Chapter – 1
INTRODUCTION

Chapter Contents

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Water is one of the most important natural resources for the survival of life on the earth. There is plenty of water on the earth but it is not always in the right place, at the right time and of the right quality and in required quantity. The supply of water available for use by mankind is made limited by nature[1].

"*Water is precious gift from the nature. Let us preserve it*[2]"

Rhyme of the ancient Mariner by Coleridge

1.1 WATER RESOURCES AND WATER SUPPLY

Water is a renewable natural resource having multiple roles as consumption good, production good and an environmental amenity. It contributes significantly to economic growth and overall human development. However, water is a scarce resource which needs to be planned, developed, conserved and managed on integrated and environmentally sound basis, keeping in view the socio- economic aspects and needs[3].

The total water resources on earth are estimated to be 1,460 Million km^3, of which, seawater is 1,420.60 Million km^3 (97.3%) and only 39.40 Million km^3 (2.7%) is sweet water on earth[3] (Refer Table 1.1) of which 76% is in snow form at North and South poles. Hardly 21 - 22% of the sweet water is available for use by the mankind. The renewal of fresh water resources on the land mass is presented through annual water cycle in Table 1.2

Table 1.1 Details of Distribution of Sweet Water Available on Earth

Sr No.	Zone Wise Details Of Water Available	Quantity Of Sweet Water (Million Km^3)	Quantity Of Sweet Water (%)
1	North & South poles in snow form	30.236	76.742
2	Ground water up to 800m depth	3.900	9.899
3	Ground water between 800m to 4000m depth	5.069	12.790
4	Natural & artificial water storage on surface of earth	0.0132	0.336
5	Water within soil, trees, plants & animals	0.074	0.188
6	Water in form of humidity in air	0.014	0.038
7	Water quantity available in rivers of the earth	0.0016	0.007
	Total	**39.400**	**100.00%**

(Source: Patel M.S, 2007)

The following table 1.2 presents annual water cycle for evaporation and precipitation in the form of rain splash.

Table 1.2 Annual Water Cycle

Evaporation:	Sea / Oceans	3,40,000 km^3
	Land Mass Water bodies	60,000 km^3
	Total	4,00,000 km^3
Precipitation in the form of rain splash:	Sea / Oceans	3,00,000 km^3
	Land Mass	1,00,000 km^3
	Total	4,00,000 km^3

(Source: Patel M.S, 2007)

However, the world scenario regarding availability of water, present and projected (Table 1.3) is not comforting keeping in view the Falkenmark criteria. The most widely used criterion of water scarcity is propounded by M. Falkenmark[4]. According to this criterion, if the level of annual renewable fresh water supplies falls below 1,700 m^3 per capita, there will be local shortage of water. If it falls below 1,000 m^3, water supply begins to hamper health, economic growth and human wellbeing. If it falls below 500 m^3 per annum, water availability becomes a primary constraint to life.

From the table 1.3 it can be observed that seven Nations (*i.e.* Algeria, Israel, Kenya, Kuwait, Saudi Arabia, Tunisia and Yemen) are likely to fall below 500 m^3 per annum per capita water availability. This will become primary constraint to life as per norms. Six Nations (*i.e.* Egypt, Ethiopia, Iran, Haiti, Morraco,

South Africa,*)* are likely to fall below 1,000 m^3 per annum per capita. This will become a hindrance to human health, economic growth and human wellbeing. And five Nation (*i.e*. Bafinaaso, Zimbabwe, Pooru, Afghanistan and India) fall below 1,700 m^3 per annum per capita. This will result in local shortage of water. The trend shows that as the population is rising, the supply of water is gradually decreasing. So, attempts should be made to improve water supply facilities. As per the UN estimate, water scarcity already affects every continent. Around 1.2 billion people, or almost one-fifth of the world's population, live in areas of physical scarcity, and 500 million people are approaching this situation. Another 1.6 million people, or almost one quarter of the world's population, face economic water shortage[5].

Table 1.3 World Population V/s Water Availability

Name of the Nation	Population for the Year 2010 (Million)	Population up to Year 2025 (Million)	Water to be Available for the Year 2025 (m^3 per Capita)
Afghanistan	27.10	35.20	1,105
Algeria	33.90	47.70	378
Bafinaaso	11.50	18.00	1,293
China	1,318.80	1,569.60	1,838
Egypt	75.50	97.60	605
Ethiopia	77.10	112.00	867
Haiti	9.60	14.00	838
India	1,169.00	1,384.60	1,498
Iran	71.20	77.00	955
Israel	7.15	8.00	275
Kenya	37.50	50.55	237
Kuwait	2.90	4.10	57
Morraco	31.20	39.90	689
Pakistan	163.60	232.90	3,201
Pooru	27.90	35.50	1,090
Saudi Arabia	24.70	32.40	274
South Africa	48.50	57.50	705
Tunisia	10.30	13.50	328
Yemen	22.40	33.00	460
Zimbabwe	13.40	16.30	1,172

