for the improvement in pressure of water in summer.

Table 4.35: Accessibility Index in Non-Summer

Variables	Mean Value	
	Corporation	KWA
Hours of water supply per day in non-summer	6.78	6.54
Pressure of connection is adequate in non-summer	1.91	1.87
Accessibility index	8.69	8.41

Source: Computed from Primary Data

The analysis table explains the mean difference and it show the mean value is higher in Corporation water service. Here, the Corporation supplies the water in average 6.78 hours per day to the beneficiaries and existing adequacy of water pressure pipeline issatisfactory. KWA connection holder's response found that hours of water availability and water pressure are comparatively low as compared to Corporation connections.

Table 4.36: Accessibility Index in Summer

Variables	Mean Value	
	Corporation	KWA
Hours of water supply per day in summer	6.33	6.29
Pressure of connection is adequate in summer	1.85	1.80
Accessibility index	8.18	8.09

Source: Computed from Primary Data

In the summer season, both Corporation and KWA have supplied water an average of 6.33 hours per day and an average of 6.29 hours per day respectively. Also, the water pressure in of both the Corporation and KWA networks are sufficient. But, the majority of the respondent's response observedthat the hours of supply and water pressure is comparatively low in summer as compared to non-summer. However, the Corporation comparatively supply better in summer as compared to KWA.

Table 4.37:Accessibility of Water Supply- Independent Sample t Text

Institutions	Mean Value	Mean Difference	t-Statistic	d.f	p value	Significant Value
Corporation	4.3432	0.1364	2.147	351	0.032	0.05
KWA	4.2068					

Source: Computed from Primary Data

The table explains P value is 0.032, which is less than the significant value of 0.05. Hence the null hypothesis (H0) is rejected at a 5 per cent level of significance. The result is statistically significant. So the accessibility of supplied water from both Corporation and KWA is different. Most of the respondents reported water supply is most accessible in the form of force supply available at proper and correct time from the corporation as compared to KWA.

4.6.3Affordability

Affordability is defined as paying capacity of the beneficiaries for availing the supplied water. Water supply is the provision of water by public utilities, but a regular charge imposedon people for the use of their local water supply. Pricing of water is also an important tool for the efficient utilization of resources and increasing the viability of public water supply. Generally, a Major part of the beneficiaries is paying for their received public water supply. Another small part of BPL families is situated in urban colonies, which do not pay for public water supply. This is because they do not need to pay for piped water and their water charge is levied by local authority.

In the present study, almost all sample respondents are paying for piped water received from their concerned authority. Based on the quantity of water consumed, a slab system is followed by Kerala for collecting water charges from different categories of consumers. Present water charges paid by the sample respondents are presented in the below table.

Table 4.38: Amount of Monthly Water Bill

Class	Corporation		KWA	
	Non-summer	Summer	Non-summer	Summer
≥50	2.7	2.3	-	-
50-100	80.0	74.1	51.1	46.6
100-150	17.3	23.6	31.6	35.3
150-200	-	-	17.3	18.0
Total	100	100	100	100

Source: Primary Data

Generally, both Corporation and KWA generate water bills in alternative months. Most of the sample households in both connections are paid more water charges in summer as compared to non-summer. Most of the households in the Corporation and nearly half of the households in KWA are paid water bills in the range between Rs 50-100 per month in both seasons.

In the Corporation connection, the sample household paid a minimum water charge of Rs 45 per month and a maximum of Rs 122 per month. The, majority of the sample corporation holders are paying water billsoffline through direct visits to the authority. However, a few per cent (7.7) of sample households also pay water bills through an agent. The Trissur Corporation gives the benefit of their beneficiaries to settle the water bill at different times of the year. Most households (76.8) regularly pay their water bill in alternative months in the last year. The other 23.2 per cent use the benefit of different time payment methods. Out of the total, 8.2 per cent pay quarterly, 7.7 per cent pay once in 6 months and the other 7.3 per cent pay one time settlement every year. The Corporation charges negligible extra finefor skipping or delaying regular payment of charges. The corporation gives the benefit to their beneficiaries to settle such water bills on an installment base. Here, the Corporation also charges a small amount of penalty for this settlement.9.5 per cent of sample households use this benefit in the present year.

In the KWA connection, the sample household paid a minimum water charge ofRs 75 per month and a maximum of Rs 199 per month. Here, the sample household pays water bills in both offline and online payment modes. Out of the total, 89.5 per cent paid water bills in offline mode through direct visits to the authority and the other 10.5 per cent paid water bill through online payment last year.KWA is not permitted to offer any concessions to its beneficiaries who pay for water. Beneficiaries are required to pay their water bills on time and on schedule. After that, everyone paid their water bill in alternative months last year. Any person who does not pay their water bill on time and on a regular basis will be required to pay an additional fee to maintain their access to water.

Table 4.39: Current Water Rate

Institutions	High	Normal	Low	Total
Corporation	11.8	75.5	12.7	100
KWA	26.3	73.7	-	100

Source: Primary Data

In corporation connection, most number of the respondents said that they get drinking water at a normal price.12.7 per cent of respondents also said that the water rate is low compared to other alternatives. 11.8 per cent said that the water charge is high. This is because; Thrissur Corporation's charge water rate is low as earlier. But, since 2017 the Corporation decided to increase the water rate and it applied to beneficiaries.

In KWA connection, the most number of the respondents also said that they use supplied water at in normal price. The other 26.3 per cent said that the water rate is high. Generally, to compare both corporation and KWA water rates in the domestic category, the corporation charges a low water rate as compared to KWA (table 4.5). A large proportion of sample households in both corporation and KWA said that normally the water rate becomes high in summer as compared to the non-summer season.

4.6.3.1 Metered Water Connection

A water meter measures the quantity of water that passes through a pipeline. A meter connection for public water supply is necessary for supplies to charge in proportion to the water used. Metering is help to judge whether the beneficiaries are over billed by the authorities for using a particular amount of water. Metering also helps suppliers keep track of how much water is being used and identify various leakages from supplying water.

Generally, the bulk of the water supply is consumed or billed on a metered basis. All connection in the sample areas aremetered.

Table 4.40: Preference of Meter Connection

Reasons	Prefer the Meter Connection			Not Prefer Meter Connection		Total
	Saving money	Accurate measure of water consumption	It compulsory to authority	Water pressure will fail	Meter breaker easily	
Corporation	10.2	77.8	2.5	2.0	7.5	100
KWA	9.8	75.2	3.8	2.3	8.9	100

Source: Primary Data

In corporation connection, above 90 per cent of sample households preferred to meter connection for their water supply. Most number of households agreed that the meter is an appropriate measurement for water consumption. However, 2.5 per cent of households accept meter connection because ofthe compulsion of authority. Only 9.5 per cent do not prefer the water meter as the reason for low water pressure and frequent damage of the meter.

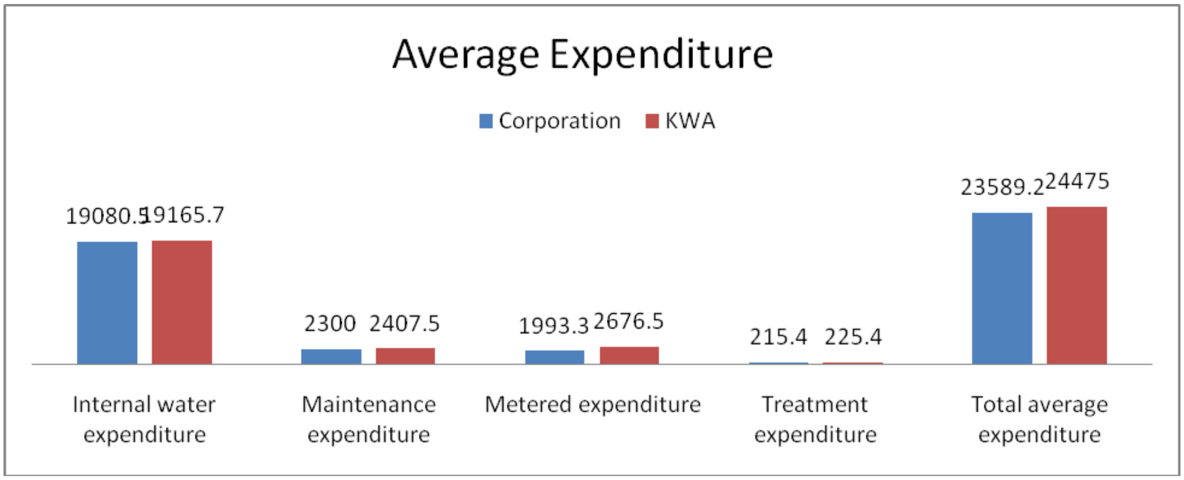
In KWA, most number of the sample households prefers to meter connections for their water supply. However, 3.8 per cent of households said that they prefer water meters only because of the compulsion of authority. At the time, 11.3 per cent of households are not preferred to take a water meter connection. Frequent meter breaking is the major reason for dislike.

4.6.3.2 Expenditure

Generally, public water supply sources arefunded by the government. However, almost all service providers charge tariffs to recover part of their total cost of water service from beneficiaries. A tariff structure is a set of procedural rules used to determine the conditions of service and monthly bills for water users in various classes or categories.

Cost is defined as the amount spent by households on water services. The cost of supplying water consists of a large amount of fixed costs and a small amount of variable costs that depend on the amount of water consumed. The total cost of the water supply by the households includes fixed cost of internal expenditure and variable cost of maintenance or repair expenditure, metered water expenditure and water treatment expenditure etc. Always, the most number of the beneficiaries will be able to pay the cost for their improved service. The below chart depicts how many households can afford to pay for their water supply.

Figure 4.4: Water Supply Related Expenditure of Sample Household



Source: Primary Data

The chart explains that the average yearly expenditure paid by sample households in both KWA and Corporation connections. A sample household spent total expenditure for water supply is depicted here.The overall cost of a household includes originally spent fixed amounts for initial costs such connection fees, installing pipes, cost of tap and meter material, the cost of storage facilities, etc. and other expenses like maintenance, metered and water treatment expenditures etc. When comparing both Corporation and KWA connections, a household's average initial expenditure and other variable expenditures are high in KWA connections.

Table 4.41 Affordability Index (Cost of Service Index)

Variables	Mean Value	
	Corporation	KWA
Internal water expenditure	2.20	2.25
Maintenance(Repair) expenditure	2.32	2.37
Metered water expenditure	2.41	3.13
Water treatment expenditure	1.19	1.20
Cost of service index	8.12	8.95

(**Note**: The study used, cost of service index measuring affordability of service.)

Source: Computed from Primary Data

The analysis table explains the amount of money needed to cover water supply expenses by beneficiaries in the sample area. The table compares mean values. It identified that the Corporation's mean value is low from KWA. Monthly water charges are the lowest for the corporation compared to KWA. Household investment in storage, connection fittings, repair costs, treatment costs etc is also higher for the KWA connections. These expenses indicate the possibility of irregularity and low quality of KWA water supply. According to the table, all of these water-related fees were regarded as largely fair by the corporation's beneficiaries. So, the corporation connection holders can afford low expenditure for their water supply as compared to KWA connection holders in the sample area.

Table 4.42: Affordability Index- Independent Sample t Text

Institutions	Mean Value	Mean Difference	t-Statistic	d.f	p Value	Significant Value
Corporation	2.3205	0.17258	4.130	351	0.000045	0.05
KWA	2.1479					

Source: Computed from Primary Data

The table explains P value is 0.000045, which is less than the significant value of 0.05. Hence the null hypothesis (H0) is rejected at a 5 percentage level of significance. The result is statistically significant. So, both Corporation and KWA connection holders afford the water-related investments are different for their satisfying water service.

4.6.3.3 Willingness to Pay

Willingness to pay provides an indication of the value that household place on improved water supply. It also assesses demand for service improvement. Generally,most households can typically afford to pay more for water provided the price increase is accompanied by improved service. The majority of the sample households in both connections are willing to pay more for current water charge. Only a small percentage is not willing to pay a higher rate. The high rate of willingness to pay reveals the urgent need to improve both the quantity and quality of piped water.

Table 4.43: Maximum Charge for Willing to Pay

Class	Corporation	KWA
0-50	12.7	15.0
50-100	51.4	27.2
100-150	22.7	24.8
150-200	-	15.0
Total	86.8	82.0

Source: Primary Data

In Corporation connection, 86.8 per cent of respondents are willing to pay more water charges in future for the current water supply. The sample households are willing to pay to add a minimum ofRS2 and a maximum of RS7 per month in the current water supply for the future. Same time, 13.2 per cent of respondents said that they are not willing to pay more charges for future supply.

In KWA connection, 82 per cent of respondents are willing to pay more water charges in future for the current water supply. Here, the sample respondents are willing to pay adding a minimum of Rs 2 and a maximum of Rs 10 per month in the present supply for the future. 18 per cent of respondents are not willing to pay a higher rate for future supply.

The small percentages of the sample respondent in both connections are not willing to pay higher rates in future. Within the sample households, one part said that they are satisfied with the current water supply in their concerned authority. The second part said that they are already paying the higher rate in the current water supply, particularly KWA beneficiaries who said that they pay a normally higher rate for the present supply. The third part said that water service is the responsibility of municipal authorities and they should manage it.

The above description said that water payment is an important one and it decides the quantity of available water service. Paying for water is a key factor determining the life of the water supply. This statement is true that the study (Choudhary, 2012) views the residents can pay and they are also willing to pay provided they get the desired levels of service.

4.6.4 Water Quality

The water supply required for personal or domestic use must be safe without any type of contamination. An analysis of the efficiency of the water supply system, without considering the quality of the water supply system is incomplete. In the study the quality of water from the public water supply has been assessed by analyzing the beneficiary's response regarding the taste, smell and colour of supplied water.

Table 4.44: Quality of Water Supply

Quality Indicators	Colour			Taste			Smell		
	Good	Poor	Very Poor	Good	Poor	Very Poor	Good	Poor	Very Poor
Corporation	21.8	28.6	19.5	32.8	32.7	4.5	20.3	37.7	12.0
Total	70			70			70		
KWA	20.9	26.8	23.6	30.0	36.8	4.5	16.8	36.8	17.7
Total	71.4			71.4			71.4		

Source: Primary Data

In Corporation connection, the bad appearance of supplied water was reported by 70 per cent of sample households in the study. However, within the sample size, 21.8 per cent of households reported good colour, 32.8 percent reported good taste and 20.3 per cent reported good smell. At the time, the remaining 30 per cent of households did not have any complaints about the quality of drinking water. They rated these three quality indicators as good.

In KWA connection, the bad appearance of supplied water was reported by 71.4 per cent of sample households. However, 20.9 per cent of households reported good colour, 30.0 percentage reported good taste and 16.8 per cent reported good smell. The remaining 28.6 per cent of households did not have any complaints about the quality of drinking water. They also rated three quality indicators of colour, taste and smell are good.

In the above analysis, only a small percentage of sample households in both connections reported in their use of supplied water are perceived as safe for drinking purposes. For the rest percentage of majorities, few perceived it was unsafe and others were unsure about the safety. The result of the field survey has identified problems of bad colour, bad taste and bad smell in both connections. Most of the respondents in both connections mostly highlighted and reported problems of muddy water, chlorine smell and chlorine taste etc in their water supply.

Table 4.45: Water Quality Index

Variables	Mean Value	
	Corporation	**KWA**
Colour	3.68	3.54
Taste	3.50	3.40
Smell	3.71	3.61
Water Quality Index	10.88	10.55

Source: Computed from Primary Data

The analyses table explains that the mean difference in supplied water quality of both Corporation and KWA, which is a higher mean value identified in the Corporation connection. The higher value indicates better water quality. In this dimension, Corporation performance is superior to KWA. This is because the corporation has used extra methods like frequently cleaning wash-out valves, developing float intake programsetc used for the improvement of supplied water quality. Also, the Corporation has conducted frequent water quality testing for improvement of safe water supply in the area.

Table 4.46: Water Quality Index-Independent Sample t Text

Institutions	Mean Value	Mean Difference	t-Statistic	d.f	p Value	Significant Value
Corporation	3.6266	0.10900	1.956	351	0.05	0.05
KWA	3.5107					

Source: Computed from Primary Data

The table explains P value is 0.05, which is equal to a significant value of 0.05. Hence the null hypothesis (H0) is rejected at a 5 per cent level of significance. So the result is statistically significant. It means that the supplied water quality of both corporations and KWA is different. The corporation performed better than the KWA in terms of adequate quantity of water supply in the sample area.

4.6.4.1 Treatment of Pipe Water

Most of the sample household's opinion is that the water available in the pipes is not safe to drink. It needs to be purified. In the sample area, most of them used tap water for drinking and they treated it before drinking and treated water at home. A large portion of sample households do take the following measures to treat water for their use.

Table 4.47: Various Purification Methods for Treatment of Water Supply

Purification Methods	Corporation	KWA
Boil	57.3	62.4
Water filter	20.5	8.3
Sieve it through cloth	4.5	5.3
Boil & sieve it through cloth	9.1	15.0
Don't do anything	8.6	9.0

Source: Primary Data

The most common method used for drinking water purification was boiling in the sample area. A major portion of sample households in both connections are used to boil the water to make it safe to drink. The other part of respondents in both connections are used various methods of filtration and sieved it cloth for their water purification. Some others have used both methods like boiling and sieving it through cloth together forensuring safety. Notably 8.6 per cent of sample households in corporation connection and 9 per cent of households in KWA connection did not use any purification method.

4.6.5 Water Management

Water management is a useful technique for keeping water resources under control, ensuring their proper flow, and preventing harm to human life while maximizing its beneficial usage. An efficient water supply means safe and continuous water available to beneficiaries. Water management ensures and efficient mechanism of water supply, which is liable to increase in demand at any time, particularly in the summer seasons.

Generally, the water demand varies from season to season. People are facing water problems in different seasons, especially summer seasons. The present study reflects that 35.5 per cent of the corporation sample households and 30 per cent of KWA sample households are facing water shortages in summer season. They are facing a serious shortage in three months ofMarch, April and May. The field survey observed that the regularity of piping supply is different in different areas of summer seasons. However, both authorities take appropriate measures for water tanker supply to be used in water-scarce areas to solve drinking water shortage at free cost in every summer season in the sample area.

Table 4.48: Sufficient Water from Tanker Supply

Tanker Supply	Yes, Always	Yes, Sometimes	No	Total
Corporation	20.4	11.6	3.5	35.5
KWA	16	9	5	30

Source: Primary Data

In the summer season, the majority of respondents in both Corporation and KWA connections replied that supplied quantity is adequate for their needs. However, in Corporation, 11.6 per cent of households said that supplied quantity is adequate only sometimes and other times insufficient. 9 per cent of KWA households also said the same opinion as corporation households in water availability from tanker supply. At the time, 3.5 per cent of corporation respondents and 5 per cent of KWA respondents replied that water supply has been rationed and reported that they do not get sufficient water from tanker supply in the summer season. They are depending on another source of water for their requirements.

Table 4.49: Water Management Index

Variables	Mean Value	
	Corporation	KWA
Take appropriate action by authority to solve water shortage in summer	0.89	0.84
Availability of sufficient water in summer	0.57	0.51
Water management index	1.46	1.35

Source: Computed from Primary Data

The analysis table explains the mean difference in the water supply management of both the Corporation and KWA and it identified mean value is higher in Corporation management. It means the Corporation is managing water supply services better than KWA. Most of the Corporation connection holders reported no shortage of water during the summer months. This is because of the strong supplementary sources like tanker supply provided by the Corporation at the free cost of beneficiaries in the sample area. KWA also provides tanker supply facilities in summer but KWA connection holder's opinion found that it is not much effective as Corporation tanker supply.

Table 4.50: Water Management Index-Independent Sample t Text

Institutions	Mean Value	Mean Difference	t-Statistic	d.f	p Value	Significant Value
Corporation	0.7295	0.05285	0.647	351	0.042	0.05
KWA	0.6767					

Source: Computed from Primary Data

The table explains P value is 0.042, which is less than the significant value of 0.05. Hence the null hypothesis (H0) is rejected at a 5 percentage level of significance. So the result is statistically significant. It means the Corporation's water management for water supply services is much more effective than KWA water management. Around 17 per cent of KWA respondents reported depending on other payable water sources much more as compared to Corporation connection holders in the sample area.

Table 4.51: Dependence on Other Sources

Other Sources	Can Water	Private Tanker supply	Well Neighbouring	Total
Corporation	5.3	1.1	2.3	8.7
KWA	8.3	4.5	4.2	17

Source: Primary Data

In this situation, the above small proportion of households in both connections are depending on other sources of water like purchased can water, private tanker supply and neighbors' well for solving frequently reported drinking water shortages during the summer season. Out of the total respondents, a small percentage of respondents are paying for water as they spot money on buying can water and private tanker supply. At same time, the other small part of respondents is not paying for another source of water in sample areas. They are getting water free from other sources including neighbors well in the sample areas.

4.6.6 Water Service Delivery Index

The water service delivery index has been calculated by aggregating the above availability index, accessibility index, affordability index, water quality index and water management index used in the study. Accordingly aggregating the five indicesare brought to the overall performance of water service delivery by the institutions. The main indicators like Availability, Accessibility, Affordability, Water Quality and Water Management are determining the effectiveness of water supply services in the study. Generally, identify that these five indicators do not give equal importance to the delivery of water supply service. So it is necessary to give weightage to each indicator based on its importance. The total weight of the indicator is given to one in the study.

In the above important indicators, water quality is considered to be most important indicator in water supply from the demand side. The UN declared "universal access to safe drinking water is a fundamental need and human right". A safe water supply is vital for public health and a healthy environment. Water quality is the most important indicator of demand by beneficiaries in the water supply. Their water consumption is highly dependent on water quality. So, a weight of 0.4 is given to the water quality indicator.Second, considers both indicators of water availability and water accessibility asimportant indices ofwater supply. Water is safe; the other priority is to avail a sufficient quantity of water for human purposes. Easily accessible methods (distance, time, pressure) also give the same priority to adequate quantity of good water supply by the demand side. So, a weight of 0.2 is given to these two indicators in the study. The other indicators like affordability and water management are considered a weight 0.1 in the water supply. This is because; the beneficiaries have no choice for their affordable payment for water supply. The concerned regularity should decide waterrate. Water management is also a priority for its concerned authority. These two indicators are given the same priority from the supply side.

Table 4.52: Comparison of Mean Value of Performance Indexes

Indicators	Corporation			KWA		
	Mean Value	Weight	Weighted Mean	Mean Value	Weight	Weighted Mean
Availability index	6.55	0.2	1.31	4.35	0.2	0.87
Accessibility index	8.69	0.2	1.738	8.41	0.2	1.682
Affordability index	8.12	0.1	0.812	8.94	0.1	0.894
Water quality index	10.88	0.4	4.352	10.55	0.4	4.22
Water management index	1.46	0.1	0.146	1.35	0.1	0.135
Total	NA	1	8.358	NA	1	7.801

Source: Computed from Primary Data

The analysis table compared the overall performance of water supply delivery service by both Corporation and KWA. To compare the averages, the mean value is higher in the Corporation. It means the corporation is much better to water supply delivery in terms of Availability, Accessibility, Affordability, Water Quality and Water Supply management performances as compared to KWA.