(Source: Patel M.S, 2007)

1.1.1 Water Resources of India

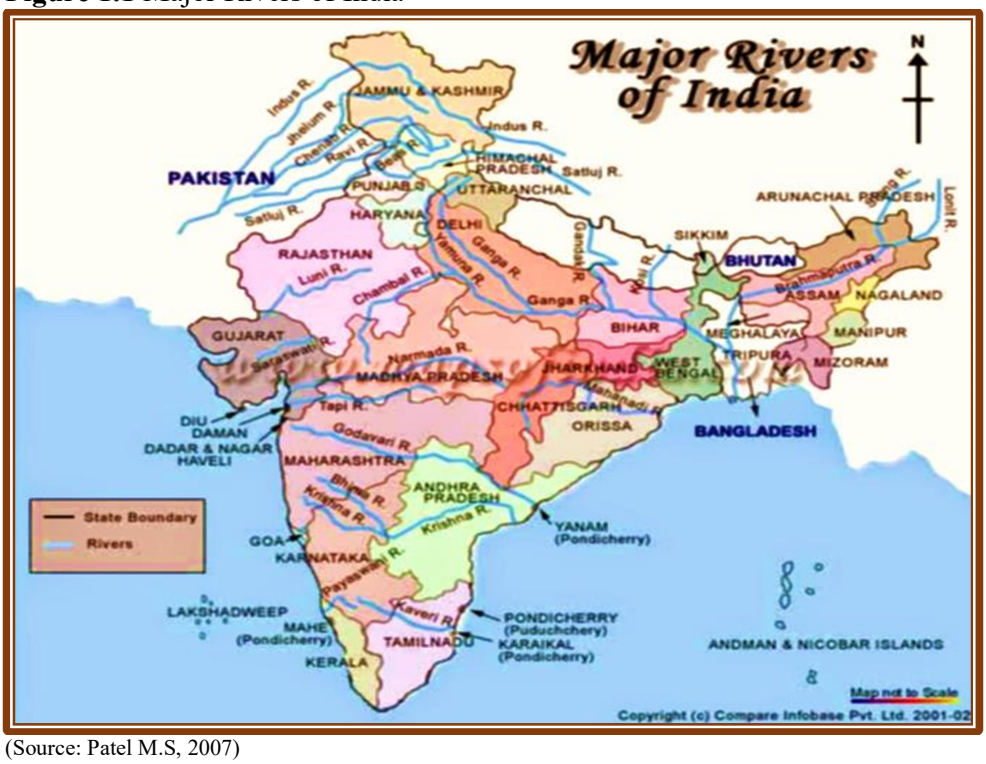
India has 2.4 per cent of land, 16 percent of world's population, 15 percent of livestock and 4 percent of water resources of the world. In India, three fourth of

the annual rainfall occur during short span of monsoon (June to Sept) only in a period of about 100 hours duration. Average annual precipitation in western states (Gujarat and Rajasthan) is less than 500 mm, whereas annual average rainfall in eastern states is, in general, more than 2,500 mm. Temporal and spatial unevenness of rainfall causes floods in one part and drought in another part of the country[6].

There is a huge disparity spatially from basin to basin and region to region, (basin of river or body of water is the land that surrounds it and the streams that flow into it). The utilizable water resources availability in the country varies from 18,417 m^3 per capita per year in the Brahmaputra Basin to as low as 180 m^3 per capita per year in the Sabarmati Basin. Major rivers of India are depicted in Fig.1.1.

Presently 605 billion cubic meter (54%) of water is being used for various beneficial purposes. The current levels of utilization of surface and groundwater resources are 70% and 30% only. Sector wise distribution is: irrigation 83%, domestic 5%, industry 3% and others 6%[6].

Figure 1.1 Major Rivers of India



(Source: Patel M.S, 2007)

The total live storage in 9,300 dam reservoirs are 177 billion cubic meter (BCM) at present. The implementation of various major, medium and minor irrigation and multipurpose projects has increased the irrigation potential of the country from 22.60 million hectare at the beginning of the plan period (1951) to 102.77 million hectare presently (2007)[6].