Water service delivery index= 1/5(Availability + Accessibility + Affordability +Water Quality + Water Management)/1

To apply this equation, get the result is depicted in the below table.

Table 4.53: Water Service Delivery Index

Water Service Delivery Index	Corporation	KWA
	1.672	1.560

Source: Computed from Primary Data

The table compared the overall performance of the water service delivery mechanism by both corporation and KWA. Whencomparingthese indices, the result shows that corporation is performing water service delivery much better than compared to KWA water service delivery. Here, the Corporation is well performing in more effective water supply delivery to its beneficiaries as compared to the KWA water supply service.

4.7 Beneficiary's Satisfaction on Current Water Supply Service

The section examines the overall level of satisfaction with water supply frombeneficiaries' point of view. Most of the respondents in both connections are satisfied with the present water supply services provided by their concerned authority. The sample respondents' common opinion is that the concerned authorities try their maximum to ensure better quantity and quality of preserved water supply with achieving maximum efficient supply to the society.

Table 4.54: Rating the Level of Present Water Supply Satisfaction by Beneficiaries

Satisfaction Level	Corporation	KWA
High satisfied	56.8	38.3
Satisfied	18.2	21.1
Low satisfied	8.6	15.0
Total	83.6	74.4

Source: Primary Data

The survey examines 83.6 percent of the Corporation and 74.4 percent of the KWA respondents who replied that they are satisfied with thepresent water supply by their concerned authority. Within the sample, more than half of the corporation respondents replied, they are highly satisfied with the present water service. However, a small percentage of the corporation sample respondents replied, they are not satisfied in some cases. In KWA connections, only 38.3 per cent of the respondents replied, they are highly satisfied with the present water supply system. The other 15 per cent of the KWA respondents replied that their satisfaction level is with the present water supply. The survey observed, when comparing both Corporations' and KWA's present water supply system, more per cent of corporation sample respondents are satisfied with water supply services as compared to KWA water supply services.

At the time, 16.4 per cent of the Corporation respondents and 25.6 per cent of the KWA respondents are indicating dissatisfaction with the present water supply service. The main reasons for their dissatisfaction are explained in the below table.

Table 4.55: Major Reasons of Present Water Supply Dis-Satisfaction by Beneficiaries

Reasons	Corporation	KWA
Low quality of supplied water	4.1	7.5
Frequent service disruption	5.0	8.3
Lack of adequate quantity	2.3	4.5
Low frequency of water supply	5.0	5.3
Total	16.4	25.6

Source: Primary Data

Within the total sample, the Corporation connection holders said that they face the problems like low frequency of water supply and frequent services disruption problems in their area. The KWA connection holders said that they face the main problems like frequent service disruption and low quality in supplied water. To compare both sides, the KWA respondents face more problems in the current water supply as compared to the Corporation connection in the sample area.Therefore, KWA respondents requested more efficient future water supply than their present supply.

4.8 Conclusion

The chapter is concluding that the Thrissur Corporation is performing well to attain its water service delivery. The Corporation supplied public water 24/7 hours per week and provides 7 or 8 hours of force supply per day to its beneficiaries. The Corporation is promoting individual house connections which supplied 24 hours of public tap water in its whole boundary, free of cost. The Corporation charged a low tariff rate for the first few units and later higher amounts of uses are charged at a higher rate. Most number of the Corporation households comes under the first slab in the sample area. The Corporation is also subsidizing poor households with a reduced connection rate for water. So the poor people are more included in the water supply system. The Corporation also keeps a regular water supply in both non-summer and summer seasons. In summer, the additional quantity of water provides to water shortage areas through tanker supply at free cost. Local bodies' self-water supply schemes are also improving water distribution in summer. The Corporation also takes considerable steps to reducing leakages and illegal connections through proper supervision in both seasons. The Corporation conducts regular tests for improving water quality and cleans up all piping valves at regular time intervals, which resulted in quality improvement. The above information concludes the Corporation has a much better than sufficient and highly accessible piping supply, affordable price, and good quality with efficient management as compared to KWA water supply. So the chapter proves that decentralized water service delivery system is more effective than centralized water service systems in Kerala.

Chapter V

ROLE OF GOVERNANCE FOR EFFECTIVE WATER SUPPLY

5.1 INTRODUCTION

The chapter discusses role of governance in assisting implementation and providing the community with a reliable water supply service. The World Bank defined governance as an institution by which authority in a country is exercised for the public good. Governance embraces the relationship between a society and its government. Service delivery is an essential function in the relationship between government bodies and communities. Government is responsible for the delivery of public services to the community. The provision of water supply is one of the basic service delivery functions of the government and it takes action to support for improvement of public water supply delivered to the community. Here it is important to analyses the depth of the relationship between the government and its community for the implementation of effective water supply. Important variables like Reliability, Transparency, Accountability, Communication, and Participation are chosen and used in the study to achieve this goal. The chapter is concluding that the governance factor is the most important element in support of the depth of effective water supply. Here the study also attempt to prove that, the involvement of governance has a favourable impact on a corporation's effective water supply

5.2 GOVERNANCE SUPPORT FOR EFFECTIVE WATER SUPPLY

Governance was previously defined almost as a synonym for government, and the act of steering society and specifically about authoritative direction and control. Governance is currently defined as a much broader concept that involves a broad range of actors in the system, which contributes to fragmental decision-making and implementation. Governance addresses linkages and processes between and within organizations and social groups involved in decision-making, both horizontally across sectors and between urban and rural areas, and vertically from local to international (Rogers and Hall, 2003).

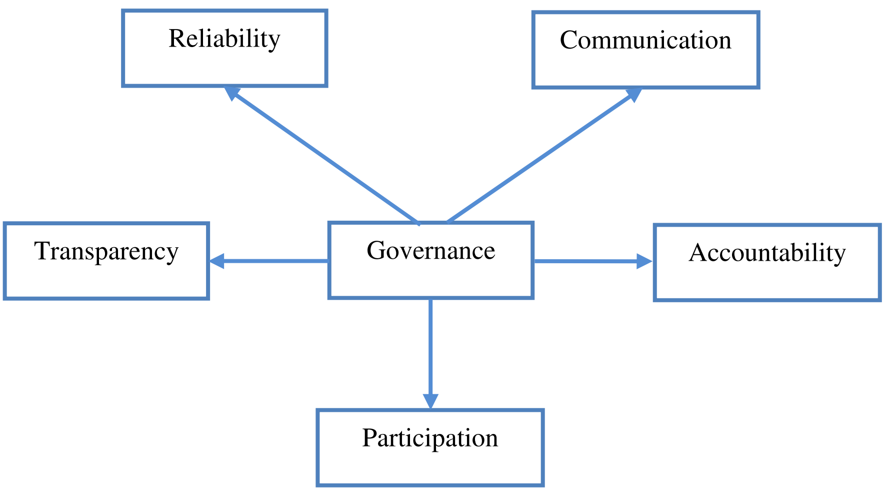
The 74th amendment of the Indian constitution was a landmark in the history of local governance in the state as it led to the strengthening of the municipality as an institution of local self-government. The functions and duties of urban local government are outlined in the constitution's 12th schedule. This schedule specifically lists out the function to be performed by the municipal bodies. Primary responsibility for the provision of water supply services usually rests with the municipal government. Then the municipal body is performing in the city-level water supply scenario. However, the state water supply system is depending on a systematic institutional setup. Both central and state governments are influencing water supply as largest funder, setting overall policy framework and setting technical standards and norms etc.

The third chapter discusses in detail the role of state's public water supply service's institutional growth, strong funding execution, and role of government support in implementing rules and policy frameworks. To do this, government institutions require organizational structures and suitably qualified people who must be supported to deliver the services they are responsible for (Whitaker, 1980).

Along with the above important elements, the administrative relationship and citizen participation are also important elements determinate governance support for good water supply and its related services. For a detailed analysis of both administrative relationships and citizen participation, it is necessary to conduct a primary survey of beneficiaries.

The defining characteristic of the core concepts like Reliability, Transparency, Accountability, Communication and Participation etc. is to build up a good governance structure. These key governance principles are considered to measure better institutional performance, efficient management and equitable delivery of service to the communities. These five variables are always interrelated and considered to be hallmarks of good governance. The UNDP suggest that, these five variables are contributing to the sound governance atmosphere for water service delivery performance. Based on the above information, these five variables are selected for analyses of the relationship between administrative organizations and their beneficiaries involved in the water supply. These important variables are depicted in the following chart.

Figure 5.1: Governance Principles



5.2.1 Reliability

Reliability is defined as an entire system performing its function for a specified time. In the study, the term reliability is used to measure the stability and consistency of the water supply. The parameter also considers the regularity of supply and maintenance of adequate supply in both non-summer and summer seasons. The term reliability is measured based on variables like occasional failures happened with water supply, the time taken to solve the problems, immediate response by authorities and fair services etc in the study. So, simply defined the term reliability is a measure of how long an asset can operate without issues.

5.2.1.1 Disruption in Water Service Last Year

In Corporation connections, 80.5 per cent of the sample respondents said that they faced various types' disruptions in water service in the last year. The other portion (19.5) opinion that they are never faced any type of water-related problems in water supply and its related services in last year. In KWA connections, 81.2 per cent of the sample respondents said that they are facing water-related disruption in their water supply in the last year. The other 8.8 per cent of the sample respondents said that they are free from all disruption in their water supply.

Table 5.1: Disruption of Water Service of Sample Area, During Last Year

Reason for Disruption	Corporation	KWA
Frequent breaking of pipelines	21.4	23.6
Present expensive billing	3.2	8.5
Piping maintenance work	21.2	12.6
Main pump or pipe broken	13.8	14.5
Service disruption	20.9	22.0
Total	80.5	81.2

Source: Primary Data

The analysis table explains the number of major disruptions related to water services faced by both connection holders in the sample area. Two types of disruptions are happening here. The first type of disruption that is happening related authorities is cleaning and maintenance work of main pipelines and other related services. In this situation, both Corporation and KWA are advance informing and arranging alternative methods for solving these types of disruptions at free cost. The other and second types of disruption like expensive billing, pipe breaking, and various service disruptions like irregular supply, low pressure etc are mainly faced by households in both connections in the study.

To compare the major disruptions that happened in both Corporation and KWA, the majority of the KWA respondents said that they faced more different problems like the frequent breaking of pipelines, expensive water bill amount and various types of service disruption, during last year. Only 12.6 per cent of KWA households replied that they faced disruption caused by authorities piping maintenance work last year. 21.2 per cent of corporation households were facing this problem last year. Here it is pointed out that the Corporation has done cleaning and piping maintenance work regularly and frequently. The table explains the frequent breaking of pipelines and service disruption as compared to KWA faced by both Corporation and KWA connection holders in the study. However, the problems affected KWA connection holders more, according to the study.

Table 5.2: Number of Times to Happen Major Interruption in Last Year

Number of Interruption	Corporation	KWA
1	8.6	8.3
2	16.8	18.0
3	27.7	33.8
4	9.5	9.0
5	4.1	2.3
6	7.3	5.3
7	2.7	0.8
8	2.3	2.3
9	1.4	1.5
Total	80.5	81.2

Source: Primary Data

The table explains that both connection holders faced only less than 10 times major water service interruptions during last one year period. In the field survey, the majority of the sample respondents in both connections replied that major water service interruptions happened 2 or 3 times in their service last year. KWA connection holders face more problems in their water supply as compared to corporation connections. Both connection holders said that their concerned authority always tried there maximum to reduce the number of major water supply interruptions.

5.2.1.2 Report on Interruption of Water Service by Beneficiaries during the Last Year

According to the field survey, the complete sample of respondents from both connections, they immediately report their water supply disruption issue to the relevant institutions in order to get it resolved. The following table explains the number of times they contacted authorities to register their complaints related to water service in the last year.

Table 5.3: Number of Contact by Beneficiaries for Solving Interruption in Last Year

Number of Contact	Corporation	KWA
One	59.5	45.9
Two	13.6	10.5
Three	7.3	9.8
Four	-	9.0
Five	-	6.0
Total	80.5	81.2

Source: Primary Data

In Corporation connection, more than half of the sample respondents said that they contacted service providers just once in last year to address their water service issues and were satisfied with the outcome. The other few per cent said that they contacted two or three times for solving their water service problems. In KWA, 45.9 per cent of the sample respondents said that they are contacted service providers at once and got good results. The remaining percentages said they are satisfied in get good results and their water-related problems were solved with two or more contact. Within the sample, 6 per cent said that they get a good result after 5 times of their contact during last year. The table concludes corporation authority is considered to take immediate action to solve problems for their beneficiaries and smoothing to its services.

5.2.1.3 Authority Takes Action to Solve Problems

In the survey, more than half of the sample respondents replied that their concerned institution takes immediate action to solve their major water problems in almost all situations. 68.7 per cent of Corporation connection holders and 56.4 per cent of KWA connection holders are responding that their institution takes sudden action for solving water supply problems. At the same time, 11.9 per cent of the Corporation connection holders and 24.8 per cent of the KWA connection holders replied that their concerned institutions take more time, especially 2-5 days to solve water service problems after they are conforming matters to the institution. It is clearly explained in the below table.

Table 5.4: Days Required for Solving Problem by Institutions in Last Year

Number of Days	Corporation	KWA
Two	0.5	2.2
Three	7.3	6.8
Four	4.1	12.0
Five	-	3.8
Total	11.9	24.8

Source: Primary Data

In the field survey, 11.9 per cent of the sample respondent opinion that the corporation was taking a minimum of 2-4 days for solving their water service complaints last year. 7.3 per cent of respondents claim that the corporation needs a minimum of three days to address significant water supply problems. 24.8 per cent of the sample's respondents said that the KWA was taking at least 2.5 days to resolve their water service issues. 12 per cent of respondents claim that KWA takes a minimum of four days, while 3.8 per cent claim that KWA needs at least five days to resolve severe issues. KWA was taking more time to solve its beneficiary's problems as compared to corporation. Here, The KWA manager said that the authority is working on various divisional tasks and functioning in several subsections. As a result, problem-solving takes more time.

5.2.1.4 Water Disruption Problem in summer

As compared to non-summer, the total sample respondent's opinion that the water disruption problem is high in summer seasons in the sample area.

Table 5.5: Water Disruption Problem by Institution during Summer Season

Institutions	Very High	High	Medium	Total
Corporation	10.3	29.3	60.4	100
KWA	12.0	35.1	52.9	100

Source: Primary Data

In Corporation connection, the major half of respondents replied that they are facing a medium level of water disruption problems in non-summer season. Fewer than half of those respondents claimed that their institution's water disruption issue is severe throughout the summer. While 10.3 per cent of respondents claimed that the prevalence of these issues is very high. In KWA connection, 52.9 per cent of the respondents replied that they are facing usual water disruption problems in non-summer. The other half of the sample's respondents remarked that summer time water interruption issues are more severe than during other seasons. While 12 per cent of respondents said that their institution has a high level of these issues during the summer months.

Here, it is important to consider the Corporation secretary's perspective. According to him, their crew performs more pipeline maintenance work during the summer, including pipeline replacement, valve cleaning, and pipeline replacement. Given that there is just a normal amount of water in the pipeline; summer is an ideal time to complete this type of operation. Thus, with maintenance work, issues such as pipe breaks and water waste can be avoided.

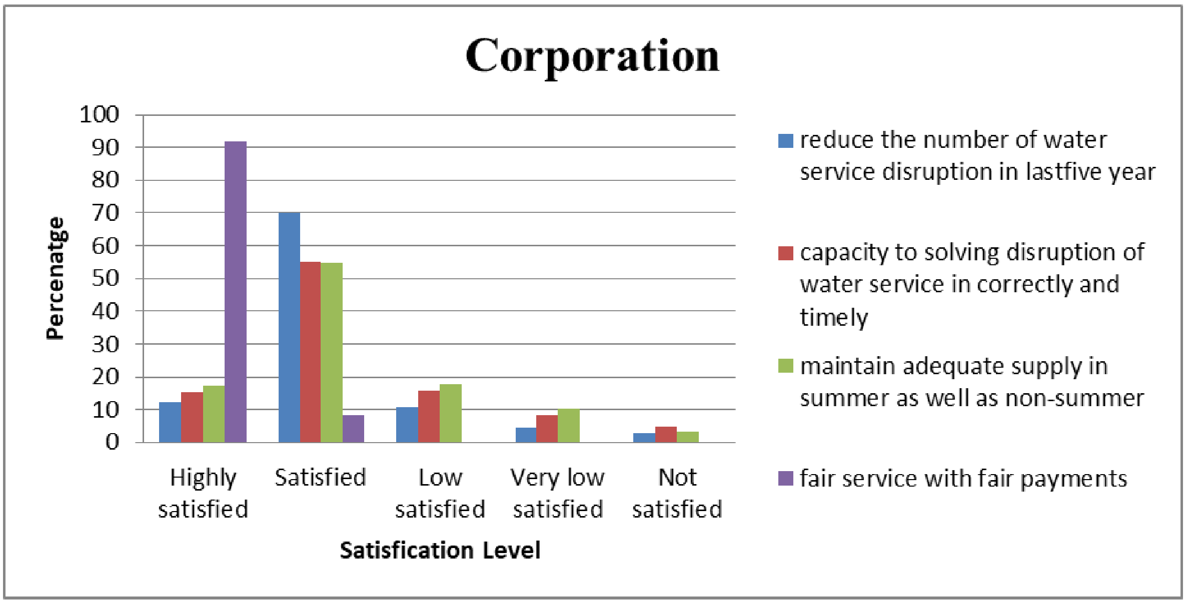
5.2.1.5 Fair Service with Fair Payment

In the field survey it was noticed no disparities was reported by any of the sample respondents in both Corporation and KWA connection. None of them is ready to pay, extra payment and any type of gift for influencing the service provider for their extra benefit to the service. Here, both authority superiors said that their subordinates are considering all beneficiaries to be equal and do not support any type of disparities in the sample area. The survey identified that there is chance for any type of bribe for water service, both in the demand or supply sides. However, the surveyors observed that a small percentage of sample respondents in both Corporations and KWA holders addressed their institutions for fulfilling services in a different form of proposal through councilors.

5.2.1.6 Level of Reliability

The section explains that, to measure the satisfaction level of both corporation and KWA connection holders,' opinions based reliability of water supply services in the sample area is to be taken. To measure the reliability based on several water supply disruptions and it solving mechanism is too studied.

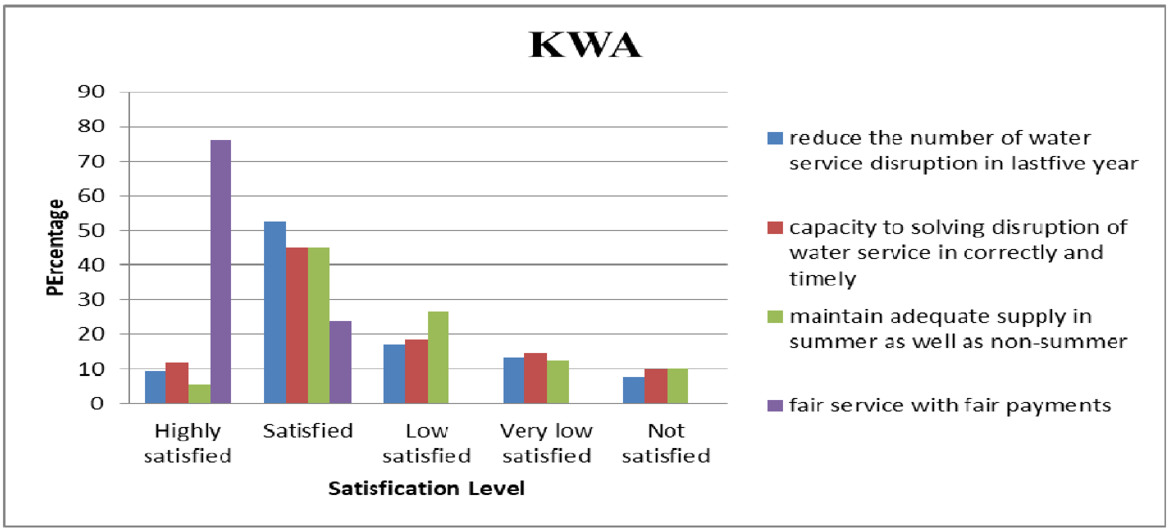
Figure 5.2: Satisfaction Level of Reliability by Corporation Beneficiaries



Source: Primary Data

In Corporation connection, most numbers of the respondents replied that they are satisfied with reduction in the number of disruptions, efficient ways of solving disruption, adequate water supply in both seasons etc. While above 10 per cent of respondents replied that they are highly satisfied with these services. The total respondents replied that they are satisfied with fair service. While 91.8 per cent of the respondent replied that they are highly satisfied with fair service. Only below 5 per cent of respondents replied that they are not satisfied with this service.

Figure 5.3: Satisfaction Level of Reliability by KWA Beneficiaries



Source: Primary Data

In the KWA connection, above half of the sample respondents replied that they are satisfied with reduction in the number of disruptions, efficient ways of solving disruptions, adequate water supply in both seasons etc. While above 5 per cent of respondents replied that they are highly satisfied with these services. The total respondents replied that they are satisfied with fair service. While 76.2 per cent of the respondent replied that they are highly satisfied with fair service. Below 10 per cent of respondents replied that they are not satisfied with this service. In the above majority of connection holders' opinion is considered that the corporation's services are more reliable than KWA services as compared to both connections.

5.2.2 Transparency

The term transparency refers to openness of government processes and free access to official information. It measures the relevant information in a complete, available, accessible, accurate and timely delivery of services to the local public.

5.2.2.1 Approach of the Institution in Water Service Last Year

In the field survey almost all sample respondents in both connections are approaching the authorities for various water-related services. Some important water services are listed in the below table.

Table 5.6: Important Water Services by Corporation and KWA

Services	Corporation	KWA	Total
New water connection	98.2	98.5	100
Solving water service complaint	76.8	64.7	100
Changing type of connection	4.5	5.3	100
Changing ownership connection	5.5	3.0	100
payment of water charge	100	100	100

Source: Primary Data

The analysis table explains that the various percentages of sample respondents in both connections approached their concerned institution for various water-related services last year. Large numbers of the sample respondents in both connections approach institutions for various water-related activities every year.

Generally, the sample households are approached by the institution in direct visits. However, a few per cent of respondents in both Corporation and KWA connection depend on other sources in fulfilling their water service from the institution recently. A small percentage of KWA connection holders are beginning to use online services for satisfying their needs from the institution recently. It is explained in the below table.

Table 5.7: Approach of Institution by Beneficiaries in Last Year

Methods	Corporation	KWA
Direct visit	82.7	62.4
Through agent	2.3	1.5
Online service	-	15.8
Direct visit/through agent	15.0	20.3
Total	100	100

Source: Primary Data

Most numbers of the sample respondents in both connections approached the institution directly to the office for satisfying their water-related services. Almost all sample respondents in both connections make payments directly at the office. At present the system of cashless economy and digitalization promote people to make online payments.15.8 per cent of the households in KWA are using online services for payment of water bills. Unfortunately, the corporation is only starting their discussion about online services. The other minorities in both connections are depending on water bill payments through agents.

5.2.2.2 Openness of Institution

Generally, the sample households are keeping close relation with their concerned institution for fulfilling their services. The survey observed that most of the sample households are closely interacting with their institution. The majority of sample households' opinions that water supply and its related procedure of both authorities are generally simple and understandable. This information is analyzed in the below table.