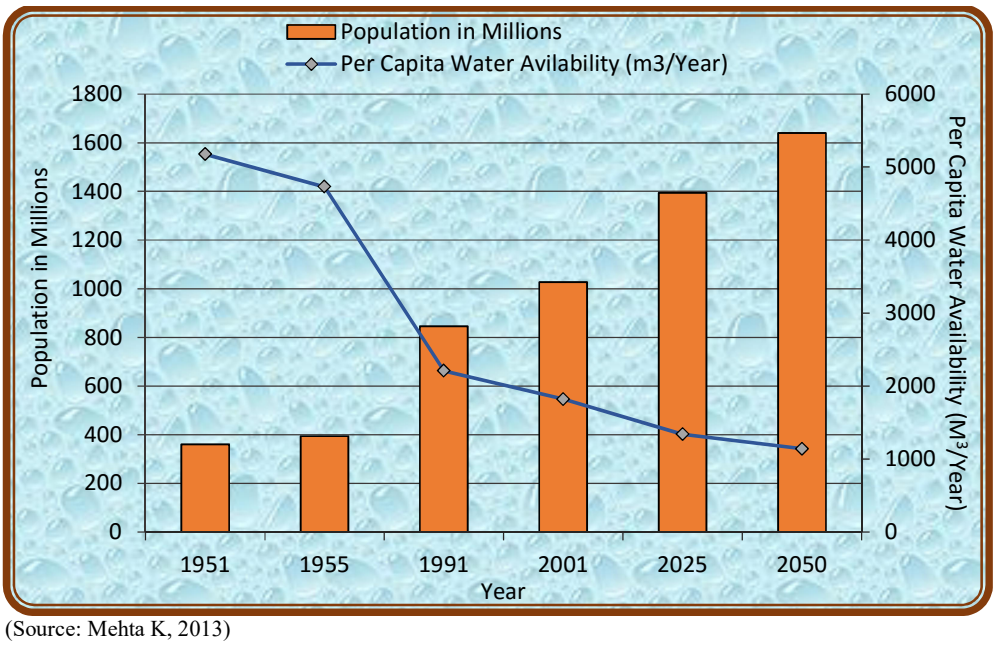
Per Capita Water Availability in India

Water supply Manual prepared by the Central Public Health and Environmental Engineering Organization (CPHEEO) is followed in consideration to technical aspect in the water supply schemes formed by Water Supply Department as well as Guidelines narrated in Rural Water Supply Programme Government of India are followed. Norms of National Rural Drinking Water Programme at least 135 liters per capita per day water is made available, however since the year 2014, it is left up to the State Government to decide for service level[7]. From last 5 decades, the variation for increase in population and decrease in available water is noticeable, in the water availability in India.

Table 1.4 Per Capita Water Availability in India

Year	1951	1955	1991	2001	2025	2050
Population in Millions	361	395	846	1027	1,394	1,640
Per Capita Water Availability (m^3/Year)	5,177	4,732	2,209	1,820	1,341	1,140

Graph 1.1 Per Capita Water Availability in India



(Source: Mehta K, 2013)

Graph 1.1 shows the variation in population and corresponding per capita water availability in India[7]. In year 1951, 1955, 1991, 2001 the per capita water availability 5,177 m^3/year, 4,732 m^3/year, 2,209 m^3/year, 1,820 m3/year are actual data and in year 2025 and 2050 per capita water availability are estimated data. Thus even though so many programs are undertaken, the per capita availability of natural resources is declining.

1.1.2 Water Resources – Challenges and Solutions in India[8]

The available utilizable water resources of the country may not be adequate to meet all future needs. All out efforts on the part of people from every walk of life need to be made to save every drop of water by adopting all possible means of water conservation and to increase efficiency of all water resources projects.

Water challenges are as follows:

(a) Floods and drought

Floods are the most frequent natural calamities faced by India. On an average, floods are affecting about 33 million persons per year. Total flood prone area in the country is about 40 million hectare, out of which, about 14 million hectare of flood prone area has been provided protection. One sixth area of the country is drought prone.

(b) Water logging, salinity and alkalinity

Inadequate drainage provision, improper water management, seepage from canals, obstructions to natural drainage on account of various development activities and inadequate system maintenance are the main causes for water logging, salinity and alkalinity. An area of 8.51 million hectare is affected by water logging, 5.50 million hectare by salinity, 3.58 million hectare by alkalinity and 4.50 million hectare by acidity in irrigation commands in the country.

(c) Other challenges

Inadequate maintenance of irrigation systems, discharge of untreated industrial effluents to water bodies, water disputes among regions, chemical contamination of water, *etc.* are other major challenges in the water sector.

Water solutions are as follows:

(a) Water management

More than three fourth of the current water utilization is through irrigation. As per tentative assessment, increase in irrigation efficiency alone may reduce the need for the development of additional water supplies in 2025 by roughly one-half. Hence water management gains importance.