Table 5.8: Procedure of Water Services by Corporation and KWA

Procedure of Water Service	Corporation	KWA	Total
Know about interaction with your authority	100	100	100
Know about write and submit application for receive the service	88.2	82.7	100
Know about file a complaint for water problems	86.4	79.7	100
Know about working hours in authority	100	100	100

Source: Primary Data

In both Corporation and KWA connection, the cent percentages of the sample respondents interact with their institution for their water supply-related services. These cent percent of respondents are also bothered about their concerned institution's working time and other general features. The survey observed that the sample households interact with their institution for various water-related services like new connection, change type of connection, ownership change, file complaint procedure and payment of water charge generally. Everybody could easily pay the water charge in the sample area. Most of the sample households in both connections replied that they know about the procedure of writing and submitting application forms and file to complaints etc. However, the corporation follows the simple official procedure and has more acceptability to its beneficiaries as compared to KWA.

5.2.2.3 Staff of the Institution

In the field survey observed that almost all sample respondents in both connections replied that the staff of their concerned institution is willing to help with their water supply and related services. In the below table, the sample respondents are rating their staff based on helping attitude.

Table 5.9: Rate the Helping Attitude of the Staff by Corporation and KWA

Helping Attitude	Corporation	KWA
Yes, Always	74.5	55.6
Yes, Sometimes	15.9	23.3
Yes, Special situations	9.5	21.1
Total	100	100

Source: Primary Data

74.5 of corporation connection holders and above half of KWA connection holders replied that the staffs of the institutions are always willing to help their beneficiaries at any time. In the rest percentage, more than one third of respondents in both connections replied that the staffs are willing to help in important situations. The other parts of the respondents replied that the staffs are willing to help only in specific matters of their activities. The overall table analysis concludes that the helping attitudes of corporation staff are high as compared to KWA staff.

Those who participated in the survey also responded to a question regarding the staff's usefulness characteristics, of each institution. The respondents said that the staff's characteristics like good ability and behaviour, helping mentality, responsibility and positive attitude for service improvement, problem-solving and service development etc are necessary for the administrative development of the institution. These good characteristics are very helpful in positively influence the total water services of any institution. These characteristics are explained in detail in the following table.

Table 5.10: Usefulness Characteristics of Officials in Institution

Characteristic	Corporation				KWA			
	Highly useful	Useful	Low useful	Total	Highly useful	Useful	Low useful	Total
Ability	23.2	65.0	11.8	100	17.3	53.4	29.3	100
Behaviour	42.7	57.3	-	100	16.5	50.4	33.1	100
Helpfulness	28.6	71.4	-	100	12.0	54.9	33.1	100
Responsibility	12.3	74.5	13.2	100	15.0	63.9	21.1	100
Attitude	17.3	70.0	12.7	100	15.0	57.9	27.1	100

Source: Primary Data

The survey observed that most number of the staff in both institutions is keeping honest, punctual and positive attitudes in providing services to their beneficiaries. There is always show respect to their customers and treat customers fairly and listen and try to understand the various grievances related to services and always try to react as quickly as possible. The staff of institutions is also capable of solving problems, maintaining better services and good relationships with their beneficiaries.

Almost all sample respondents in both Corporation and KWA connection are responding that the institutional staffs are always useful. While a major part of the respondents said that the staffs are very useful in fulfilling their service. The other small part of respondents said that the staff are low useful in their services. When comparing the staffs of Corporation and KWA, it may be said that the Corporation staffs are more beneficial to their beneficiaries.

5.2.2.4 Information about Official Documents and Sources

The concept of transparency is measured based on the level of availability of information and accessibility of information. The degree of openness of the institution is measured based on how much these important documents and important sources are available and the use of its beneficiaries.

Table 5.11: Accessibility of Information about Respective Documents

Documents	Corporation					KWA				
	Low accessible	**No accessible**	**No experience**	**Don't know**	**Total**	**Low accessible**	**No accessible**	**No experience**	**Don't know**	**Total**
Annual budget report	32.7	26.4	24.5	16.4	100	15.8	50.4	21.1	12.8	100
Present progress report	35.5	30.5	17.7	16.4	100	19.5	48.1	19.5	12.8	100
Report of complaints and its solving methods	32.3	30.5	20.5	16.8	100	18.0	52.6	16.5	12.8	100

Source: Primary Data

In the survey, more than half of the sample respondents from the Corporation said they were aware that their institution published a variety of documents on a regular basis. While the respondent's opinion is split, the majority of them believe that different reports are not easily accessible. However, they added that the reports were available when the beneficiaries wanted it in certain circumstances. Most sample respondents indicated that they were unconcerned about these materials. While the first group of respondents claimed to be aware of the documents' availability but if is of no use for them. The second group of respondents claimed to be ignorant of the existence and accessibility of these reports.

The KWA connection is experiencing the same issue. Only a tiny portion of responders to the KWA connection indicated that they had limited access to the relevant reports from their institution. Over 50 per cent of respondents claimed that their institution did not provide access to these reports. Of the rest, the first group of respondents stated that they had no experience with readily available reports, and the second group claimed to know nothing about these publications. The majority of connection holders replied that the corporation assumes greater responsibility for publishing and circulating its documents than KWA.

The Corporation secretary said that, the authority properly drafted, stored, and promptly published the official documents periodically. He feels that he and his staff are always willing to share all of these records with their beneficiaries. But in the majority of cases, no one requests these records. Rarely did someone request is just a connection register to serve their needs. In the meanwhile, the KWA manager stated that the above official documentation were generated, maintained, and published online in a timely manner. But almost always, no one asked for these documents.

Table 5.12: Accessibility of Information about Various Sources

Information Sources	Corporation				KWA			
	Very useful	Useful	Not useful	Total	Very useful	Useful	Not useful	Total
Notice board	-	9.5	90.5	100	-	6.0	94.0	100
Service bulletin	20.7	58.5	20.8	100	19.6	50.8	29.6	100
Service desk	34.1	65.9	-	100	22.3	60.9	16.8	100
Councilor	12.3	71.4	16.3	100	13.6	60.6	25.8	100

Source: Primary Data

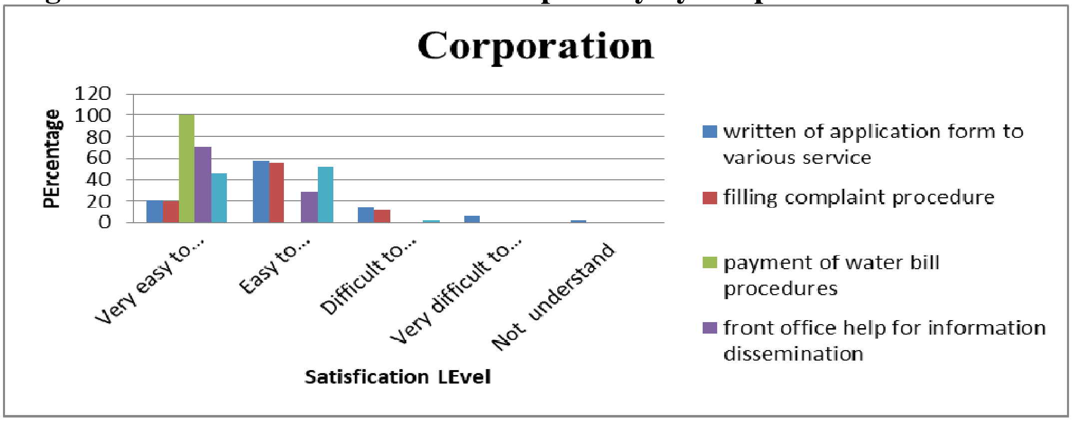
The most vital components that link institutions with their beneficiaries are information sources. Institutions use these information sources to quickly and accurately provide their beneficiaries with pertinent information. The table explains the general sources used by both institutions for passing information to their beneficiaries. The survey observed that almost all sample respondents in both connections depended on the above said common sources. However, more recently, only a few per cent of the sample respondents are depending on notice boards. Now, they mostly depend on three important sources like service bulletin, service desk and councilors etc. The majority of the sample respondents in both connections said that they are most dependent on these three sources and it’s useful. While the other portion also said that these information sources are very useful. Meanwhile, the rest of the percentages said that these sources are not are always dependable. When comparing both connections, the corporation connection holders are more dependable on these information sources. This is because the information sources are more effective than KWA.

According to the superiors of both Corporations and KWA, the majority of beneficiaries rely on online connections, such as phones, to communicate with the institutions that they are concerned in order to receive satisfactory service in the modern era.

5.2.2.5 Level of Transparency

This section intends to measure both Corporation and KWA connection holders’ satisfaction level on transparency and accessibility to their institution for implementing service delivery.

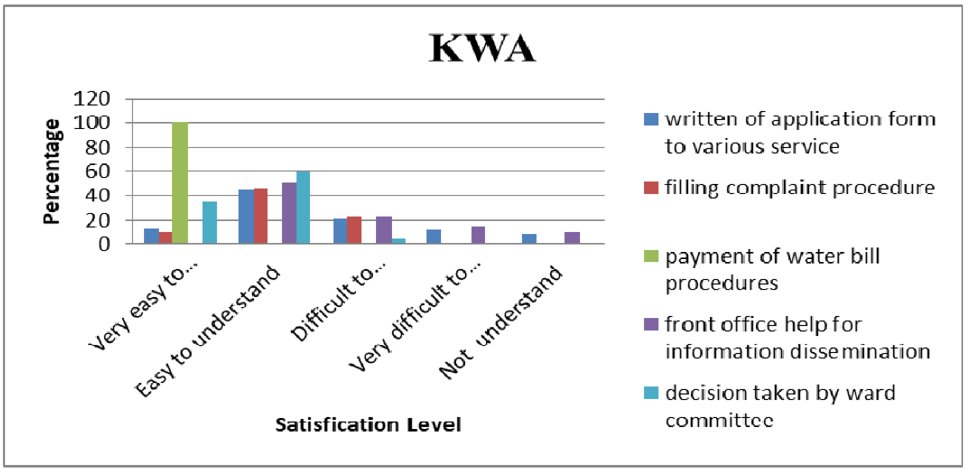
Figure 5.4: Satisfaction Level of Transparency by Corporation Beneficiaries



Source: Primary Data

In Corporation connection, high percentage of the sample respondents replied that they can easy to understand their institutional procedure of filling application forms, filling complaints and find it easy to fill them. While 20.9 per cent replied that the procedure is very easy. Cent per cent of respondents said that they are highly satisfied with the payment procedures of the water bill. Almost all percentages said that they are satisfied with front office management and 70.9 percentages responded that they are very easy to approach them. Only 2.4 per cent of the respondents replied that they cannot fill out applications for various services. Nearly all respondents said they could easily attend ward committee meetings and participate in the discussions, and 45.5 percent said the topics were very simple and comprehend. Only 2.5 per cent of respondents indicated it was challenging to understand the talks during ward committee meetings.

Figure 5.5: Satisfaction Level of Transparency by KWA Beneficiaries



Source: Primary Data

In the KWA connection, above half of the sample respondents replied that easy to understand how to fill the application forms and complaint procedures for respective services. While above 30 per cent replied it is difficult to understand and 8 per cent replied that they understand nothing. Cent percentage of the respondents replied that payment of water bills is a very easy procedure and some of them use online payment. Half of the total respondents said that front office administration is a simple process. But nobody gave an easy response. , 23.5 per cent of the other half of respondents said managing the front office was challenging, 15.5 per cent said it was extremely difficult, and the remaining 10 per cent said it was not easy. This is due to the fact that the KWA authority divided its functions into different sections and subsections. A large majority of respondents said that attending ward committee meetings was simple and that they could easily participate in the discussion. While 35.3 percent of respondents said the discussions were extremely simple to comprehend. Only 4.5 per cent of respondents claimed they found it challenging to understand ward committee discussions.

Ward councilors said that the ward meeting is typically held four times a year. Every meeting is attended by half of the total beneficiaries from the particular ward. In general, the discussion covered the requirements on the demand side and the most recent information on the supply side. Additionally, councilors stated that they aim to simplify complex topics and include the most significant debates possible.

When comparing Corporation and KWA, connections holders' opinions that the Corporation implements water service delivery with greater transparency than KWA.

5.2.3 Accountability

To put it simply, accountability is the commitment of actors involved in water governance, to ensure an efficient management and minimum quality standards. Here, the concept of accountability measures the quality of the relationship between the service providers and their users. The term accountability refers to interconnecting the concepts of responsibility, answerability and enforceability. Responsibility requires that the authority have clearly defined duties and performance standards, enabling their behaviour to be assessed transparently and objectively. Answerability requires the authority to provide reasoned justifications for their actions and decisions that affect the beneficiaries. Enforceability requires that public officials and institutions must keep established standards and ensure that appropriate corrective and remedial action is taken when required.

5.2.3.1: Performance of Functions by the Institution

The mayor of Thrissur Corporation said that the system should maintain administrative structure and professional standards by following and maintaining routine reviews and social audits. The superiors of both the Corporation and KWA also emphasize their thoughts that the authority should maintain accurate records and actual utilization of the resources granted to its beneficiaries. The following important functions are used to measure accountability criteria for the study.

Table 5.13: Performance of Functions by Corporation and KWA

Functions	Corporation			KWA		
	Yes	No	Don't know	Yes	No	Don't know
Authority is doing proper recording of consumer details and it open at any time	81.8	7.3	10.9	69.9	16.5	13.5
Authority is properly utilize various funds for consumer services and get its benefits	77.7	11.8	10.5	65.4	19.5	15
Authority follow the clear policy &planning for water services and informed honesty	75.5	13.2	11.4	57.1	27.1	15.8
Authority is record & kept opinion in ward committee meeting and its applicable	70.5	15.0	14.5	60.2	21.1	18.8
Authority is prepared and supplied water bill correctly and timely	100	-	-	100	-	-

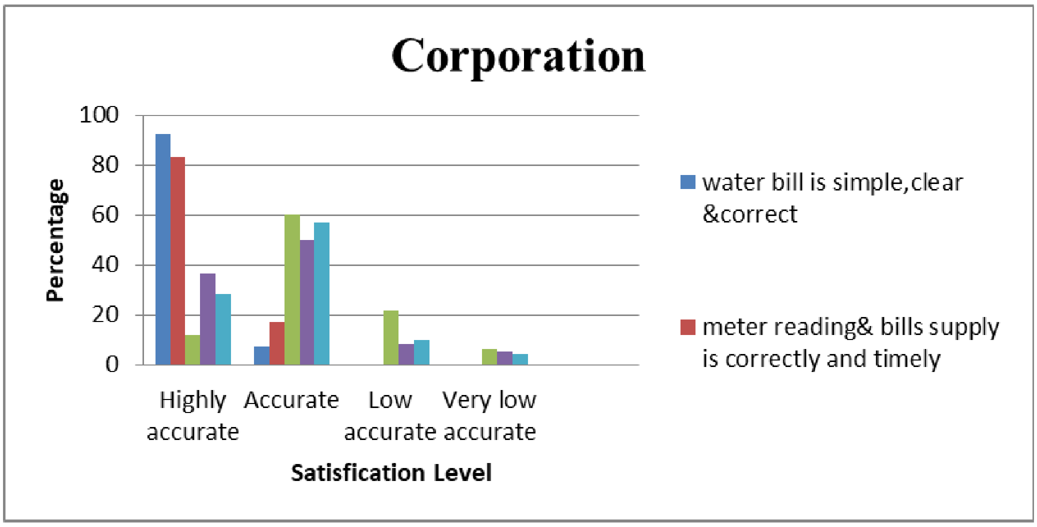
Source: Primary Data

The table illustrates majority of both connection holders' are of the opinion that the institution is reliable in carrying out its responsibilities. In both connections, almost all sample respondents claimed that their institution's preparation and supply of water bills are quite accurate. In the remaining percentage, a negligible number of respondents complained that their authority was not carrying out the above said responsibilities in a timely and accurate manner. They also replied that they were not benefiting from the above services. The second group of respondents is unconcerned about these services. They replied that they 'don't know' about these services. To compare corporation and KWA services, the sample respondents said that the corporation performing the above services is more accurate than compared to KWA functions.

5.2.3.2 Level of Accountability

The section intends to measure both Corporation and KWA connection holders' opinions on the satisfaction level of both institutional performances of its functions follow accurate, efficient management and ensure minimum quality standards.

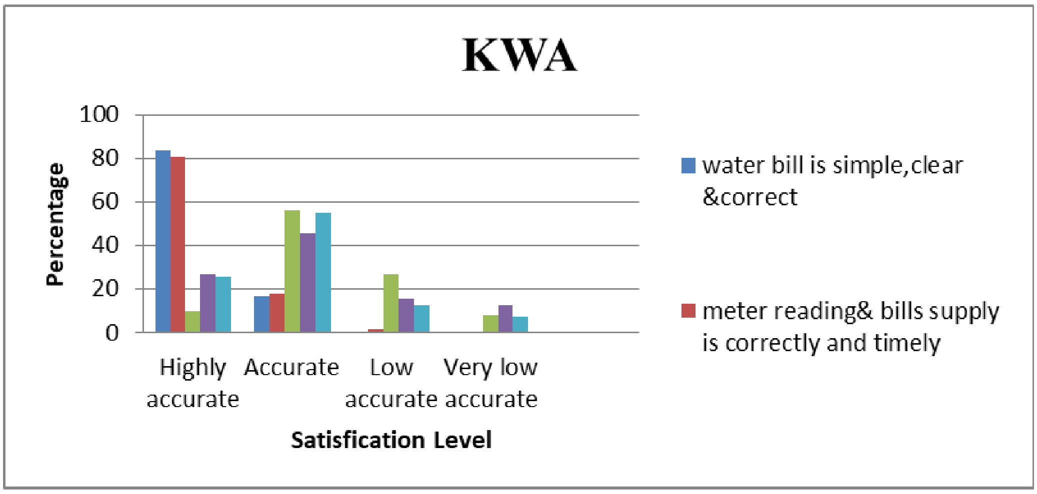
Figure 5.6: Satisfaction Level of Accountability by Corporation Beneficiaries



Source: Primary Data

In Corporation connection, the total sample respondents replied that the water bill, meter reading and supply are accurate. While the majority of the sample respondents replied that the performance of these functions are highly accurate. A major portion of respondents replied that their institution is following accurate documentation of records and revising recent policies and procedures. Most numbers of the participants said that the ward committee meeting is effective. Only a small percentage of the respondents replied that these above services are less accurate.

Figure 5.7: Satisfaction Level of Accountability by KWA Beneficiaries



Source: Primary Data

In the KWA connection, almost all sample respondents replied that the water bill, meter reading and supply are accurate. While above 80 per cent replied they are highly accurate this services. The above half of respondents said that the services like documentation of records, and updating rules and procedures are accurate. Most number of the participants also replied that the ward committee meeting is effective. Only a small percentage of the respondents replied that above said services are less accurate.

While comparing corporation and KWA, both connections holders' are of the opinion that the Corporation is performing its functions more accurate than KWA performing its functions. A large number of participant’s opinion that the ward committee meeting is more effective in corporation wards as compared to KWA wards.

5.2.4 Communication

Communication is defined as the exchange of information between persons. It is a process of creating and sharing ideas, information, views, and facts, feelings from one person or group to another. Communication is helping to build a good relationship by allowing us to share our experiences, needs and help us connect to others. Communication is a key element in dictating the functions of management. Here, communication plays an important role between the institution and the people of the city.

5.2.4.1 Institutional communication

People have the right to get factual and accurate information. An efficient institution always creates a systematic communication system between themselves and beneficiaries.

Table 5.14: Popular Methods of Communication

Methods	Corporation	KWA
Ward committee meeting	85.9	75.9
athalath	10.0	6.8
Online service	-	11.3
Area committee	4.1	6.0

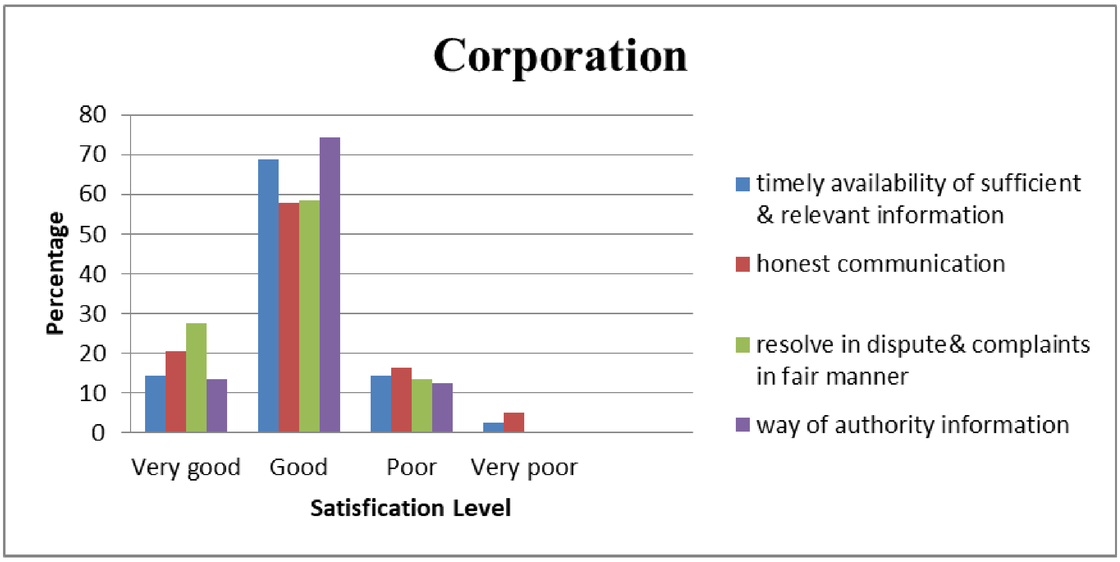
Source: Primary Data

The survey observed that the institutions like Corporation and KWA communicate with their beneficiaries mainly through four common methods. Most numbers of the sample respondents in both connections communicate with their institution through ward committee meetings. The rest percentages of both connection holders are communicating their institution through adhalath and area committee meetings. 11.3 per cent of the KWA respondents have communicated with their authority through online mode recently. The survey observed that both institutions have used to communicate through telephone. It is followed by agents and public notice etc is used to pass information to the beneficiaries in the sample area.

5.2.4.2 Level of Communication

The section intends to measure both Corporation and KWA connection holders' satisfaction level of their concerned institution's communications facilities.

Figure 5.8: Satisfaction Level of Communication by Corporation Beneficiaries



Source: Primary Data

In Corporation connection, the most number of the sample respondents replied that institutional communication is good. While above 10 per cent respondents said that institutional communication is very good. The respondents replied that public servants' communications are honest in related to solving disputes and complaints fairly. Also passing updated information is the correct time. Only a few percentages said that they are very dissatisfied with public servant's honest communication and their passing information as correctly and timely. The chart is clearly explained that the ways of institutional communication are effective.

Figure 5.9: Satisfaction Level of Communication by KWA beneficiaries

Source: Primary Data

In the KWA connection, above half of the sample respondents replied that institutional communication is good. While, above 10 per cent replied that it is very good. Meanwhile, the other portion of sample respondents said that institutional communication is poor. The chart explains more than 10 per cent of respondents are there satisfaction level is low in related to public servants' honest communication and their passing of updated information correctly and timely. 7.2 per cent are also dissatisfied with the method of solving disputes and complaints fairly. Most numbers of the sample respondents opinion that communication methods followed by -institutions are good.

When comparing both Corporation and KWA, connections holders' are of the opinion that the communication methods followed by corporation are better than KWA communication.

5.2.5 Participation

Participation refers to the involvement and possibility of citizens to provide information with timely and meaningful input and to influence decisions at various levels. Simply defined, participation offers every citizen an opportunity to meet their responsibilities as well as the opportunity to claim their rights. Participation gives the ordinary citizen a means of voicing his opinion and showing by his behaviour and action that he can take responsibility. Participation comprises every kind of citizen intervention in administrative action.

5.2.5.1 Participation by Beneficiaries in Various Committees

Ward committee, is the legally constituted decision-making body in cities. The ward committee is constituted as a strong foundation for the entire grass root democratic structure. Ward committee provides a link between the community and authorities (Reddy & Sikhakhane, 2008). The ward committees are visualized as the forum where people can periodically demand information. It plays a pivotal role to improve service delivery in the cities. The corporation mayor said that she considers holding all meetings timely and periodically every year and is trying to cooperate with every ward councilors and all meetings. Generally ward committee is met four times a year. Adhalath is a one time settlement forum where pending cases of the customers are settled. Generally, adhalath is met one time a year. All the committees have well-defined roles to play and their subject specifications. All the committees are intended to develop a team spirit and collective leadership among the members.

Table 5.15: Participation by beneficiaries of various committees during last year

Forums	Corporation	KWA
Ward committee meeting	84.0	84.2
Athalath	10.5	11.0
No participation	5.5	4.8
Total	100	100

Source: Primary Data

The survey observed that the majority of sample respondents in both connections attended ward committee meetings last year. A small percentage of the sample respondents in both connections consistently attend the Adhalath, which helped them with their issues. 10.5 per cent of the corporation respondents and 11.0 per cent of the KWA respondents attended Adhalath last year. At the time, 5.5 per cent of respondents from corporations and 4.8 per cent from KWA said they did not attend any of the meetings organized by both bodies last year.

In the survey observed that 44 percentages of the Corporation respondents and 30.8 percentages of the KWA respondents regularly attended their ward committee meeting. The other portion of households attended the ward committee meeting at their own convenience. This is clearly explained in below table.

Table 5.16: Participation by beneficiaries in ward committee meeting

Attendance	Corporation	KWA
< 25 Per cent	7.3	6.0
25-50 Per cent	10.9	15.0
50-75 Per cent	9.1	15.0
>75 Per cent	12.7	17.3
Total	40.0	53.4

Source: Primary Data

According to the table, 12.7 per cent of respondents from the corporation sample and 17.3 per cent of respondents from KWA attended more than 75 present of the meetings last year. 9.1 of the corporation respondents and 15 per cent of the KWA respondents attended half of the total meetings last year. A small percentage of both corporation and KWA respondents attended only a few times in meetings. The above analysis observed that the participation attitude of the corporation respondents is more in comparison to KWA respondents. More percentages of corporation respondents regularly attended ward committee meetings as compared to KWA respondents in the sample area.

Table 5.17: Beneficiary's Demand and its Outcome in Ward Committee Meeting

Rating	Corporation		KWA	
	Record of customers opinion	**Result of customers opinion**	**Record of customers opinion**	**Result of customers opinion**
Yes, always	57.7	50.5	55.4	50.0
Yes, few times	17.3	25.4	19.8	28.3
Yes, occasionally	-	18.2	-	14.8
Never	9.0	5.9	9.0	6.9
Total	84		84.2	

Source: Primary Data

Ward committee serves as a democratic forum for ensuring the participation of people and important information source on differential developmental matters. Ward members consider it as an easier way to communicate with their customers and understand their demand for various services.

The majority of sample respondents in both connection stated that the authority takes their demanding concerns into account and records them more frequently. 57.7 per cent of the corporation respondents and 55.4 per cent of the KWA respondents replied that the authority is always considering their demand and it is recorded in almost all situations. Meanwhile, only 20 per cent of sample respondents in both connections said that the authority was taking their request into consideration and that only a few instances had been recorded. 9.0 per cent of the sample's respondents in both connections claimed that the government pays attention to their demands; however it is not always show interest in noting it down.

The majority of sample responders in both connections stated that they were satisfied with the outcome of the ward committee meeting. 55.4 per cent of the corporation respondents and 50 per cent of KWA respondents replied that they get results in all situations. The other parts; the majority of respondents in both connections' stated that they occasionally or when necessary receive results from authorities. The other small percentages of respondents in both connection said they never got responses to their opinions in meetings. The table indicates that both authorities take their beneficiary's needs into account and provide positive outcomes. However, compared to KWA ward meetings, the Corporation gives better results and pays greater attention to the opinions of its beneficiaries.

Table 5.18: Participation by Beneficiaries in Athalath

Athalath	**Corporation**	**KWA**
	10.5	11.0

Source: Primary Data

Generally, Adhalath was often held once a year by both the Corporation and the KWA. The survey observed that 11.0 per cent of KWA respondents and 10.5 per cent of Corporation respondents respectively participated in Adhalath last year. The sample respondent believes that the Adhalath is helpful and that their problem can be solved simply.

Table 5.19: Evaluate by Beneficiaries Experience in both Ward committee and Athalath

Rating	**Corporation**		**KWA**	
	Ward committee	**Athalath**	**Ward committee**	**Athalath**
Very useful	17.7	7.3	22.6	9.0
Useful	44.5	3.2	33.8	2.0
Useful few times	21.8	-	27.8	-
Total	84	10.5	84.2	11.0

Source: Primary Data

The majority of sample respondents in both connections felt that attending Adhalath and their ward committee meetings were helpful. In both cases, the majority of samples indicated that the ward committee meeting is beneficial. While 17.7 per cent of respondents from the corporations and 22.6 per cent from the KWA said that the ward committee meeting is very helpful for them in demanding their problems. While 22.6 per cent of respondents from the KWA and 17.7 per cent of respondents from corporations claimed that the ward committee meetings are very beneficial for them demanding their problems

5.2.5.2 Membership in Area Committee

Area Committee which involves a small group of local people chosen to represent a larger community in their areas, either to make decisions or collect information for it and inform communities demand to their concerned institution. The survey found that just a tiny proportion of the sample respondents in both connections represented area committee members. These members are representing an area of their association.

Table 5.20: Members of Area Committee

Area committee	Corporation	KWA
	5.9	8.3

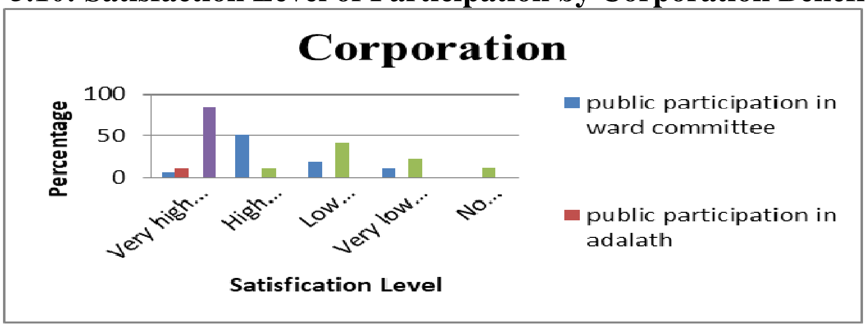
Source: Primary Data

The survey observed that a small portion of 5.9 per cent of the corporation respondents and 8.3 per cent of the KWA respondents are members of their local area committees. The member feels that they can effectively address the majority of water issues in their locality. They are capable of resolving common issues like poor water quality and quantity, faulty water delivery issues, etc. in their localities. The survey found that the area committees continue to function well in both connection regions.

5.2.5.3 Level of Participation

The section explains both corporation and KWA connection holders' opinions on the satisfaction level of their participation in the ward committee and Adhalath meeting. The participants also discussed the rating of participation attitude of other connection holders, staff representatives and elected representatives' involvement of these meetings.

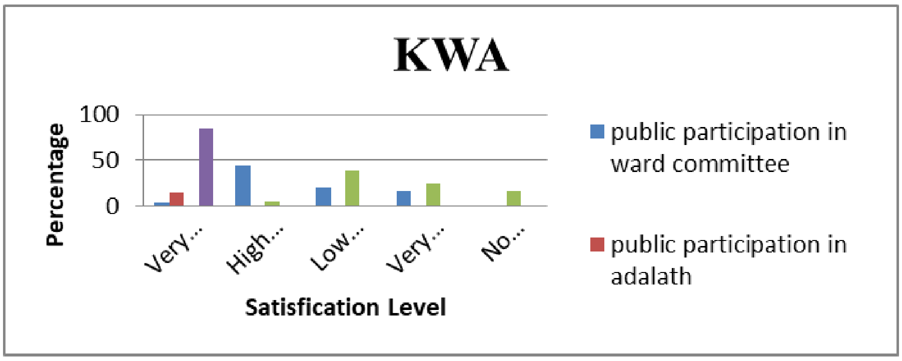
Figure 5.10: Satisfaction Level of Participation by Corporation Beneficiaries



Source: Primary Data

In Corporation connection, the participants are of the opinion that more than half of the general public attends every ward committee meeting and makes demands for their basic requirements. A very high level of beneficiary participation and satisfaction of their requirements was also seen at Adhalath sessions. According to the participant, the authority staff really shows a poor attitude towards involvement. They only take part in certain specific situations and ward meetings. However, the councilors should be participated in each ward committee meeting and Adhalath

Figure 5.11: Satisfaction Level of Participation by KWA Beneficiaries



Source: Primary Data

In the KWA connection, the participant's opinion is that only around half of the general population attends ward committee meetings and requests their basic necessities. The beneficiaries' involvement in Adhalath meetings is very high, and their requirements are being met. According to the participant, the authority staff has a really poor attitude towards involvement. They only take part in certain specific situations and ward meetings. However, the councilors should attend every ward committee meeting and Adhalath

According to the survey, Corporation councilors actively participate in every ward committee meeting and Adhalath They aim to meet the majority of their recipients' requests while also gather information about their basic needs. Additionally, councilors took part in the Adhalath and made every effort to address the issues of the beneficiaries. The councilor's opinion is that the institution-wide cooperation among public employees is required to meet beneficiaries' needs and resolve their issues. The corporation's mayor stated that she priorities the needs of beneficiaries and makes every effort to work with each ward councilor and public official from the corporation and KWA to meet their needs.

5.2.6 Beneficiary's Satisfaction with Governing System

The majority of survey participants who provided a response indicated that their government's support on an effective water supply has satisfied them. 90.5 per cent of respondents from corporations and 82.7 per cent from KWA indicated they were satisfied with the governance and administration of the water supply service. However, the respondent's level of satisfaction is different. It is depicted in the below table.

Table 5.21: Rating of Beneficiary's Satisfaction

Rating	Corporation	KWA
High satisfied	66.4	48.9
satisfied	16.8	18.0
Low satisfied	7.3	15.8
total	90.5	82.7

Source: Primary Data

According to the table, the majority of sample respondents in both connections indicated that they are satisfied with their governance performance. While a major portion of respondents said they are extremely satisfied. Only a small percentage of respondents indicated that they are not satisfied with certain specific ways in which governance operate.

Meanwhile, the survey found that 9.5 per cent of respondents from corporation and 17.3 per cent from KWA respondents expressed dissatisfaction with the governing administration's handling of the water delivery service. Both connections' sample respondents cited the primary explanations listed in the table below.

Table 5.22: Main Reason for Dissatisfaction by Beneficiaries

Reasons	Corporation	KWA
Lack of skilled public servants	1.4	3.8
Weak political leadership	1.8	3.0
Interest on political parties	3.2	6.0
Councilors personal gain	3.2	4.5
Total	9.5	17.3

Source: Primary Data

Public servants and ward councilors are the main service providers providing administrative success for good water supply services to the beneficiaries. The primary role of the ward councilors is to ensure that service delivery concerns related to their wards are being attended to by the authority (Thornbill and Dlamini, 2014). Public servants are the main connector between both authority and beneficiaries for successful service delivery. The services have been negatively impacted by the service provider's improper use of the service delivery. The survey identifies this kind of issues. Also, a small percentage of both sample respondents replied that they are dissatisfied with governing functions.

Table 5.23: Suggestion for Future Water Supply

Suggestions	Corporation	KWA
Improve quality	10.5	11.3
Increase frequency(time) of water supply	3.2	6.0
Regular days water supply	10.5	14.3
Improve political leadership and involvement	6.3	3.0
Importance to public interest	3.2	3.0
Solve service disruption and improve supply	8.2	13.5
Adequate quantity & quality of water supply in summer	5.0	6.0
Fair service with good supply	4.5	7.5
Good help of service authorities	6.8	10.5
No suggestion	41.8	24.8
Total	100	100

Source: Primary Data

The table explains that the total sample respondents in both Corporation and KWA connections are suggesting various demands for future water supply. In Corporation, respondents demand that prime importance must be given in regularizing daily water supply and improving the quality of the water delivery. They also requested that authority resolve service disruption immediately. 41.8 per cent of respondents said they were satisfied with the water supply as it was and had no suggestions for future supply. In KWA, respondents demanded that primary importance must be given in areas like consistent water supply, a prompt resolution to service interruption by the authority, an improvement in the quality of the water supply, and the necessity of good assistance from service authorities etc. Only 24.8 per cent of the respondents are satisfied with the present water supply mechanism in the sample area. They have no suggestion for future water supply.

5.3 Conclusions

This chapter concludes that the corporation’s water service delivery performance dependents a lot on its governance strong support. The successful administrative performance is crucial in its effectiveness of the corporation’s service delivery. Local governance system is ensuring the participation of local communities and allows them to participate in the decision-making process and service delivery. Participation in the ward committee is strong. It shows the strong support of citizens’ attitudes and knowledge. Local political leaders and administrative leaders are also involved in the decision-making process. The corporation is close to the community and highly transparent about official matters and communication processes. The Ward committee also ensures high transparency. The people have the right to get information on different matters and they get good communication from corporation. The corporation also followed official procedures accurately and improved the quality of relations between its beneficiaries. The corporation tries its level best to ensure adequate supply and minimize water supply-related disruptions. Corruption is not taking place here. It provides fair service with fair payment. Community participation in municipal services is necessary for improving the quality of various services. So, local administrative governance provides strong support in its effective water supply. When comparing the local level and state level governance support, it is evident the local level administrative support and community participation is more effective than the state level. This is because the local body is closest to its beneficiaries and is performing based on their actual basic needs. The chapter proves it; the strength of institutions depends on their governance framework. Administrative support is a necessary governance factor which helps to implement an effective public service delivery by institutions.

Chapter VI

SUMMERY, FINDINGS AND CONCLUSIONS

6.1 INTRODUCTION

The present study titled 'Public water service delivery mechanism in Urban Kerala: An Analysis of Governance and Effectiveness 'tries to trace the role of municipal bodies' performance ineffective water service delivery in the state. Decentralization of power to the local government gives the local government more responsibility for meeting local community needs. Therefore, the local bodies have a fundamental role to play in public water supply delivery in the state. The decentralized governance architecture also promises an efficient water supply delivery in the state. So the present study looked at whether municipal bodies in Kerala are providing water more effectively than centralized systems.

The main objectives of the study are, firstly to describe the current situation of the urban water service delivery mechanism in decentralized Kerala and to provide a detailed explanation of the current state of the state's water supply service delivery system. The second objective looks at the extent (depth) of decentralization that has improved the state's water service delivery. To assess the depth of the Municipal Corporation's efficient water service delivery when compared to the centralized system (KWA) in the Thrissur district. Public water supply service delivery requires considerable support from the governing system in its smooth running. In order to achieve the third objective, this was established in this manner, to assess how the governance structure supports the enhancement of effective water service delivery by the institutions.

The study is based on both primary and secondary data. The Thrissur Municipal Corporation area is taken into consideration for primary survey, and primary data gathered from both the Corporation and KWA connection holders are included in the corporation area. Thrissur Municipal Corporation is the only local body in Kerala which manages water service delivery mechanism. Hence the study is relevant. For the purpose of gathering primary data, the study used quantitative and qualitative survey approaches. In the qualitative survey, data was collected from randomly selected households by using a well-structured questionnaire method and in the quantitative survey; data was collected from purposively selected representatives of experts in the field by using a semi-structured interview schedule. In the present study, comparisons were done between the water service delivery methods used by KWA and Corporation connection holders in terms of crucial aspects of both effectiveness and governance. The key tools used to analyses the data are the water service index, multiple regression, correlation, and growth rate.

6.2 VALIDATING HYPOTHESIS

The study hypothesized that the Municipal Corporation delivers water services more effectively than KWA does. The Municipal Corporation is very close to the community and allows them to participate and make decisions. The Corporation is performing at the grass root level and gives importance to people's preference and their necessities in everyday life. As a result, it can operate effectively and give better water services to communities than a centralized supply system through KWA run by the state government.

The primary goal of decentralization is to bring governance very close to governed. The governance system can encourage a bottom-up approach when addressing the realities of local needs. Local communities' involvement also encourages efficient service delivery by service providers. Decentralization thereby improves the quality of governance. As a result, there is improved governance, and the Corporation performs better in delivering water services.

6.3 MAJOR FINDINGS OF THE STUDY

The first objective is to depict the present status of the public water supply service mechanism in the state. Generally, the state water supply system includes three categories of schemes owned and operated by the state government via KWA and local government, external aid projects like JBIC, ADB and World Bank water supply and family-managed drinking water supply in the state. The first one is popular in Kerala state. The state's main source of drinking water is KWA, which also distributes water throughout. However, in Kerala, which has successfully decentralized, local government takes on more responsibility for running and providing public water supply services. The externally funded agencies are also contributing their own share in the public water supply in the state. As a result, the state currently provides its water supply services using a multi-service delivery system. Public water supply services are provided in the state in large part by state-level organizations including KWA, KRWSA, local government institutions, and beneficiary organizations.

Kerala now uses a hybrid paradigm for providing water services. However, 74th Amendments gave urban local governments more responsibility and the legal authority to execute "Water Supply" at the municipal level. Additionally, the local governments have more financial and operational autonomy, which enhances the state's provision of water supply services. Under the Kerala Panchayati Raj Act 1994 and Kerala Municipality Act

1994, providing for water supply is a mandatory function of panchayath and municipal bodies in the state. However, on one side Panchayati Raj institutions are actively involved in water supply delivery since 1995. Unfortunately, on the other side urban local bodies have played only little role in water service delivery till now.

Along with the state's growing urbanization trend and the pressure on local governments to offer urban water services, the role of urban local bodies is crucial. The study discusses how urban bodies participate in and carry out water service delivery, and it reveals the significant role that the Thrissur Municipal Corporation plays in the state of Kerala. The city's water supply services are provided directly by Trissur Corporation, a local government entity in Kerala. Since 1962, the Thrissur Municipal Corporation has assumed responsibility for the state's effective water supply, serving as a model for all other municipalities. The study proves that Thrissur Corporation consistently provides high-quality water services at long time.

The second objective examines the performance of Thrissur Corporation’s water service delivery mechanism and finds out to what extent they are effective. This comparison is made between the Corporation's service performance and TKWA's service delivery performance. The main data set for the analysis was taken from Thrissur Corporation's chosen sample locations. The present study uses significant indicators such as availability, accessibility, affordability, water quality, and water management to assess the idea of effectiveness.

In the sample area, pipe water delivery is the main source of water supply. However, a small percentage of people in the sample area also depend on supplementary sources such well water and water bought from the open market. To analyze the socio-economic characteristics of the sample area, it is important to note that it is Hindus predominant in the religious distribution, whereas other dominant social groups are from OBC category. The sample area is home to 71.4 percent of middle-income groups and 80 percent of the households fall into the APL category. 78.8 per cent of people live in housing colonies. Pucca homes are occupied by 74.5 per cent of households. Nuclear families make up the majority. These descriptions demonstrate that the sample respondents enjoy increasingly comfortable living conditions. These socio-economic factors are connected to consumption. The correlation remains statistically significant. The average family has a high level of consumption. As a result there is a greater need for public water supply delivery in the area.

Additionally, the study explains show seriously sample families take water conservation methods and give water storage more importance. There exists an urgency to look into how seriously the institutions in the area take their responsibility for providing effective water services.

The Corporation supplied public water in seven days a week and keeps up a seven to eight-hour force supply per day to its clients. KWA only keeps 5–6 hours of force supply available to its clients each day. According to the survey, KWA holders in the sample area have access to water on average 1.80 days per week, compared to 3.64 days per week for Corporation owners. Individual house connections are encouraged by organizations like Corporation and KWA. However, the Corporation also provides free access to public tap deliveries for 24 hours within its boundaries.

The Corporation charges a low tariff rate for the first few units and later higher amounts of consumption are charged at a higher rate. A large number of Corporation households are consuming in the first couple of blocks in the sample area. The Corporation also subsidizes poor households by providing a reduced connection rate. Meanwhile, KWA maintenance a standard tariff rate for all units, which is considerably higher than that of the Corporation. No concessions were made by KWA for its customers who needed water services. One family pays Rs. 8.12 for a Corporation water connection and Rs. 8.95 for a KWA connection in initial stage for water connection. Then the cost of service index is high in KWA. Therefore, in comparison to KWA connections, the corporation's water delivery system includes the poor in a greater capacity.

Both Corporation and KWA ensures regular water supply in both seasons. Through tanker supply, the corporation offers the benefit of higher-quantity water to places with a shortage of it at no additional expense. The corporation's self-water supply schemes also provide sufficient water availability during the summer. KWA also provided water through tanker service at a cost-per-unit fee. However, KWA's Tanker supply is ineffective where there is strong presence of well water.

Both Corporation and KWA obtain treated water from the Peechi reservoir and provide it to their beneficiaries. However, compared to KWA, the Corporation maintains higher quality in its distributed supply. This is as a result of the additional purification steps taken by the Corporation before supplying it to its beneficiaries'. The Corporation uses the product of 'alkayi' for treated quality water. Also, the Corporation introduced a system of washout valves in pipelines and cleaned up piping valves at regular time intervals. It results in good quality. The Corporation's authority also maintains correct operations for all services at proper intervals. They maintain good oversight and make an effort to frequently visit the sites in order to stop pipeline leaks and reduce the number of unauthorized connections. In KWA connections, the process is difficult since many divisions perform various functions. These departments don't cooperate quickly or easily. The survey observed that 83.6 percent of Corporation owners and 74.4 percent of KWA owners indicated their satisfaction with the current water delivery system. According to the study above, the Corporation is performing better than KWA in delivering water services. Delivery of the Corporation's water services is more effective than KWA's water supply.

The third objective of the study is to examine the governance supporting role in the implementation of efficient water service delivery performance of institutions in Thrissur Corporation. The effectiveness of institutional water service delivery performance depends on the assistance of the administrative governance structure. Reliability, transparency, accountability, communication, and participation in the study are key factors that should be used to measure governance. The objective concludes that a corporation's ability to provide successful water services depends on the strength of its governance.

In contrast to the centralized system, the local government system ensures local communities' participation and gives them access to the decision-making process. The quality of municipal services must be improved through community involvement. This is so because local residents participate in the government of their jurisdiction. It contributes to the Corporation's more dependable water service being improved. The local governance system also creates a new relationship of accountability between national and local policymakers. It helps to satisfy local demand the community's involvement is increased automatically. The Corporation is close to the community and it makes highly transparent services and easily communicates with its beneficiaries. Meanwhile, the centralized governance system did not reach the poorest or most remote population areas. Due to ineffective operations and a lack of coordination in the service authority's subsection, the quality and quantity of services provided by the centralized system are unreliable. So we can safely conclude that local government may be in a better position to provide services to the people than a centralized governing system.

6.4 CONCLUSION

The general public has a wrong impression that local governments have little to no control over the state's water supply and that KWA alone is responsible for it. But this study demonstrates that Trissur Corporation provides its inhabitants with clean and adequate water supplies and does so more efficiently than KWA water supply. So it proves that water supply services can be delivered more efficiently in places where the local self-governments are strong. This is due to the fact that decentralization creates a responsible area for local level public participation. To implement efficient service delivery and to achieve highest performance level, the communities must be actively involved at governance system. Local governments are best positioned to formulate policies and actions that satisfy the needs of their constituents since they are closest in comprehending the issues and demands of their constituents. Hence, the local government is effectively carrying out its small-scale designated functions. The general interest is taken into consideration while developing national or state-level policies. In a local-level perspective, these measures are insufficient. So, the local government is closer to its beneficiaries than any other level of government structure and it performs well in its defined functions in a closed circle. Given this fact, the government at the local level may be better positioned to make service delivery to the people (Oates, 1972, 1999).The "principle of subsidiarity" states that "doing things at the level at which they can be done in the best way". The idea that institutional success should start at a lower level and gradually involve higher ones is also strongly advised. In keeping with this, the study discovered that in decentralized Kerala, local government outcomes are more significant in the lower strata.

6.5 POLICY IMPLICATIONS

- Generally speaking, in the centralized system, the state should adhere to the system of implementing and delivering its services for establishing policy plans at higher levels and its implementation at local levels. Through administrative flaws and a lack of public involvement, it develops policy loopholes. Effective service delivery must priorities of public involvement and decision-making and successful outcomes depend on public support and cooperation. Also, the smooth running of water service delivery needs to be in close collaboration between authority and the public. The Strong support of the local community is needed to provide effective service delivery. In order to provide for the community's needs and priorities, a decentralized system must provide with a public involvement mechanism and policy. From the study, it is revealed that Thrissur Municipal Corporation operates efficiently and delivers water services to the general public. As the water supply is a mandatory function of the local system, it is advised that decentralization system service delivery be elaborated across the entire urban Kerala.

- The research found that the municipal officers who are in charge of water service delivery do agree that the main problem of water service is ageing infrastructure facilities. The government is currently authorizing funding for the replacement of outdated infrastructure as part of the Amurth water project. It was suggested that the Amruth project work with municipal officials to take urgent action on installing high-quality materials, which is essential for effective supplies. It helps to solve major problems like leakages, pipe bursting, and low-pressure water service. Then the municipality can guarantee a sufficient supply of clean water. This is due to the fact that community health needs to be a top concern. Public satisfaction will be based on the provision and treatment of water that is satisfactory.
- From the response received, it is clear that communication between the municipal corporation and its beneficiaries is to be improved further. It is recommended that Municipal authorities should effectively use internet medium for their services. Additionally, make sure that customers receive information on a regular basis, whether or not they ask for it. It needs to improve accountability and openness. To increase coordination in advance and prevent communities from having to wait too long for their services to be restored, this openness is necessary. The Municipal Corporation must make sure that the meeting is adequately scheduled and that proper information is distributed. Municipal representatives should also contribute by offering the community top-notch service.
- The research advises that ward committee meetings to be crucial for effective water service delivery. The Ward committee is involved in determining community needs and adjusting municipal programming in accordance with regional conditions. Communities can communicate with authorities about their needs and opinions by using this participatory strategy. Additionally, the Ward Committee ensures effective contact between the local community and the municipal council. Additionally, it benefits communities when they have the chance to take part in the planning, creation, and management of services. The better water service is decided by it.

- The study suggested that in order to ensure efficient delivery, water services should be routinely evaluated and supervised by staff that review meter readings as well as household experiences and provide comments. This is because there is a potential that members of the community will misuse water supplies by establishing unauthorized connections and using water for non-reimbursed uses like gardening and car washes. Water scarcity is a problem brought on by this kind of reckless water use. Therefore, it is crucial to avoid these mistakes, and punishments are required.

6.6 FUTURE RESEARCH

- **Performance of Thrissur Corporation's self-supply schemes.**
  Corporation supply schemes are actively implementing schemes in water scarce areas of Thrissur Corporation. These programmes play a significant role in addressing the issue of water scarcity in the Thrissur area.
- **Public water consumption pattern of communities.**
  The present study concentrated on the institutions engaged in the Thrissur district's supply-side water service delivery mechanism. The study is did not used the local demand-side service delivery model. Public water utilization by consumers is also important for measuring the effective water supply.
- **Role of stakeholder's support for making effective water service delivery mechanism**
  The present study identifies the significance of stakeholders in the engagement of an effective water supply. Principal investors such as elected officials and members of local committee serve as key intermediaries between institutions and recipients.
- **Private sector involvement in public water supply**
  The present study shows that a tiny percentage of sample families rely on private tanker supplies, cans, and bottles of water in both seasons, particularly during the summer.

APPENDIX

Schedule (Household Survey)

Dear Respondent

I would like to conduct the survey for the partial fulfillment of the degree of Doctor of philosophy in Economics on "**public water service delivery mechanism in urban Kerala: An Analysis of Governance & Effectiveness".** I humbly request you to spare some of your precious time to help me in completing data by filling up the following interview schedule. I assure that the information provided by you in this regard will be used only for academic purpose.

Part 1

1. Basic information

1.	Name of Respondent			8	Ownership 1.Owned 2.Rented 3.Leased	
2.	Name of the Division					
3	Gender 1.Male 2.Female 3.Transgender			9	Type of Dwelling Unit 1.pucca 2.Semi-pucca 3.Kutcha 4.Semi-kutcha 5.flat	
4	Natural of locality 1. Apartments 2. Quarters 3.Housing colony 4.Slum			10	Size of Homestead (in cent)	
5	Religion 1.Hindu 2.Christian 3.Muslim 4 .Others			11	Total floor Area(sqft)	
				12	Source of Energy 1.KSEB 2.Solar 3.Kerosene 4.Others	
6	Social Group 1.General 2.OBC 3.OEC 4.SC 5.ST			13	Size of family (number of family members)	
7	Type of ration card 1. White 2.Blue 3.Yellow 4.Red 5. No card			14	Monthly income	

2. Household Expenditure of Basic Necessities (Monthly)

Sl.No	Items	Expenditure (Rs)
1	Food	
2	Water	
3	Electricity	
4	Health	
5	Education	
6	Housing facilities(e.g. rent, house maintenance)	
7	Communication facilities	
8	Transportation	
9	Others(specify)	
Total household monthly expenditure		

3. Water Connection

1.	Source of Connection 1.KWA2.Corporation	
2.	Year of Connection	

3.	Why did Prefer theConnections 1.Proximity2.Water quality3.Throughout water supply 4.Low Expenditure5.No better alternative6.Other (specify)	

4. Main Source of Water (Please write code of appropriate answer)

Sl.no	Type	Source of Water	Non- summer	Summer
1.	Well water	1. Own well / bore well		
		2.well/ bore well neighboring		
		3.Public well		
2.	Corporation water	1.Household connection		
		2. Public tap		
		3.Both		
		4.Tanker supply		
3.	KWA water	1.Household connection		
		2.Public tap		
		3.Both		
		4.Tanker supply		
4.	Buying / packed water	1.Bottle water		
		2.Can water		
		3.Tanker		
5.	Rain water			
6	Others(specify)			

Note: **Summer** – (February – May), **Non – summer-(**June-January)

5.**Supplementary water sources** used in summer and non-summer seasons?

Sl.no	Type	Source of Water	Non- summer	Summer
1.	Well water	1.Own well / bore well		
		2.Well / bore well neighboring		
		3.Public well/ bore well		
2.	Corporation water	1.Household connection		
		2. Public tap		
		3.Both		
		4.Tanker supply		
3.	KWA water	1.Household connection		
		2.Public tap		
		3.Both		
		4.Tanker supply		
4.	Buying / packed water	1.Bottle water		
		2.Can water		
		3.Tanker		
5.	Rain water			
6.	Others(specify)			

6. Availability/accessibility of water, If house connection

Sl. No	Water Availability/accessibility	Non – summer	Summer
1.	Do you get water daily?1.Yes 2.No		
2.	If No, Frequency of water is available?		
3. fromQ 1	If yes, is water available throughout the day? (24/7) 1.Yes 2.No		
4.	If No, How many hours a day do you get water(in Hours)		

5.	Is the pressure of connection is adequate? 1. Very good 2.Good 3. Average 4. Low 5.Very low		
6.	Do you get adequate quantity of water per day? 1. Always sufficient 2. Somewhat sufficient 3.notsufficient		

7. Water Availability/ accessibility in Public tap

1.	Do you have public tap nearby? 1. Yes2. No		
2.	How far is it from your house? 1.Below 0.5 meter 2.50- 100 meter 3.100-150 meter 4.150 meter & above		
3.	Do you get tap water in daily 1.Yes 2.No	Non-Summer	Summer
4.	**If no,** Frequency /Regularity of water is available		
5.	How many hours a day do you get water(in Hours)		
6.	Transportation for fetching water 1. By walking 2. By pipeline 3.By vehicle		
7.	How many trips necessary for collecting water normally per day	Non-summer ----trip	Summer -----trip
8.	Size of container your household carry to fetch water (In liter)		
9.	Do you experience any difficulty incollecting water from tap 1.Distance from house 2.Frequency of water availability 3.Carry the water 4.More Time for collection 5.Others(specify)		
10.	Is the pressure of connection is adequate? 1. Very good 2.Good 3. Average 4. Low 5.Very low	Non-Summer	Summer
11.	Do you get adequate quantity of water per day? 1. Always sufficient 2. Somewhat sufficient 3.notsufficient		

8. Water Storage,Use and Consumption

1.	Do you have water storage facility1.Yes 2.No		
2.	How do you store drinking water at home 1.Roof tank 2.underground level tank 3.container 4.Bucket5.Others(Specify)		
3.	Storage capacity of Tank (Liter)		
4.	How many containers (bucket) does your household usually use per day	Non-Summer	Summer
5	Quantity of water consumed per month (water bill)		

Change & prefer in water use between Summer & Non-Summer seasons

Sl.no	Purpose	Non-summer		Summer	
		6. Water use per day	7. Preference of water use	Water use per day	Preference of water use
1	Domestic purpose		1.Drinking 2.Cooking 3.Bathing 4.Washing 5.Housecleaning 6.Sanitation 7.Others(specify)		1.Drinking 2.Cooking 3.Bathing 4.Washing 5Housecleaning 6.Sanitation 7Others(specify)

2	Productive purpose		1.Vegetables production2.Cultivation 3.Gardening 4.living stocks 5.Others(specify)		1.Vegetables production 2.Cultivation 3.Gardening 4.living stocks 5.Others(specify)
3	Non –Domestic purpose		1.Vehicle cleaning 2.Others(specify)		1.Vehicle cleaning 2.Others

9. Water management in shortage seasons

1.	Did you experience water shortage? 1.Yes 2.No	
2.	**If yes**, which months	
3.	Whether the time gets recorded and after replayed and take actions from authority (solve drinking water shortage)1.Yes,always 2.Yes,sometimes 3.No	
4 from Q 3	**If yes,** What measure taken by the authority during shortage season	
5	Does this alternative measure help to get sufficient water 1.Yes,always 2.Yes,sometimes 3.No	
6	Did you pay for alternative measures of water shortage?1.Yes 2.No	
7	If yes, what is the rate per liter	
8 from Q 3	**If No**, How did you solve drinking water shortage, explain	
9	At the time of shortage, Do you share water with other households 1. Yes 2.No 3. Some times	
10	At the time of shortage ,Do you change your residence (Place) 1.Yes 2.No	

10. Affordability

a. Water Bill

1	Do you pay for your water supply 1.Yes 2.No		
2	**If Yes**, amount of monthly water bill	Non summer	Summer
4	How frequent do you pay bill 1. Monthly 2. Quarterly 3. Yearly 4.On delivery 5.Others(specify)		
5	Schemes of the bill 1.Spot billing2.Installment base3.Once in full payment 4.Others(specify)		
6	How did you pay the bill 1. Direct payment to office2.Through agent 3. Online payment 4.Others		
7	Have you ever been granted any benefits or discounts in payment of water bill?1.Yes 2.No		
8	If yes, what is discount rate		
9	Did you ever skipped or delayed bill payment? 1.Yes 2.No		
10	If yes, reasons 1.Over billing 2.Irregular service 3.Too expensive service 4.Not working on meter is long time 5.Billing methods are inaccurate 6.other (specify)		
11	Did you ever pay fine or penalty for the non-payment of water bill during the last year? 1. No 2. service cult off 3.penalty payment 4.Other(Specify)		
12	What do you think about the current water rate/ tariff 1.Too high 2.High 3.Normal4.Low5.Too low		

b.Water Meter

1.	Do you have metered water connection1.Yes 2.No	
2.	**If yes,** When did you get meter connection (year)	
3.	Type of meter installed 1.Electronic meter2.Non-electronic meter3.Others(specify)	
4.	Do you prefer water meter installed system? 1.Yes 2.No	
5.	**If yes**, Reasons 1. Saving money 2.Accurate tariff rate 3.Accurate measure of water consumption 4.It compulsory to authority 5.Others(specify)	
6.	**If No**, Reasons 1.meter too expensive 2.meter breaker easily 3.water pressure will fall 4.not correct measurement 5.others(specify)	
7.	Does your meter working properly1.Yes 2.No	
8.	**If No,** how long does your meter not working	
9.	Do you pay water bill during this time 1.Yes 2.No	
10.	On what base do you pay water bill	
11.	Are you satisfied with the method adopted for computing your water charges at the time of non-working ofyour meter 1.Accurate 2. Low accurate3. Inaccurate 4. I don't know	

c. Water Expenditure of Household

Sl.no	Expenditure	Cost (Rs.)
1.	**Internal (install) water related expenditure** (connection fee, meter fitting, pipes, tap, building materials, cost of storage facility)	
2.	**Maintenance expenditure (repair expenses) (yearly)** (repair of pipes, tanks, pumps, regular maintenance cost, cleaning blocked pipes, pumps or tanks, storage facility cleaning expenditure, meter repairing)	
3.	**Metered water expenditure(monthly)** (meter charge)	
4.	**Water treatment expenditure (Yearly)** (boiling, bleaching, filtering of water, regular water purification cost)	
5.	**Transportation cost or delivery cost (monthly)**	
6.	**others, (specify)**	

d. Willingness to pay

1.	If Government improves the existing water supply with better quality and sufficient quantity of water, Are you ready to pay more charges for it? 1.Yes 2.No	
2.	**If yes**, what are the maximum charges you will be willing to pay for a month	
3.	**If No,** why 1.Poor services 2.Connection is expensive 3.Regular fees is expensive 4.Satisfied with current supply 5.Others (specify)	

11. Water Quality

			Excellent	Very good	Good	Poor	Very poor
1.	How did you rate the quality of drinking water	Colour					
		Taste					
		Smell					

2.	If poor, what is/are the reason? 1.muddy2.brackish or salty3.Hardness 4. chlorinate5.Bad smell6.Others(specify)	
3.	Do you treat water before use1.Yes 2.No	
4.	How do you purify the water 1.Boil 2.Bleach/ chlorine 3.Water filter 4.Sieve it through cloth 5.Don't do anything	
5.	Has government provided any water testing kits1. Yes…….. 2.No	
6.	Do you take laboratory test for water quality1.Yes 2.No	
7.	If Yes, its frequency 1.Once in week 2.Once in month 3.Once in quarter 4.Once in year	
8.	Have you or any one in your family suffered any water borne disease in last year1.Yes 2.No	
9.	If Yes, Which Disease 1.Cholera 2.Malaria 3.Typhoid 4.Diarrhea 5.skin diseases 6.worm disease 7.Others(specify)	
10.	If yes, medical expense for treatment	
11.	What is your opinion about safety of tap water for drinking? 1.Completely safe 2.Somewhat safe 3.Slightly safe 4. not safe5.I don't no	

12. Water Literacy (Water knowledge, Water saving, Water conservation)

1	Are you aware aboutGlobal water crisis? How? 1.Yes …… 2.No	
2	Do you know, Where does your water comes from1. Yes …… 2. No	
3	Are you aware of the different source of water in your locality?1. Yes… 2.No	
4	Do you know, the per liter charge of water consuming1.yes … 2.No	
5	Are you aware the slab of water rate charged by authority1.Yes … 2.No	
6	Do you think the misuses of water should be controlled?1.Yes 2.No	
7	Is there any method (water saving measures)practiced in your home1.Yes 2.No	
8	**If yes,**which methods 1.Use recycled water 2. Reduce frequency of bathing/ washing 3.Drip irrigation 4.water saving automatic taps 5.Automatic control appliances 6.Other(specify)	
9	Could you reduce the wastage of water in your houses by practicing above measures 1.Yes 2.No	
10	Have you ever informed your children about the importance of saving water 1.Yes 2.No	
11	Whether your children practices water saving 1.Yes 2.No	
12	If yes, how	
13	Did your parents informed you about the importance of water saving1.Yes 2.No	
14	Did you attend any water saving programme or class 1.Yes 2.No	
15	**If Yes** which programmes	
16	Do you currently practice water conservation at your house1.Yes 2.No	
17	**If yes**, which method did you practiced to water conservation 1.Rain water recharging 2.well recharging 3.roof top recharging 4.Maintains& protect surface water near by 5.others(specify)	

Part 2

13. Reliability

1.	Did you face any disruption in the water service in last year1.Yes 2.No	
2.	If Yes, what type of disruption 1.Frequent breaking of pipelines 2.Long term of meter is not working 3.Public tap broken 4. Present expensive billing system 5.Water unavailable from source 6.Piping maintenance work 7. Main pump or pipe broken 8.Service disruption 9.Other (specify)	
3.	How many times the major interruptions or break down take place in the last year	
4	Do you think, number of major interruptions or break downs are reduced year to year1.yes 2.No	
5.	Did you get information about Interruption of service in advance from concerned authorities1.Yes 2.No	
6.	During these interruptions, did you getany alternative source from authority 1.Yes 2.No	
7.	If Yes, Please Specify	
8.	Did you report this interruptions immediately to the authorities1.Yes 2.No	
9	How often did you contact your service provider or related authorities to solve your problems	
10	Does the concerned authorities take immediate action to solve your problems in the time frame1.Yes 2.No	
11	**If No**, how many days required tosolve your problem	
12	Did you pay any fees for these services1.Yes 2.No	
13	**If yes** how much	
14	How often water disruption problem take place during summer season 1. Very high2.high 3. medium 4.Low 5.very low	
15	Do you ever feelings the following problems to solving for pay your concerned organization 1Over billing 2.Avoiding compliance with regulation 3.Over charging of activities 4.Fraudulent meter reading, 5.poor supervision of works, 6.lack of availability of information	1. Never 2.Rarely 3. sometimes 4.most of the time 5.Always
16	Did you make any other payment (other than fees) any time in the following services? 1.to get a connection 2.to access water supply 3.to finish repair work 4.immediate action to solve the problem	1.Never 2.Rarely 3.sometimes 4.most of the time 5.Always
17	If paid, How much did you pay	
18	If paid, Was the payment demand 1. Demanded 2. Paid on my own 3.Both	
19	In your opinion, 'the level of payment have an effect on service delivery 1.Very effective2.effective3.low effective 4.very low effective 5.no effective	
20	What are the other disparities affected you while receiving water service any time 1.Favoritism 2.Nepotism 3.Influences 4.Improper gifts	

21 Please mark your assessment about level of reliability in various activities of authorities

SI.no	Level of Reliability (various activities of authority)	highly satisfied	satisfied	Low satisfied	Very low satisfied	Not satisfied

1	Reduce the number of major disruption in water service during last five years					
2	Capacity to solving disruption of water services in correctly and timely					
3	Maintain adequate water supply in summer months as well as non-summer months					
4	Fair service with fair payments					

14. Transparency

1	Did you approach the authority for any of the following water service 1.New water connection1.Yes 2.No 2.Solving water service complaint1.Yes 2.No 3.Changing type of service connection1.Yes 2.No 4.Changing ownership of water connection1.Yes 2.No 5.Payment of water charges1.Yes2.No	
2	How did you approach concerned authority 1.Direct visit 2.Through agent (Councilor) 3.Online service	
3	How many times you visit concerned authority for water service in last year	
4	Did you ever approach concerned authority for getting your service fulfilled1.Yes 2.No	
5	Do you know about online services provided by the authority? 1.Yes,I know 2.I don't know	
6	**If yes**, did you make use any of the online customer service provided by authority 1.New water connection 2.Meter related 3.Ownership change 4.Alternation 5.Disconnection 6.Others(specify)	
7	How long, do you use online services	
8	Do you know how to interact with your water service authority in its office for water service1.Yes 2.No	
9	Do you know how to write and submit an application for receiving service 1.Yes 2.No	
10	Do you know how to file a complaint for your water problems1.Yes 2.No	
11	Did you know working hours of your authority1.Yes 2.No	
12	Which all staff of the authority is always willing to help you 1.Yes, always 2.Yes, sometimes 3.Yes,special situations 4.No help	

13. Please put tick mark in appropriate columns regarding the usefulness of characteristics of officials at the time water service related services and issues

Sl. no	Characteristics of Officials	Highly useful	useful	Low useful	Not useful	No experience
1	Ability (capacity of staff to solve the problem, time taken to attend & resolve problem ,capacity of staff involve service delivery)					
2	Behaviour (treat you with respect, staff treated customer fairly)					
3	Helpfulness (listen & understand for problems)					
4	Responsibility (honesty & punctuality to attain the service to customers)					
5	Attitude (positive attitude)					

14. Please mark your opinion about accessibility of information about respective documents of water service authority.

Sl.no	Documents of authorities (Annual reports)	High accessible	Low accessible	No accessible	No experience	Don't know
1	Annual budget report					
1	Present Progress reports on service standards & delivery					
3	Reports on complaints and it solving mechanism					
4	Management working report					
5	Progress report on new project &programmes					

15. Please mark your opinion about accessibility ofinformation about various source of water service authority

Sl.no	Information sources	Very useful	Useful	Not useful	No experience	Don't Know
1	Notice board of authority					
2	Service bulletin(connection register, complaint register)					
3	Service desk in the authority					
4	Political representatives(councilor)					
5	Citizen character					

16. Please mark your assessment about level of transparency in various activities of authorities

Sl.no	Level of transparency (various activities of authority)	Very easy to understand	Easy to understand	Difficult to understand	Very difficult to understand	Not understand
1	Clarity & simplicity of process& procedures in the official matters					
2	Written of application form to various service					
3	Filing complaint procedures					
4	Payment of water bill procedures					
5	Online services procedures					
6	Front office management system for information dissemination					
7	Identification of beneficiaries selection process for various projects and schemes					
8	Decision taken by ward committee meeting					

15. Accountability

1	Do you think that the authority is doing proper recording of consumer details and it is open at any time1. Yes 2. No	
2	Do you think that authority properly utilize various funds for consumer servicesand do you get its benefit1. Yes 2. No	
3	Do you think that authority is up to date in incorporating the new rules & guidelines for service applicable for your water service 1.Yes 2. No	
4	Do you know your authoritypublishing documentsto periodically and its opening to society1. Yes 2. No	
5	Do you think that authority publish the selected beneficiaries of the various water related project &schemes timely and truly1.Yes 2. No	

6	Do you think that authority follows the clear policy & planning for water related activities and it informed honesty1. Yes 2. No	
7	Do you think that authority record & kept your opinion in ward committee meeting and it applicable1. Yes 2. No	
8	Do think that authority prepared and supplied water bill correctly and timely 1.Yes 2.No	

9. Please mark your assessment about level of accountability in various activities of authorities

SI.no	Level of accountability (Various activities of authority)	Highly accurate	accurate	Low accurate	Very low accurate	Inaccurate
1	Water bill is simple and clear ,correct fixation of water charge					
2	Meter reading and bill supply is correctly and timely					
3	Authority is correctly prepared, kept and open up various records properly					
4	Benefit as per revising the rules & procedure as per changed situation					
5	Beneficiaries identification&selection is timely and accurate					
6	Timely reporting progress and sharing correct information to beneficiaries					
7	Ward committee meeting discussion are kept &record and correctly applicable to beneficiaries valuable suggestions					
8	Quality of ward committee meeting discussion					

16. Communication

1	How did the authority communicate with you 1. Public meeting 5. Area committee 2. Ward committee meeting 6. Open forum 3.athalath 7.all of them 4. Online service 8.Others (specify)	
2	What way of communication is used by the authority 1.Notice board 5.Internet(online) 2.Public notice 6.Door Door canvassing 3.Posters7.Agent 4 .Telephone8. Others (specify)	

3. Please rateyour satisfaction regarding the authorities' communication

SL. no	Are you satisfied with	Excellent	Very good	Good	Poor	Very poor
1	Timely availability of sufficient & relevant information					
2	Availability of necessary knowledge & skills from public servants					
3	Honest communication					
4	Resolve the disputes & complaints in fair manner					
5	Announces the important decisions in advance					
6	Way of authority inform about matters					

17. Participation

1	Have you attended or participate any of the following 1.Public meetings 2.ward committee meeting 3. Open form 4.workshops / seminars/ Water saving activities 5. Athalath 6. All of them 7. No participation 8.Others (specify)	

2. Participation in various meetings&various programmes

1	Have you attended meeting/programmes regularly 1.Yes 2. No	
2	**If No**, How often do you attend meeting/programmes 1.Attended below 25% of meeting 2.Attended 25-50% of meeting 3.Attended 50-75 % of meeting 4.Attended above 75% of meeting 5.Never attended	
3	How often are meeting/programmes conduct by the authority(Number of meeting/programmes held in last year) 1.Public meetings- 2.ward committee meeting - 3. Open form - 4. Area committee meetings - 5.workshops / seminars/ Water saving activities-	
4	Does your voice opinion being recorded in meetings/programmes 1.Yes, always 2.Yes, sometimes 3.No	
5	Do you get a result for your opinion demanded 1.Yes, always 2.Yes, few times 3.Yes,occasionally4.Never	
6	How do you evaluate your experience in participating the event 1. Very useful 2.useful 3.useful to some extent 4. Not useful	

3. Participation in adalath

1	Did you participate in any adalath1.Yes 2.No	
2	If yes, How often adalaths held in a year	
3	How often do you attend athalath	
4	Did you ever get the problems or complaints solve through adalath 1.Yes 2.No	
5	If Yes, please explain	
6	How do you evaluate your experience in participating theadalath 1. Very useful 2.Useful 3. Low useful 4.Very low useful 5. Not useful	

4	Are you member in any committee/programmes related water service 1.yes 2.No	
1	**If yes**, which committee/programme	
2	When did you take the membership	
3	Are you involved to solve the water issues in your area in last year1.yes 2 .No	
4	If yes, in what issues are you involved 1.Water quality issues 2.water quantity issues 3.Illegal connection of water lines 4.over water bill 5.Broken of water supply 6.Others (specify)	
5	Was any issue resolved with your interaction 1. Completely resolved 2.partially resolved 3.not resolve 4. Don't know	

6	Does the association still working effectively 1. Very effective 2.effective 3.low effective4.Very low effective 5.ineffective	

5. Pleaserate your evaluation of levelof participation is following

Sl.no	Level of participation	Very high participation	High participation	Low participation	Very low participation	No participation
1	Public Participation in ward committee meeting and its discussions					
2	Public Participation in adalath					
3	Public Participation in workshops / seminars/ Water saving activities					
4	Participation attitude of representatives in authority to public meetings/programmes					
5	Participation Attitude of elected representatives to public meetings/programmes					

18. Beneficiariessatisfaction

1	Are you satisfied with current water supply in your authority1.Yes 2.No	
2	If yes, 1. Very high satisfied 2.high satisfied3. Somewhat satisfied4. low satisfied 5.Very low satisfied	
3	If no,why 1. broken water supply 2. Over billing 3.Avoiding compliance with authority 4.Fraudulent meter reading 5.Bad quality of water corruption 6.Others(specify)	
4	Are you satisfied with support of governance system in your water service 1.Yes 2.No	
5	If yes, 1. Very high satisfied 2.high satisfied3. Somewhat satisfied 4. low satisfied 5.Very low satisfied	
6	If no, why 1.lack of skilled public servants 2.corruption 3.weak political leader ship 4.interest on political parties 5.councilors personal gain 6.lack of citizen participation 7.Others(specify)	
7	Suggestion for further improvement of the current water supply system	

THANK YOU

INTERVIEW SCHEDULE

As part of my research, I am required to interview selected officers by meansof semi-structured questionnaire. I therefore kindly request your participation&contribution.The research study will not be possible without your participation.Hence your corporation in this regard would be highly appreciated. I assure that the information provided by you in this regard will be used only for academic purpose.

Name of interviewees	Organization	position	Date of interview
-------	Trissur corporation	Mayor	-------
-------	Corporation	Officer(secretary from water department)	------
-------	KWA	Officer(A.E from water authority)	------
-------	Corporation	Councilor	------
-------	KWA	Councilor	------

<u>MAYOR IN THRISSUR CORPORATION</u>

1. Name:
2. Sex:
3. What is your role / function of council?
4. How many years have you been in your current post?
5. Do think council has enough& clearly defines powers and functions to undertake the responsibility.
6. Council has sufficient human resource.
7. Does council get any budget from central, state for water supply &expenditure? What is the actual amount granted? What does the average time have to take to issue allocated money? Is the revenue support its expenditure requirement.
8. Did you participate & conduct budget formulation and presentation in council? Are the budget allocation clearly linked with service target? Is the budget is open to the public?
9. What are the other sources of finance for water service? It able to meet set a target.
10. Does your council maintain good relation between any stakeholders for helping to managing & distributing water supply? If yes which stakeholders? What purpose?

11. Is the sufficient water resource is available in the corporation for water supply. Does the council take any adequate measures to protect the water bodies in your corporation?
12. How regularity are council meeting held in your municipality? Is the council meeting usually well attending by all councilors? What discussion& implementation about water service delivery in your corporation? How would you evaluate your experience in these meeting?
13. Have council implemented any ideas/strategies in order to ensure the better water service delivery. What are ideas/strategies?
14. Does your council have measure to guarantee access to water services to beneficiaries? Is the council take special consideration to serving the need of the poor? How?
15. What is your opinion to your councilor act in the best interest of both municipality &public? How knowledgeable? How responsible? How well council decisions are implemented?
16. Do the public give their full support to the council to address their needs?Ifyes how?
17. In your opinion,what are the major challenges affect the better water service delivery in your corporation?
18. Do you have suggestions to how council can overcome its challenges?
19. What plans &arrangements for improve access to water in your communities for future?
20. Did you get any award for your service?

OFFICER

1. Name of the respondent:
2. Sex of the respondent :
3. What is your post?
4. Define the powers&function in your post?
5. How many years have you been in your current post?
6. When your authority did begin to water supply?
7. What is/are the main source?
8. Do you describe the brief picture of humanresources in your office?Is sufficient human resource is discharge of responsibility.
9. How do you assess physical resource at the authority,which help to deliver the service?
10. Did yourorganization can sufficient distribution of water every day?How can manage the storage of water for this purpose?
11. Did your authority face any water shortage situation? If yes, how can manage the shortage season?
12. Did your authority doing anything in water saving & conservation. If yes how method used to protect water resource?

13. How would yourate the quality of water in supply? How can measure it? Ifpoor, how can you solve it?
14. Have you experienced any water service complaints frombeneficiaries? Which type of complaint is most? How do you handle the matters?
15. What are the main sources of finance in your authority for water service?What is your role of fund raising,fund allocation&fund utilization?Is the fund is sufficient to expenditure requirements.
16. Which reports published in your office periodically? Is the report is shared with public? How?
17. Did your authority provide any online service? If yes which services?
18. Did you consider timely provide important information to the public. How can informing?
19. Did you consider the public involvement for discussion & implementation of new schemes/projects?
20. Did you ready to always willing to help us your consumers for official matters?Do you get full support to your collegic?
21. Can you follow the present rules & regulation of corporation? How do you utilize the guidelines & policies?
22. Did you consider the criteria for identification selection of beneficiaries?
23. Do you keep the official records(technical,administrative,financial) & publications regularly?
24. Do you keep accounting & proper recording of various funds?
25. Did you consider evaluating the benchmarking to water quality &quantity in periodically?
26. Do you participate the budget formulation process? Is the budget allocation clearly linked with service target?
27. Do you maintain good communication with your superiors, Stakeholders, Public? How?
28. Do you conduct/attend any meeting/events related in your water service? How would you evaluate your experience in participating in these meeting/events?
29. Have you implemented any project/schemes related water supply? Is the project is highly demanded by public.
30. Do you consider takingstrong & suitable decision always in your service? Did you get full support from your authority & public?
31. How would you describe the major challenges, the authority faces when water delivery to the city?
    a. Administrative gap
    b. Management gap
    c. Financial gap
    d. Transparency & accountability gap
    e. Information & communication gap
    f. Malpractices
32. Do you think you can help a government to effectively deliverwater services in your corporation?

33. Do you think beneficiaries are satisfied with the service you provide if how do you know?
34. Did you experience/ observe a change in the water service delivery in long period.
35. Do you have any suggestion for improving water service delivery for future?
36. Did you get any award for your service?

COUNCILOR

1. Name of the respondent:
2. Sex of the respondent :
3. What is your post?
4. Define the powers & function in your post?
5. How many years have you been in your current post?
6. How do you interact & support the public for water service. What is the important discussion here? How do you handle the matters?Is the fixed calendar of dates for engaging the public in various activities?
7. Do you conduct /participate any meeting? Is the meeting discussing about water utility. How is the public participation in the meeting?How would you evaluate your experience in participatethese meetings?
8. Did you give special consideration to the weaker section for water service? Whether there has been any improvement in the participation of public meetings?
9. Is any type of water service forums functioning in your area? Ifyes, explain?
10. Have you implemented any project/schemes of water supply in your area?Is the project/schemes is demanded by public. What mechanism for electing public opinion in execution of important project/schemes
11. Do you feel that, sufficient water distributed in beneficiaries. Did you take any action to save& protect water resource in your area
12. Did you attend council meeting regularly. What discuss about water utility in this meeting. Had you demand your division? How well the council decisions are implemented? What is your experience?
13. What is your role of fund raising, fund allocation & fund utilization from council?
14. Do you participate the budget formulation process? Are the budget allocation clearly linked with service target? Is the budget is open to the public?
15. Did you maintain good communication with your superiors &collegic? Did you get full support to the council for delivery of water service to public?
16. Did you maintain good communication with authority? How can you interconnect with public to the authority for various water services and complaints? Can you protect equal interest of both?
17. Do you know with regard to government policies,guidelines or conditions governing the provision of good water supply? Can you follow the present rules and regulation in your corporation?
18. Did you consider taking strong & suitable decision always in your service for better water service delivery? Do you get full support from your council & beneficiaries?
19. In your opinion, how well the corporation/KWA's water service performance in your area?

20. What are the major challenges faced by you for implementing better water service delivery in your corporation?
21. Do you think you can help a government to effectively deliver water services in your corporation?
22. Do you think beneficiaries are satisfied with the service you provide if how do you know?
23. Did you experience/observe a change in the water service delivery in long period?
24. Did you have any suggestion for improving water service is run smoothly for future?
25. Did you get any award for your service?

Thrissur City Location Map

Thrissur Corporation Water Supply Map

REFERENCE

BIBLIOGRAPHY

Abate, F. (2007). Beyond the Public Realm: local governance network and service development in the Amhara and Tigray regions, Ethiopia.

Adamu, B. (2019). Patterns of pipe-borne water supply in the Buea Municipality: Challenges and way forward. International Journal of English Literature and Social Sciences (IJELS), 4(3).

ADB. (1997). Second water utilities data book: Asian & pacific region, Asian development bank, manila.

ADB. (2004).Water in Asian Cities: utilities performance and civil society views, Asian Development Bank. Technical Advisory Committee of the Global Water Partnership, Namibia.

ADB. (2007). Best practices in water supply and sanitation.,leaning from successful projects, ADB,Operations evaluation departments by marco gatti.

Addo, L. Y. (2010). Institutional analysis of urban water supply in Ghana: The case of Accra Metropolitan assembly. Ph.D. thesis from science in environmental management, Aalborg: Denmark.

Adeoye, P. A., Adesiji, A. R., & Mustapha, H. I. (2013). Appraisal of rural water supply: case study of Kwara state, north central Nigeria. Int. J. Basic Appl. Sci., 1(4), 816-826.

Adeyemi, O. O. (2012). Corruption and local government administration in Nigeria: A discourse of core issues. European journal of sustainable development, 1(2), 183-183.

Administrative Report. (2018-19). KWA, jala bhavan, Thiruvananthapuram, government of kerala ,http://www.kwa.ker.gov.in

Afridi, F. (2017). Governance and public service delivery in India. indian statistical institute of economic and planning unit research report, new delhi, india,april.

Agagu, A. A. (1997). Local Government. Kolawole (ed). Readings in Political Science. Ibadan: Dekaal Publishers.

Ahmed.S. (1995). Status of Civic Amenities in Metros, Main Stream, 18(10).

Ali, M. H., & Sulaiman, M. S. (2006),. The causes and consequences of the informal settlements in Zanzibar. In XXIII Congress of the International Federation of Surveyors, Munich, Germany.

Allan, T. (2001). The Middle East water question. The Middle East Water Question, 1-400.

Allen, A., Dávila, J. D., & Hofmann, P. (2006). The peri-urban water poor: citizens or consumers? Environment and Urbanization, 18(2), 333-351.

Aminuzzaman, S. M. (2010). Local Governance Support Project-Learning and Innovation Component (LGSP-LIC). Local Government Division, Government of Bangladesh.

Andres, L., Biller, D., & Dappe, M. H. (2016). A methodological framework for prioritizing infrastructure investment. Journal of Infrastructure Development, 8(2), 111-127.

Anifowoshe, T. O. (1987). Water: An essential basic necessity—a case study of Ogun State of Nigeria. Geo Journal, 14(2), 253-261.

Anifowoshe, T. O. (1987). Water: An essential basic necessity—a case study of Ogun State of Nigeria. Geo Journal, 14(2), 253-261.

Annual Report .(2002-03). National water policy, april, Ministry of water resources, Government of India

Annual Report .(2013-14). National water policy, june, Ministry of water resources, Government of India

Annual Report. (1987). National water policy, september, Ministry of water resources, Government of India.

Araral, E., & Wang, Y. (2013). Water governance 2.0: a review and second generation research agenda. Water Resources Management, 27, 3945-3957.

Asian Development Bank. (1999). Handbook for Economic Analysis of Water Supply Projects, Manila (Mimeo)

Awal. H. (2005). Administrative Decentralization: A Framework for Discussion and Its Practices in Bangladesh, Available at: http://unpan1.un.org/Intradoc/Groups/Public /Documents/Unpan/Unpan019445.Pdf [accessed on 19 February 2011).

Awortwi, N. (2013). Contracting out public services to private agents: Lessons from the Management of Local Government Contracts in Ghana. Thirty Years of Public Sector Reforms in Africa: Selected Country Experiences, 295.

Bagchi, S. (1999). Financing and cost recovery of urban water supply and sanitation: A case study of Surat city. Urban India, 19(2).

Bagchi, S., & Chattopadhyay, S. (2004). Decentralized urban governance in India: implications for financing of urban infrastructure. Economic and Political Weekly, 5253-5260.

Bajpai, P., & Bhandari, L. (2001). Ensuring access to water in urban households. Economic and Political Weekly, 3774-3778.

Bakker, K., Kooy, M., Shofiani, N. E., & Martijn, E. J. (2008). Governance failure: rethinking the institutional dimensions of urban water supply to poor households. World Development, 36(10), 1891-1915.

Banerjee, T., & Roy, K. (1990). Delivery of Urban Services in Calcutta Metropolitan Area. Urban India, 10, 13-26.

Bardhan, P., & Mookherjee, D. (2006). Decentralization and accountability in infrastructure delivery in developing countries. The Economic Journal, 116(508), 101-127.

Baron, C. (2003). La gouvernance: débats autour d'un concept polysémique. Droit et société, (2), 329-349.

Bellaubi . F and Pahl-Wostl. C. (2017). Corruption risks, management practices, and performance in water service delivery in Kenya and Ghana an agent-based model. Ecology and Society, 22(2).https://www.jstor.org/stable/26270072

Ben .W.C, Hibhert. M. (1995). Water related infrastructure in medieval London, The London encyclopedia, ISBN 0-333-57688-8,retrieved 24 march 2007.

Bendahmane, B. (1993). Lessons learned in water, sanitation & health: thirteen years of experience in developing countries. Arlington,Virginia,water & sanitation for health (wash) project.

Besley, T., & Ghatak, M. (2007). Reforming public service delivery. Journal of African Economies, 16(suppl_1), 127-156.

Bhagat, R. B. (2011). Urbanization and access to basic amenities in India. Urban India, 31(1), 1-13.

Bhatnagar., V & Ramanujam.,S.R .(2011). Addressing the challenge of financial sustainability in urban water supply service-role of performance, monitoring and planning. Water policy and performance for sustainable development, indian infrastructure report, oxford university press,new delhi.

Bhuyan, M., & Husain, Z. (2013). Urban Growth and Water Supply in Jorhat, India. Journal-American Water Works Association, 105(11), 72-75.

Bijlani, H.U and P.S.N. Rao, P. S.N. (1990). Water Supply and Sanitation: Role of Public Agencies, Urban India Vol X (1), 74-85.

Birner, R. (2007). Improving governance to eradicate hunger and poverty. Twenty twenty (2020) focus brief on the world's poor and hungry people/International Food Policy Research Institute (IFPRI).

Boateng, K. A. (1997). Urban governance in relation to the operation of urban services in developing countries. Habitat international, 21(1), 65-77.

Boex, J., Lane, B., & Yao, G. (2013). An assessment of urban public service delivery in South Asia: an analysis of institutional and fiscal constraints. Washington, DC: Urban Institute.

Bohra, O.P. (2001). Supply of Drinking Water, Water Pollution and Role of Local Government, the New Environmental Age, 241-251.

Bos, R., Roaf, V., Payen, G., J Rousse, M., Latorre, C., McCleod, N., & Alves, D. (2016). Manual on the human rights to safe drinking water and sanitation for practitioners (p. 120). IWA Publishing.

Bovaird, T., & Löffler, E. (Eds.). (2015). Public management and governance. Routledge.

Bowonder, B., & Chettri, R. (1984). Urban water supply in India: environmental issues. Urban Ecology, 8(4), 295-311.

Boyle, C. E. (2014). Adapting to change: Water utility financial practices in the early twenty-first century. Journal-American Water Works Association, 106(1), E1-E9.

Briscoe, J. (1993). Managing water as an economic good: Rules for reformers. Water Supply, 15(4), 153-172.

Brown, T. L., & Potoski, M. (2003). Contract–management capacity in municipal and county governments. Public Administration Review, 63(2), 153-164.

Burek, P., Satoh, Y., Fischer, G., Kahil, M. T., Scherzer, A., Tramberend, S., & Wiberg, D. (2016). Water futures and solution: fast track initiative (final report). International Institute for Applied Systems Analysis, Laxenburg, Austria.

Catherine E.C and William J.C (2012) .The dynamics of global water futures driving forces 2011-2050, United nations world water assessment programme, UNESCO. http://www.unesco.org/water/wwap

Census of India. (2011). Ministry of Home Affairs, Government of India. Office of the Registrar General and Census Commissioner, India.

Centre for Water Resource Development and Management. (1993). Report of the Environment Impact Analysis of Water Resource Project, CWRDM, Calicut.

CESPA. (2012).Governance, accountability and effective basic service delivery in sierra leone., Global research project, uk government & partnership for African social and governance research.

Chakrapani, R., India, W., & Samithi, C. P. S. (2014, March). Domestic water and sanitation in Kerala: a situation analysis. Pune: Forum for Policy Dialogue on Water Conflicts in India.

Charles, D Z & Mertler, R. (1993). The human right to water. Water Policy ,1 487-503.

Chitharanjan, K.V, Vyas .A, & Gupta,P. K. (1993). Pricing Urban Services: Case of Water Supply and Sewerage in Baroda City, Nagarlok, XXV, 48-55.

Cloete, J. J. N. (1995). Public administration glossary. JL van Schaik Academic.

Cohen, B. (2006). Urbanization in developing countries: Current trends, future projections, and key challenges for sustainability. Technology in society, 28(1-2), 63-80.

Collier, P. (2007). Accountability in the provision of social services: A framework for African research. Department of Economics, Oxford University.

Collins, M. A. (1985). Challenges in urban water management in the United States. Geo Journal, 11, 215-228.

CPHEEO .(2014). Water supply and sanitation, ministry of urban development, Government of India.

CPHEEO. (2005). Status of water supply, sanitation and solid waste management in urban areas. National institute of urban affairs, ministry of urban development, government of India.

CRRID. (2006).Capacity building of local self-government institutions in Punjab, ISBN 81-85835-50-0.

Cullet, P. (2011). Evolving regulatory framework for rural drinking water. India Infrastructure Report. IDFC(infrastructure development finance company), OXFORD university press,university of OXFORD,UK.

Dale Whittington,W. , Hanemann.M. , sadoff .C, jeuland. M. (2009). The challenges of improving water and sanitation services in less developed countries, foundations & trends in microeconomics, 4(6-7), 469-609.

Dalhuisen J.M., Groot. H.D., Rodenburg.C.A ., Nijkamp.P .(2002). The Economics of Urban Drinking Water Use, Water Management in Urban Areas, 28 (2), 111-123 https://www.jstor.org/stable/23288795.

Davis, J. (2004). Corruption in public service delivery: experience from South Asia's water and sanitation sector. World development, 32(1), 53-71.

Davis, J., Garvey, G., & Wood, M. (1993). Developing and managing community water supplies (Vol. 8). Oxfam.

De Loe, R., Moraru, L., Kreutzwiser, R., Schaefer, K., & Mills, B. (2001). Demand side management of water in Ontario municipalities: status, progress, and opportunities 1. JAWRA Journal of the American Water Resources Association, 37(1), 57-72.

De Visser, J., Cottle, E., & Mettler, J. (2003). Realising the right of access to water: Pipe dream or watershed?. Law, Democracy & Development, 7(1), 27-53.

Deininger, K., & Mpuga, P. (2005). Does greater accountability improve the quality of public service delivery? Evidence from Uganda. World development, 33(1), 171-191.

Department of Water Affairs and Forestry. (2003). Strategic framework for water services. Republic of South Africa, Pretoria.

Devas, N. (1999). Who Runs Cities? the relationship between urban governance, service delivery and poverty. Theme paper 4, Birmingham, university of Birmingham.

Dinesan V., P. (2016). Worsening drought, drought water life, kerala calling, kerala an authentic handbook, 37(1), Government of Kerala.

Dinesan V.P. (2019). Surface water resources of Kerala: management issues, future strategies, surface water and ground water resources of Kerala: management issues, policies, future strategies. (book), proceeding of national seminar jointly organized by department geology, university of Kerala & geological society of India.

DISTRICT,A.(2011). District Census Handbook, Part A, Census of India.

Drinking Water and Health .(1982). Safe drinking water committee, board on toxicology and environmental health hazards , National research council, ISBN-0-309-55424-1, 299.

Drollery E, B., & Wallis, J. (2001). Political Economy of Local Government: Studies in Fiscal Federalism and State –Local Finance, Cheltenham: Edward Elgar.

DWSS report. (2018). Decentralization and the delivery of water and sanitation services in kerala, India. available net on http://decenralisation-net/wp-content/uploads/2018/03/DWSS-kerala-2017.pdf.

Dynamic Ground Water Resource of India. (2017) .Central ground water board, ministry of water resources, river development & ganga rejuvenation, government of India, Faridabad.

Economic Review. (1984). State Planning Board, Thiruvananthapuram, government of Kerala.

Economic Review. (1990). State Planning Board, Thiruvananthapuram, government of Kerala.

Economic Review. (2002). State Planning Board, Thiruvananthapuram, government of Kerala

Economic Review. (2008). State Planning Board, Thiruvananthapuram, government of Kerala

Economic Review. (2012). State Planning Board, Thiruvananthapuram, government of Kerala

Economic Review. (2013). State Planning Board, Thiruvananthapuram, government of Kerala.

Economic Review. (2018). State Planning Board, Thiruvananthapuram, government of Kerala.

Economic Review. (2021). State Planning Board, Thiruvananthapuram, government of Kerala

Economic Review. (2015). State Planning Board, Thiruvananthapuram, government of Kerala.

Economic Review. (2017). State Planning Board, Thiruvananthapuram, government of Kerala.

Edwards, M. L. (2013). Measuring public perceptions of water governance in Nebraska and Washington. ph.d work in Washington state university, Department of sociology, may.

EEFSA panel on dietetic products, nutrition and allergies. (2010). Scientific opinion on dietary reference values for water. EFSA journal 8(3),1459, doi 10 2903/jesfa.2010.1459

Eigeman, J. (2007). Service delivery, a challenge for local governments. VNG International.

Emezi, C. (1984). Local government in historical perspective. Nigerian Journal of Public Administration and Local Government, 2(2), 50.

Euromarket. (2003). Analysis of the European Union's Explicit and Implicit Policies and Approach in Large Water sector, Unpublished Final Report for work package 1. Phase 1, the European Commission.

FAO. (2010). AQUASTAT data base, http://www.fao.org/nr/water/aquastat/water_ use/index.stm.

FAO. (Food and Agriculture Organization). (2013). AQUASTAT- http://www.fao.orginatar/water/aquastat/data/quey/results

Ferris, J & Graddy.E.E .(1996). Institutional Economics and Government Contracting:Lessons for the New Public Management. Paper prepared for the conference on The New Public Management in International Perspective Institute of Public Finance and Fiscal Law, St Gallen, Switzerland, 11-13.

Fewtrell, L., Kaufmann, R. B., Kay, D., Enanoria, W., Haller, L., & Colford, J. M. (2005). Water, sanitation, and hygiene interventions to reduce diarrhoea in less developed countries: a systematic review and meta-analysis. The Lancet infectious diseases, 5(1), 42-52.

Fogden, J., & Wood, G. (2009). Access to safe drinking water and its impact on global economic growth. Bothell, WA, USA: A Study for HaloSource.

Fox, W. & Meyer, T.H. (1995). Policies for public service transformation. Eliot Avenue: Creda Press

Gadgil, A. (1998). Drinking water in developing countries. Annual review of energy and the environment, 23(1), 253-286.

Garrett. H. (1968) . The Tragedy of the Commons, Science 162:1243-1248.

Gary, M. (1993). Structural policy and multilevel governance in the EC. The Maastricht debates and beyond, 392.

Gauthier, B., & Reinikka, R. (2007). Methodological Approaches to the Study of Institutions and Service Delivery: A review of PETS, QSDS and CRCS.

General Guidelines for Water Audit and Water Conservation. (2017). Evaluation of water utilsation directorate, central water commission, central ground water board, ministry of water resources, RD& GR gol, ,new delhi.

George, M. S. (2007). An Introduction to Local Self Governments In Kerala. SDC Capdeck.

George.S .(2009) .Trends in Urbanisation and Urban Governance in Kerala , Kerala Economy: Trends during the Post Reforms Period, (ed) by K. Rajan, Serials Publications, New Delhi, 2009, 421-427.

Ghosh, A. (1993). Status of Water Supply and Sanitation Facilities in Urban India-An Overview. Urbanization in Developing Countries: Basic Services and Community Participation, (1), 147.

Gildenhuys, J. S. H., & Knipe, A. (2000). The organization of government: An introduction. Van Schaik Publishers.

Gisselquist, R. M. (2012). Good governance as a concept, and why this matters for development policy (No. 2012/30). WIDER Working Paper.

Goel, R.K. and Saunoris, J.W. (2014). Government decentralization and the prevalence of the shadow economy. Public Finance Review: 1-26.

Goldblatt, M. (1996). Making the cup run over—the challenge of urban water supply for South Africa's Reconstruction and Development Programme. Geo Journal, 39, 21-26.

Goncalves. N, Teresa.V, Jorge P. (2019). Water supply and access to safe water in developing arid countries. SDRP journal of earth sciences and environmental studies, ISSN: 2472-6397 ,Research gate publications.

Graham, M. R. (2005). Water service delivery and its typologies in Urban Africa. A comprehensive project submitted in partial satisfaction of the requirements for the degree Master of Arts in Urban Planning, University of California, Los Angeles.

Ground Water Year Book. (1995). Central ground water board, ministry of water resources, river development & Ganga rejuvenation, Government of India, Faridabad.

Ground Water Year Book. (2017-18). Central ground water board, Ministry of water resources, river development & Ganga rejuvenation, government of India, Faridabad.

Gupta, S., Kumar, S., & Sarangi, G. K. (2011). Does greater autonomy improve performance? Evidence from water service providers in Indian cities. Evidence from Water Service Providers in Indian Cities (October 25, 2011). Centre for Development Economics, Department of Economics, Delhi School of Economics Working Paper, (205).

Gupta, S., Kumar, S., & Sarangi, G. K. (2012). Measuring the performance of water service providers in urban India: implications for managing water utilities. Water Policy, 14(3), 391-408.

Hall, D. (2006). Water and electricity in Nigeria A report commissioned by Public Service International (PSI). Business School University of Greenwich. Available online :< www. World-psi. org.

Hand book of Water Related Information. (2017). Central Water commission, Ministry of Water Resources, Government of India.

Hasan .Z. (2018). History headlines: 1971 & now, a tale of slogans, indian express, Status of urban water supply in India, water aid.

Heggade, O.D. (1998). Urban Development in India, Mohit Publications, New Delhi, 148-160.

Holgate, G.(2000). Environmental and wastage management, 3, 105-112.

Holland, S.A. (2005). The water business. University press Dhaka.

Hota, S. (2014). Utilization and consumption pattern of water in urban areas: a study in Sambalpur city of Odisha (Doctoral dissertation)http://ethesis.nitrkl.ac.in/5757/1/e-98.pdf.

Human development report. (1990). United Nations development programme (UNDP) New York, Oxford University press, 1990. Economic and Financial Review, 29(2), 6.

Human Development Report. (2006). beyond scarcity: Power, poverty and the global water crisis. United Nations Development Programme , new york,united states http//:hdr.undp.org/en/content/human-development-report-,accessed on 11 september 2013

Hussain. A. (2005). Administrative Decentralization: A Framework for Discussion and Its Practices in Bangladesh. Available at: http://unpan1.un.org/Intradoc/Groups/Public /Documents/Unpan/Unpan019445.Pdf [accessed on 19 February 2011).

Hydrology & Water resources Information System for India. (2020). Water resource system division, national institute of hydrology jalvigyan, India, http//:117.252.14.242/rbis/rbis.htm.

IEA (Internal Energy Agency). (2016). Water energy nexus: excerpt from the world energy outlook 2016. OECD/ international energy agency.

Ikelegbe, A. O. (2005). The local government system and grassroots development in Nigeria: Issues, problems and challenges. Perspectives on Development: A Book in Honour of Pius Oghenerukohwo Sada. Benin City: Centre for Population and Environmental Development, 37-63.

India Assessment Report. (2002). Water supply and sanitation,a WHO-UNICEF sponsored study, planning commission, Government of India.

Integrated Hydrological Data Book. (2012).non-classified river basine,central water commission,ministry of water resource,government of india. internet, http://www.irma.ac.in/silver/themepaper/BALLABH.pdf

Israel, D. C. (2009). Local service delivery of potable water in the Philippines: national review and case analysis (No. 2009-38). PIDS Discussion Paper Series.

Ivan, A., & Cuglesan, N. (2009). Multi-level governance and decentralization in the unitary states of the European Union. Case study: France and Romania. Novos Estudos Jurídicos, 14(1), 47-60.

Iyer, R. R. (2011). National water policy: an alternative draft for consideration. Economic and Political Weekly, June 25, Vol XLVI Nos 26 and 27.

Jachtenfuchs, M. (1995). Theoretical perspectives on European governance. European Law Journal, 1(2), 115-133.

Jalanidhi. (2011). Environmental Assessment and Environment Management Framework for Jalanidhi-2 , prepared by ABC Environ Solutions Ltd. for the proposed second phase of Kerala Rural Water Supply and Sanitation Project, Available at http://www.jalanidhi.kerala.gov.in/docs/emf_final_report.pdf

Jensen, M. C., & Meckling, W. H. (2019). Theory of the firm: Managerial behavior, agency costs and ownership structure. In Corporate governance (77-132). Gower.

Joe. B .(2014). History of water supply and distribution, angel water , http://angel water.com/blog/history-of-water-supply-and-distribution.

John, J. (1997). Economics of public water supply system: with special reference to Kerala, Ravat publications, New Delhi.

Juuti, P. S. (2007). First innovations of water supply and sanitation. Environmental History of Water, 17-43.

aleel. M. M. (2016). Pipe-borne water consumption and its wastage: a study based on panandura urban area in srilanka , http://www.worldscientificnews.com/wp-content/uploads/2016/11/wsn-66-2017-250-262.pdf.

Kayaga, S., & Franceys, R. (2007). Costs of urban utility water connections: Excessive burden to the poor. Utilities Policy, 15(4), 270-277.

Kayser, G. L., Amjad, U., Dalcanale, F., Bartram, J., & Bentley, M. E. (2015). Drinking water quality governance: A comparative case study of Brazil, Ecuador, and Malawi. Environmental science & policy, 48, 186-195.

Kerala ENVIS Centre. (2020). Information on water resources in Kerala, Kerala State Council for Science, Technology and Environment, MoEF, Govt. of India. Available at http://www.kerenvis.nic.in/Database/WATER_820.aspx.

KGWYB. (2015). Central ground water board, ministry of water resources, government of India, Kerala region, Thiruvananthapuram.

KGWYB. (2017-18). Central ground water board, Ministry of water resources, Government of India, Kerala region, Thiruvananthapuram.

KGWYB. (2018-19). Central ground water board, ministry of water resources, government of India, kerala region, Thiruvananthapuram.

Khan, M. M. (2009). From government to governance: Expanding the horizon of public administration to public management. New Delhi: The University Press Ltd.

Khanna, P., & Koshy, B. (1992). When city growth exceeds supply. World health. July — August.

KLGSDP. (2013). Baseline study of the Kerala local government service delivery project. Kerala local government service delivery project, center for socio-economic& environmental studies, kochi, government of Kerala.

KLGSDP. (2017). End line study of the Kerala local government service delivery project. Kerala local government service delivery project, center for socio-economic& environmental studies, kochi, government of kerala, November.

Kroukamp, H. (2007). Leadership in local governance: a prerequisite for good governance and effective service delivery?. Journal of public administration, 42(5), 59-70.

KSCSTE Study report. (2009). Environmental monitoring programme on water quality, centre for water resource development and management, sasthra bhavan,Npattom,tvm, ,ISBN 81-86366-70-9.

Kundu, A., & Thakur, S. (2006). Access to drinking water in urban India: An analysis of emerging spatial pattern in the context of new system of governance. Managing Water Resources: Policies, Institutions and Technologies, Oxford University Press, New Delhi

Kundu, A., Bagchi, S., & Kundu, D. (1999). Regional distribution of infrastructure and basic amenities in urban India: Issues concerning empowerment of local bodies. Economic and Political Weekly, 1893-1906.

Lai, K. C. & Vito.C. (2005). Decentralized Development in Agriculture: An Overview. Module 12. Food and Agriculture Organization. Available at: http://www.fao.org/docs/up/easypol/342/decen_dev_in_agri_012EN.pdf

Lawal, S. (2000). Local Government Administration in Nigeria: A Practical Approach. Ibadan: University Press Limited.

Lehner, B., & Döll, P. (2004). Development and validation of a global database of lakes, reservoirs and wetlands. Journal of hydrology, 296(1-4), 1-22.

Logan, J. A. (1960). The international municipal water supply program: a health and economic appraisal. The American journal of tropical medicine and hygiene, 9, 469-476.

Luis Andres, Saubhik Deb, Martin Gambrill, Elisa Giannone, George Joseph, Pramod Kannath,Manish Kumar, P.K. Kurian, Rajesh Many, and Abdu Muwonge.(2016).Sustainability of Demand Responsive Approaches to Rural Water Supply: the case of Kerala.Economic Political Weekely, issues 2, vol 3, 2344-2354.

Mafunisa, M. J. (2013). Role of leadership in creating commitment in the public service. Journal of Public Administration, 48(si-1), 751-763.

Majekodunmi, A. (2012). The state of local government and service delivery in Nigeria: Challenges and prospects. Africa’s Public Service Delivery & Performance Review, 1(3), 84-98.

Makanyeza, C., Kwandayi, H. P., & Ikobe, B. N. (2013). Strategies to improve service delivery in local authorities. International journal of information technology and business management, vol 15,(no 1)29. ISSN 2304-0777.http://www.jitbm.com

Makhari, C. L. (2016). Assessment of water service delivery in the municipalities of City of Tshwane, City of Cape Town and EThekwini. Master of Science Dissertation. University of the Western Cape, South Africa.

Malatjie .P.G. (2016). Ph.D. thesis in management and law, university of Limpopo

Maria Saleth, R., & Sastry, G. S. (2004). Water supply and sanitation sector of Karnataka, India: status, performance and change. Water Policy, 6(3), 161-183.

Maserumule, M. H. (2005). Good governance as a sine qua non for sustainable development in the New Partnership for Africa's Development (NEPAD): A conceptual perspective. Journal of Public Administration, 40(si-1), 194-211.

Maserumule, M. H. (2011). Good governance in the New Partnership for Africa’s Development (NEPAD): A public administration perspective. Doctor of Literature and Philosophy thesis Pretoria, University of South Africa.

Mathew, G. (1999). Decentralised Institutions: Governmental and Voluntary Sector. Economic and Political Weekly, 529-534.

Mathur, M. P., & Chandra, R. (2008). Norms and standards of basic urban services–A situational analysis. Urban India, 28(1&2), 122-151.

Mathur, O. P. (1993). Responding to India's Urban Challenge: A Research Agenda for the 1990s. National Institute of Public Finance and Policy.

Mathur.M,.P. (2001). In Obtaining Water Connection and Fixing Water Tariff: A Case Study of Rajkot Municipal Corporation Urban India, XXI (2) 75-95.

MDPI. (2016). intermittent domestic water supply: a critical review and analysis causal-consequential pathways. Water, 8(30), 4-25, doi: 10.3390/w8070274.

Mehta. M., Mehta.D. (1993) .Planning for Metropolitan Water Supply and Sewerage: A Case Study of Ahmedabad, in Bidyut Mohanthy (ed),Urbanisation in Developing Countries, Basic Service and Community Participation, Concept Publishing House, New Delhi.

Metha. M & Metha. D. (ed). Accountability and Incentives for Improving Performance in Urban Water Supply and Sanitation in India. pas.org.in/portal/document/resources files/pdfs/working%20 paper%20 accountability%20&%20 incentives.pdf.

Ministry of urban development. (2012). Improving urban water supply and sanitation services-advisory note. Ministry of urban development, government of India.

Mintesnotbeyene. (2016).Governance and public service delivery: the case of water supply in akaki kaliti sub city. Ph.D. thesis in public management and policy specialization area in development management, addis-ababa University, Ethiopia.

Mogakane, M. M. (2018). The effectiveness of municipal water service delivery in Hluvukani Community in Bushbuckridge, Mpumalanga (Doctoral dissertation).

Mohanty, B. (Ed.). (1993). Urbanisation in Developing Countries: Basic Services and Community Participation (No. 1). Concept Publishing Company.

Mubangizi, B. C., & Tshishonga, N. (2013). Political and community oversight for good governance in South Africa. Journal of Public Administration, 48(2), 299-320.Lautze, J., De Silva, S., Giordano, M., & Sanford, L. (2011, February). Putting the cart before the horse: Water governance and IWRM. In Natural Resources Forum (Vol. 35, No. 1, pp. 1-8). Oxford, UK: Blackwell Publishing Ltd.

Mukherjee, A. (2009). Issues in introducing a realistic water pricing regime in Urban Local Bodies: Jabalpur Case Study. Urban India, 130-138.

Muralidhar, S. (2006). The right to water: an overview of the Indian legal regime. The human right to water, 65, 322.

Muriisa, R. K. (2007). The AIDS pandemic in Uganda: Social capital and the role of NGOs in alleviating the impact of HIV/AIDS. PhD thesis, Public Administration and Organization Theory, Bergen, Norway.

Muriisa, R. K. (2008). Decentralization in Uganda: prospects for improved service delivery. Africa development, 33(4).

Mutsuddi, D. (2015). Impact of behavioural changes of water supply in Kalighat and Adjoining areas. Indian Journal of Regional Science, 47(1), 145-156.

Muzondi, L. (2014). Urbanization and service delivery planning: analysis of water and sanitation management systems in the city of Harare, Zimbabwe. Mediterranean Journal of Social Sciences, 5(20), 2905.

Nagendra & suresh. (2009). Demand –supply gap in urban water supply and sanitary services-a case study of Mangalore city corporation area. , Journal of global economy, 5(2), 107-130.

Naidoo, G. (2004). Leadership and governance for a sustainable public service. The case for selected South African public service organizations (Doctoral dissertation, University of Pretoria).

Nair, S. (2010). Challenges in urban water management in a changing environment case study from a growing tropical city. In 7th International Conference on sustainable techniques and strategies for urban water management (1-6). GRAIE, Lyon, France.

Nastar, M. (2014). What drives the urban water regime? An analysis of water governance arrangements in Hyderabad, India. Ecology and Society, 19(2).

National Commission on Urbanization (1998). Urbanization in India: A Demographic Reappraisal. International Union for Scientific Study of Population, 1-17.

National Water Supply and Sanitation Committee. (2019). Jal jeevan mission, Union government of india.http://government. Economictimes.indiatimes.com/news/policy/ial-jeevan-mission-achieves-milestone-of-13-crore-rural-households-tap-connections/103420605.

Ndiaye, A. S., Dedehouanou, S. F. A., & Diop, I. T. (2013). Effect of governance on public service delivery in the water sector in Senegal. Global Development Network.

NIPFP. (1995). Redefining state-municipal fiscal relations, options and perspectives for the state finance commission, National institute of public finance & policy, New Delhi.

NIUA .(2007). Norms and standards of municipal basic services in India, National institute of urban affairs, Government of India.

Niyathi. N. (1994). Planning of Rural Water supply in Kerala — Problems and Prospects. Working Paper, State Planning Board, Government of Kerala Trivandrum.

Norström, A., McConville, J., & Kain, J. H. (2009). The complexity of water and sanitation provision in peri-urban areas in developing countries: the example of Adenta, Ghana. Vatten, 65(4).

NRLD(National Register of Large Dams), C. (2019). National register of large dams. Central Water Commission. Ministry of Water Resources, Government of India.

Nsibambi, A. (1998). Decentralisation and civil society in Uganda: The quest for good governance. Kampala.fountain.

Oates, W. E. (1972). Fiscal Federalism, Harcourt Brace Jovanovich. New York, 35.

OECD. (2001). Organizacja Współpracy Gospodarczej i Rozwoju, & Programme for International Student Assessment. PISA Knowledge and Skills for Life: First Results from PISA 2000. Organization for Economic Co-operation and Development.

OECD. (2009).Dealing with post-decentralization implication in water sector, OECD (Organization for economic co-operation and development).

OECD. (2010). Strategies to Improve Rural Service Delivery. Available at www.oecd.org/publishing/corrigenda, Accessed on December 12, 2012.

Offical website of Trissur corporation. (2020). The corporation of thrissur- general information, www.corporation of thrissur. net. archived the orginal pdf on 30 nov 2012,retrieved 9july 2021

hchr. (2013). who will be accountable? Human rights and the post-2015 development agenda. available http://www.ohchr.org/documents/publications/whowillbeaccountable.pdf

Ojofeitimi, T. (2000). Managing at the grassroots: local government and rural development in the 21st century. Lagos: Centre for Management Development.

Okeke., R.C., & Agu . S.U. (2016). Institutional mechanisms for local government accountability: Evaluating the Nigerian provisions against the European charter of local self-government, World scientific news 40, 285-300.

Olajuyigbe, A. E. (2010). Sustainable water service delivery: an assessment of a water agency in a rapidly urbanizing city in Nigeria. Journal of sustainable development, 3(4), 210.

Organisation for Economic Co-operation and Development (OECD). (2010). Strategies to Improve Rural Service Delivery. Available at ww.oecd.org/publishing/corrigenda, Accessed on December 12, 2012.

Ostrom, E. (2010). Beyond markets and states: polycentric governance of complex economic systems. American economic review, 100(3), 641-672.

Oxford English Dictionary. (1973). in partnership modalities for enhancing good governance in Africa, economic commission for Africa, vol (i),874.

Oyebande. L. (1987). Urban water supply planning and management in Nigeria, geo journal, vol.2 (5), 403-412.

Padmalal.D .(2019). Fresh water sources of kerala-environmenal threats and management strategies, surface water and ground water resources of Kerala: management issues, policies, future strategies (book), proceeding of national seminar jointly organized by department geology, university of Kerala & geological society of India.

Pahl-Wostl, C. (2009). A conceptual framework for analysing adaptive capacity and multi-level learning processes in resource governance regimes. Global environmental change, 19(3), 354-365.

Panda, G. R., & Agarwala, T. (2013). Public provisioning in water and sanitation: Study of urban slums in Delhi. Economic and Political Weekly, 24-28.

Panickar .M .(2007).State responsibility in the drinking water sector: an overview of the Indian scenario. Working paper, IELRC (international environmental law research Centre), international environmental house, Geneva, Switzerland. http://www.ielrc.org/content/w0706.pdf

Panwar, A. M., & Antil, M. S. (2015). Issues, challenges and prospects of water supply in urban India. IOSR Journal Of Humanities And Social Science (IOSR-JHSS),20, 68-73, e-ISSN: 2279-0837, p-ISSN: 2279-0845

Paul, S. (1994). Public services for urban poor: Report card on three Indian cities. Economic and Political Weekly, 3131-3134.

Paul, S., Balakrishnan, S., Gopakumar, K., Sekhar, S., & Vivekananda, M. (2004). State of India's public services: benchmarks for the states. Economic and Political Weekly, 920-933.

Perry, C. J., Seckler, D., Rock, M. T., & Seckler, D. W. (1997). Water as an economic good: A solution, or a problem? (Vol. 14). International irrigation management institute (IIMI), ISBN 92-9090-351-1.

PIDS. (2009). improving local service delivery for the MDGs in Asia: the Philippines case, working paper 34, Philippine institute for development studies (PIDS), http://hdi.handle.net/10419/126780.

Plan outlay and Expenditure Kerala. (1951-2007). State Planning Board, Thiruvananthapuram, Vol,2 ,government of Kerala.

PLAN, T. F. Y. (2017). Approach Paper. State Planning Board, Thiruvananthapuram, government of Kerala.

Plan,T.F.Y.(2007). Five year plan document, planning board, Thiruvananthapuram, government of kerala.

Plan,T.F.Y.(2017). Five year plan document, planning board, Thiruvananthapuram, government of kerala.

Planning Commission. (2007). Report of the expert group on ground water management & ownership. Government of India, yojana bhawan, New Delhi.

Polumen, I.M.W.H. (2010). (in) equity in drinking water provision: KWA in Trivandrum, india. Ph.D thesis on public policy and human development, Maastricht graduate school of governance, Maastricht University, nether lands.

Poornachandra., S & Venkatesh., S .(2011). Urban Infrastructure Projects : Issues and Challenges, Southern Economist, 51-54.

Potter, R. B., Darmame, K., & Nortcliff, S. (2010). Issues of water supply and contemporary urban society: the case of Greater Amman, Jordan. Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences, 368(1931), 5299-5313.

Pradeep .(2011).Challenges of local government service delivery :a case matara municipal council. phd thesis from master in public policy & governance, General and continuing education department.

Pretorius, D., & Schurink, W. (2007). Enhancing service delivery in local government: the case of a district municipality. SA Journal of Human Resource Management, 5(3), 19-29.

Provan, K. G., & Milward, H. B. (2001). Do networks really work? A framework for evaluating public-sector organizational networks. Public administration review, 61(4), 414-423

Radhakrishnan .(2003) .Urban water supply management: a study of centralized and community based systems in Calicut city, ph.d thesis, department of applied Economics, cochin university of science and technology,cochin-682022, kerala.

Radhakrishnan .N. (2006). Distributional and availability problem of piped water in an urban center in Kerala: findings of a micro level research study. , The Asian economic review, vol 48(2), 263-274.

Radhakrisnan, A., Dina, S., Shaji, C., Thankamani, V., & Calvert, P. (1996). Bacteriological quality of water from a coastal village-Pulluvila (Kerala). In Proceedings of a National seminar on Rural Water Supply and Sanitation, Trivandrum (pp. 147-148).

Rahman. H. M. & Khan. M. M. (1997). Decenralization and Acces: Theoritical Framwork and Bangaladesh Experince. Asian Profile. Vol. 25 (6), P. 513-526.

Raj, K. (2013). Where All the Water Has Gone? An Analysis of Unreliable Water Supply in Bangalore City.

Rao, G.M. & Bird.R.M .(2010). Urban Governance and Finance, Working Paper No.68, NIPFP, 3-61.

Rao, P.D. (2008). Urbanization in India: Causes and Consequences, Nagarlok, XL(2), 1-13.

Rao, R. (1994) .Urban Water supply Sector 2 Some Issues. Urban India XlV(2).(July— December), 82-102.

Rathore, M. S., Reddy, V. R., & Ramanathan, S. (1994). Urban Water Supply in Rajasthan: Problems and Prospects. Economic and Political Weekly, 2272-2274.

Reassessment of Water Availability in India Using Space Inputs. (2019). basin planning & management organization, central water commission, new delhi-110066.

Rebuild Kerala Initatives .(2019). Rebuild kerala development programme, a resilient recovery policy frame work and action plan for shaping kerala s resilient risk, informed development & recovery from 2018 flood, http://rebuild.kerala.gov.in.

Reddy.,R.V.(1996).Demand management of water: A Review, Anvesak, 25(1).

Report on Status of Drinking Water Schemes in Kerala (KDWSR). (2015).directorate of economics and statistics,survey design division, government of Kerala.

Richter, B. (2014). Water markets: A new tool for securing urban water supplies? Journal-American Water Works Association, 106(3), 26-28.

Ritchie, H., & Roser, M. (2017). Water Use and Stress, Our World in Data. URL https://ourworldindata. org/water-use-stress.

River Basin Atlas of India. (2012). Central water commission, ministry of water resources, gol, New Delhi.

Rogers, P., & Hall, A. W. (2003). Effective water governance (Vol. 7). Stockholm: Global water partnership.

Rogers, P., Bhatia, R., & Huber, A. (1998). Water as a social and economic good: How to put the principle into practice. Stockholm: Global Water Partnership, Swedish International Development Cooperation Agency, Stockholm, Sweden.

Rondinelli, D. (1981). What is decentralization? Decentralization briefing notes 2-5. Available at: http://siteresources.worldbank.org/WBI/Resources/Wbi37142.pdf [Accessed on 11 September.

Sabida das, D.S & laya K.S. (2016). Urbanization and development in Kerala. International journal of applied research, 2(8), 586-590, 2394-5869.

Sadler, P. (1997). Leadership. The fast-track MBA series. London: Kogan Page.

Saha, P. K. (1971). Self-Financing Urban Water Supply: A Model for Asansol-Durgapur. Economic and Political Weekly, 1285-1290.

Sahu., B.P .(2010). Transparency, accountability in water service delivery, problems and prospects-brahmapur city in orissa. Youth for social development, brahmapur city, Orissa,india.http://www.ysdindia.org/publications.

Saleth, R. M., & Dinar, A. (1997). Satisfying urban thirst: water supply augmentation and pricing policy in Hyderabad City, India (Vol. 395). World Bank Publications.

Sandelin, S. (1994). Low-income area water supply and sanitation in selected African cities. Tampere, Finland, institute of water and environmental Engineering, Tampere University of Technology.

Sangita.S. (2007). Decentralization for good governance and service delivery in India: theory and practice. The Indian journal of political science, 68(3), 447-464.

Sarshar, M. (2006). Improving service delivery in FM: case study of a UK hospital facilities directorate. Journal of Facilities Management, 4(4), 271-285.

Savage, D., & Dasgupta, S. (2006). Governance and urban services. Yojana-Delhi-, 50, 8.

Schuringa. M.W. (2009). The Urban Poor and Water Demand Management, Economic and Social Commission for Asia and the Pacific, Water Resources Journal, 9-15.

Second Plan Document (1961). Five year plan document, planning board, Thiruvananthapuram, government of kerala.

Seitlholo, S. I. (2016). Challenges facing the effective functioning of ward committees as mechanism to promote local democracy in the Tlokwe City Council's area of jurisdiction (Doctoral dissertation, North-West University (South Africa), Potchefstroom Campus).

Shab .M .(2013).Water :towards a paradigm shift in the 12th plan, Economic and political weekely, 48(3).

Shaban, A., & Sharma, R. N. (2007). Water consumption patterns in domestic households in major cities. Economic and political weekly, 2190-2197.

Shafi.S.S (1995) .Quality of life and Indian Metropolis. A Process of Reverse Accumulation, Urban India, Vol.33, Nos.l and 2.

Shah, M., & Kulkarni, H. (2015). Urban Water systems in India: typologies and hypotheses. Economic and Political Weekly, 57-69.

Shai, L. K. (2017). Leadership and governance in service delivery at the Greater Tubatse Municipality Limpopo Province in South Africa (Doctoral dissertation, University of Pretoria).

Shaji. E., kunhambu, A.P., pradeepkumar. R.B Binoj kumar .(2019) . Post- flood ground water scenario of kerala: a critical analysis. Surface water and ground water resources of kerala: management issues, policies, future strategies (book), proceeding of national seminar jointly organized by department geology, university of Kerala & geological society of India.

Shaji. E., kunhambu, A.P., pradeepkumar. R.B Binoj kumar .(2019) . Post- flood ground water scenario of kerala: a critical analysis. Surface water and ground water resources of kerala: management issues, policies, future strategies (book), proceeding of national seminar jointly organized by department geology, university of Kerala & geological society of India.

Singh, A. K. (2017). An issue of governance in urban water supply: a study of Varanasi, Uttar Pradesh. Sustainable Smart Cities in India: Challenges and Future Perspectives, 459-473.

Singh, S. (2014). Decentralizing water services in India: The politics of institutional reforms. Asian Survey, 54(4), 674-699.

Singhal, S., & Johri, R. (2002). An approach directed towards developing a performance measurement system for urban local bodies for better management of water supply services in India. Journal of Environmental Studies and Policy, 5(1), 53-62.

Sivaramakrishnan. K. C. (1993). Provisions of Basic Services in Urban Areas: Some Issues in Bidyut Mohanty : Urbanization in Developing Countries, Basic Services and Community Participation, Concept Publishing House, New Delhi.

Sreekumar, S. Public service delivery in smart cities a case study of water and sanitation services in Ahmedabad. Ph.D. thesis from school of liberal studies, pandit deendayal Petroleum University, Gandhinagar, Gujarat. India

Sridhar, K. S. (2007). Reforming delivery of urban services in developing countries: Evidence from a case study in India. Economic and Political weekly, 3404-3413.

Stren, R. (2012). Donor assistance and urban service delivery in Africa (No. 2012/49). WIDER Working Paper. 49, Helsinki, UNU-WIDER.

Stubbs, P. (2005). Stretching concepts too far? Multi-level governance, policy transfer and the politics of scale in South East Europe. Southeast European Politics, 6(2), 66-87.

Sudheer padikkal, Soumya R Chandran, Joshy K A. (2019). impact of 2018bdeluge-need to evolve Kerala water resources information system for long term mitigation, surface water and ground water resources of kerala: management issues, policies, future strategies(book)", proceeding of national seminar jointly organized by department geology,university of kerala & geological society of india, prasanth printers, kazhakuttom,india.,http:// www.researchgate.net/publication337652343.

Suprabha, L.(2016). Economics of Urban water supply system a case study of public water supply in Kollam district

Taylor, J. B. (2009). The financial crisis and the policy responses: An empirical analysis of what went wrong (No. w14631). National Bureau of Economic Research.

Teshome.W. Tolossa.D., Mandefro., F , Alamirew. B. (2013). Governance and public service delivery-the case of water supply and road service delivery in addis ababa and hawassa cities, Ethiopia.

Thippeswamy.,M.N .(2005). Issues of waste water resources, seminar of statistical accounting of water resources, 24-25(6), central statistical organization, ministry of statistics and programme implementation, GOI, 128-137.

Thornhill, C., & Dlamini, K. (2012). Councillor's role in service delivery: The case of Ekurhuleni Metropolitan Municipality. African Journal of Public Affairs, 5(3):36-41

Thrissur corporation budget. (2014).,Thrissur municipal corporation,Thrissur, mathrubhumi, retrieved 27,aug 2014

Thrissur Corporation Service Directory. (2020).Annual report, Thrissur Corporation,Thrissur

Tiebout, C. (1956). A Pure Theory of Local Expendi- tures, Journal of Political Economy, 64- 416.

Tiwari, V. K. (1997). Urbanization in India: Patterns and Perspectives. Urban India, Vol XVII No.1 &2, 1-13.

UN ESCAP. (2004). water and disaster: be informed and be prepared, http://unescap.org/events/world-water-day-2004-waterand disaster-be-informed-and-be-prepared.

UNDESA .(2017). World Population Prospects: The 2017 Revision, Key Findings and Advance Tables. Working Paper ,No. ESA/P/WP/248. New York, United Nations. esa.un.org/unpd/wpp/publications.

UNDP. (1997). Governance for sustainable human development.. A UNDP policy paper, UNDP, 2-3.

UNDP. (1998).Consumption for human development. human development report, http://www.hdr.undp.org/en/content/human-development-report

UNDP. (1999). Evaluation of UNDP Role in Decentralization and Local Governance. Working Paper. New York: UNDP.

UNEP(United Nations Environment Programme). (1992). Climate variability, climate change and fisheries, http;//wedocs.unep.org/handle/20.500.11822127894

UNEP. (2002). Global water resources, adapted from Vital Water Graphics: An Overview of the State of the World'sFresh and Marine Water, Unep report. http://www.unep.org/vitalwater[Accessed 11 August 2006]

UNESCO.(2006).World water development report, World water assessment programme, UNESCO, http://webworld.unesco.org/water/wwap/wwdr/indicators.

UNGAR (United Nations General Assembly Resolution). (2010). 65th session, the United Nations and decolonization.

Unicef & pids. (2009). improving local service delivery for the MDGs in asia: the Philippines case, joint project of the united nations children's fund & Philippine institute for development studies, 15.

United nations water conference. (1997). The UN conference on water, new york.14-25. who.int/water-sanitation-health/unconfwater.pdf.

United Nations. (1992). Documentation, Reference, & Terminology Section. Environment and Development (Vol. 2). http://un,org/en/conferences/environment/rio.

United Nations. (1998). Long Range World Population: Based on the 1998Revision, Population Division, Department of Economic and Social Affairs, United Nations Secretariat, New York.

United Nations. (2002).world summit on sustainable development (johanneshurg summit),Johannesburg,south africa,26 (4) .http://sustainable development.un.org/milesstones/wssd.

United Nations. (2008). World Population Prospects: The 2006 Revision and WorldUrbanization Prospects: The 2007 Revision, Population Division, Department of Economic and Social Affairs, United Nations Secretariat, New York.

United Nations-Habitat. (2002). Water & Sanitation Problems, UN-Habitat Backgrounder, www.unhabitat.org/mediacentre/documents/wwf5.pdf (Accessed 15 March 2014).

Urban Age. (1993). the changing Nature of Infrastructure. Urban Infrastructure Issue, the World Bank, Washington D.C.

USGS .(1995). Public water supply, National hand book of recommended methods for water data acquisition, USGS publication, http//: pubs.usgs.gov. chapter 11/chapter 11c.html.

Van Vuuren, L. (2013). Poor and angry-research grapples with reasons behind social protests: water and society. Water Wheel, 12(6), 14-16.

Vedachalam, S. (2010). 17. Water supply and sanitation in India: Meeting targets and beyond. Global Water: Issues and Insights, 97, 95.

Venkateswarlu, U. (1998). Urbanisation in India: Problems and prospects. New Age International Limited Publishers. New Delhi, 3-105.

Vhonani, D. S. (2010). Evaluating the delivery of water and sanitation services in the Thulamela Municipality of Limpopo Province (Doctoral dissertation).

Vinod .G & Biju .T. (2015).Financial sustainability of urban local bodies in Kerala, southern economist, 54 (12), 10-15.

Vuorinen, H. S., Juuti, P. S., & Katko, T. S. (2007). History of water and health from ancient civilizations to modern times. Water Science and Technology: Water Supply, 7(1), 49-57.

Vyas . A., Anand., P.B .(1998). Some Issues in Management of Urban Water Supply Systems: A Case of Ahmedabad, Nagarlok, Vol XX , 66-79.

Wagle, S., Deekshit, P., & Pol, T. (2011). Review of reforms in urban water sector. Chapter in: India Infrastructure Report, 199-209.

Wankhade. K., balakrishnan. K., Vishnu m.j. (2014). Urban water supply and sanitation in india.policy paper,indian institute for humansettlements(iihs),Bangalore.

Water aid. (2008) .Financing water & sanitation at local levels, report of water aid.

Water aid. (2009). Status of service delivery related to water supply and sanitation across low-income settlement of Delhi ,a city survey report, center for urban and regional excellence, water aid India.

Water Aid. (2018). Status of urban water supply in India, http://www.wateraid.org/in/sites/g/files/jkxoof336/files/state-of-urban-water-supply.pdf

Water and Related Statistics. (2013). Water resource information system directorate, information system organization, water planning and project wing, central water commission.

Water and Related Statistics. (2015). Central Water Commission, Department of water Resources, RD & GR, ministry of jal Shakti.

Water and Related Statistics. (2019). information system organization, Central water commission, department of water resources, RD & GR, ministry of jal Shakti, government of India.

Water Data Book.(2005). Residential sector water consumption.https://www.cwc.gov.in/water-year-book-sediment-year.

Water Policy. (2008). Water resources department , Government of Kerala. http://kerala.gov.in /documents/10180/46696/water %20policy

WBCSD Water Facts & Trends.(2009). (http:/ / www. wbcsd. org/ includes/ get Target. asp? type=d& id=MTYyNTA) . Retrieved 2009-03-12.

Whitaker, G. P. (1980). Coproduction: Citizen Participation in service delivery. Public administration review, 240-246.

WHO / UNICEF Joint water supply, & sanitation monitoring programme. (2010). Progress on sanitation and drinking-water: 2010 Update. WHO/UNICEF Joint monitoring Committee for Water Supply and Sanitation.

WHO/ UNICEF. (2017). Progress on drinking water, sanitation and hygiene. Update& SDG baseline, United Nations children's fund and world health organization, July 12.

WHO/UNICEF. (2008).Water, Sanitation and Hygiene, annual report, United Nations children's fund and world health organization.

WHO/UNICEF. (2010). Clean water supply, determinants of public health, http://www.who.int/water-sanitation-health/monitoring/fast-facts/enclean water supply-determinants of public health.

WHO/UNICEF. (2017). b Track Fin: Tracking Financing to Sanitation, Hygiene and Drinking-Water. WHO website. www.who.int/water_sanitation_health/monitoring/investments/trackfin/en/.

WHO/UNICEF. (2017). b Track Fin: Tracking Financing to Sanitation, Hygiene and Drinking-Water. WHO website. www.who.int/water_sanitation_health/monitoring/investments/trackfin/en/.

WHO/UNICEF. (2017).a. Progress on drinking water, sanitation and hygiene: update and SDG baselines, World Health Organization, Geneva, Switzerland and the United Nations Children's Fund, New York, USA.

WHO/UNICEF.(2018). WHO Fact Sheet: Obesity and Overweight. WHO website. www.who.int/news-room/fact-sheets/detail/obesity-and-overweight.

Wild, L., Chambers, V., King, M., & Harris, D. (2012). Common constraints and incentive problems in service delivery-ODI Working Papers 351-Discussion papers.

Williamson,O.E.(1979). A conceptual framework for the design of organizational control mechanisms, management science, 25, 833-848.

WMO (World Meteorological Organization).(1997). Water futures: assessment of long range patterns and problems, report, INBN, 01-88714-45-4.

World Bank. (1994). World Development Report, the World Bank, Washington D.C.

World Bank. (2000). Decentralisation: Rethinking, World Development Report. 2000/2001: Attacking poverty. The World Bank.

World Bank. (2004). Making Services Work for the Poor. World Development Report, World Bank, Washington D.C.

World Bank. (2004). World development report 2004: making services work for poor people. The World Bank.

World Bank. (2008). Review of effectiveness of rural water supply schemes in India, sustainable development unit, South Asian region, World Bank, report no 44789.

World Bank. (2009). urban water supply in India: status, reform options and possible lessons. Development research group. USA, 442-460.

World Bank. (2009).Citizen review of service delivery and local governance in bosnia & Herzegovina. Governance working paper serious, the international bank for reconstruction & development, world bank, Washington,dc 20433.

World Bank. (2012). India: improving urban water supply and sanitation service provision, World Bank report, World Bank.

World Bank. (2017). Main streaming citizen feedback on service delivery using ICTs ,findings and lessons from ICT-based feedback surveys on water supply and sanitation services in indian cities. World Bank working paper, water and sanitation programme.

World Bank. (2017). World water use for agriculture, http://world bank.org/en/topic/water-in agriculture.

World Health Organization & United Nations Children's Fund. (2010). Joint Monitoring Programme for Water Supply and Sanitation, water sanitation & hygiene: household survey gaza. http://whqlibdoc.who.int/publications/2010/9789241563956_eng_full_text.pdf (Accessed 01 February 2014).

World Health Organization (WHO, & Unicef. (2000). Global water supply and sanitation assessment 2000 report. World Health Organization (WHO).

World Health Organization. (2006). Meeting the MDG drinking water and sanitation target: the urban and rural challenge of the decade. World Health Organization.

World Health Organization. (2012). UN-Water Global Analysis and Assessment of Sanitation and Drinking-Water: The Challenge of Extending and Sustaining Services. GLAAS 2012 Report.

World Health Organization. (2012). UN-Water Global Analysis and Assessment of Sanitation and Drinking-Water: The Challenge of Extending and Sustaining Services. GLAAS 2012 Report.

World Health Organization. (2017). Guidelines for Drinking Water Quality–Fourth Edition Incorporating the First Addendum, 2017.

World Health Organization. (2019). Progress on household drinking water, sanitation and hygiene 2000-2017: special focus on inequalities. World Health Organization.

WWAP (world water assessment programme), U. (2009). Water in a changing world. The United Nations World Water Development Report, 3. UNESCO, Paris, 349.

WWAP. (2003).The United Nations world water development report as .Water for people, water for life. http://www. unesco.org.

WWAP. (2015). The United Nations World Water Development Report: Water for a Sustainable World. , United nations, Paris, UNESCO.

WWC (World Water Council). (1995) .The use of water today, http://world water council.org/fileadmine/wwc/library/wwwvision.chapter2 pdf.

WWDR(World Water Development Programme).(2006). the united nations world water development report 2, UNESCO ,http://www.unesco.org/water/wwap/wwdr2/pdf.

WWDR. (2009). Water in a changing world, the United Nations world water development report 3, UNESCO, Earth scan. http://www.unesco.org/water/wwap/wwdr/wwdr3/

Zakaria, R. C., Ramasubramaniam, K. A., Lal, P., Rustogi, O. P., Modi, N. L., Idnani, K., & Daniel, G. E. (1963). Augmentation of financial resources of Urban local bodies: report of the committee of ministers constituted by the Central council of Local self-government. Controller of Publications, New Delhi.

Zeraebruk, K. N., Mayabi, A. O., Gathenya, J. M., & Tsige, Z. (2014). Assessment of level and quality of water supply service delivery for development of decision support tools: case study Asmara water supply. International Journal of Sciences: Basic and Applied Research (IJSBAR), 14(1), 93-107.