(b) Interlinking of rivers

The occurrence of floods and droughts has been a regular feature in India. Many river basins in the country have surplus water and on the other hand, other basins have serious shortage of water. Creation of storages and inter basin transfer of water from surplus to deficient basins may therefore be an option for equitable distribution and optimum development of water resources in the country.

(c) Rainwater harvesting

Under the situations of dwindling per capita availability of fresh water, over-exploitation of ground water coupled with depletion of ground water leads to the deterioration of ground water quality.

(d) Reuse and conjunctive use

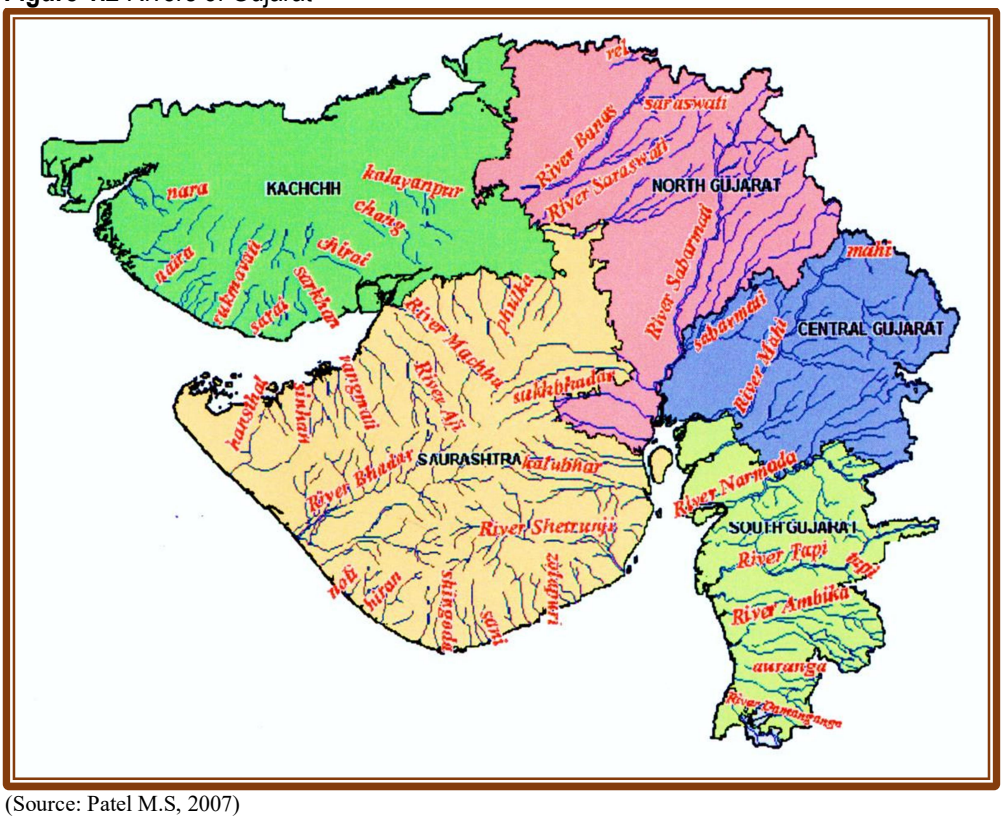
Recycle and reuse, conjunctive use of surface and groundwater, may also need to be resorted in order to avoid facing day after day diminishing per capita availability of water in future[8].

1.1.3 Water Scenario in Gujarat

The State of Gujarat with a population of 6.04 crores (year 2011) is situated on the West Coast of India and has a geographical area of 1,96,000 sq. km (19.6 M. ha)[9]. The State has many geographical advantages, *viz.* 1,600 km long coastline, varied climatic conditions, highly skilled people, *e.g.* farmer, lively entrepreneurs and great diversity. In spite of these advantages, Gujarat is prone to disasters such as drought, cyclones, and earthquake situations. Gujarat state has common border with Rajasthan, Madhya Pradesh and Maharashtra states in North, East and South respectively and with Pakistan in the North West. For administrative purpose state has been divided into 26 District and 225 Talukas[10].

Low and erratic rainfall results into scarcity of water in two- third area of the State. The average annual rainfall, confined to three months of the monsoon season, is 760 mm, which is highly variable both in space and time, the southern part receiving 2,500 mm of rainfall while the northern portion including Kutch and the Saurashtra peninsula receiving rainfall of 300 to 450 mm[11]. Intra-state rivers are small with very low and highly variable flows. Every third year is a drought year in Saurashtra, North Gujarat and Kutch region. Monsoon waters are required to be stored in reservoirs for use in the lean nine months of the year. The limited utilizable ground water has been over exploited over the past 3 to 4 decades and ground water tables are presently depleting rapidly by as much as 3 meters every year in North Gujarat and Kutch regions. In addition, due to the long coastline and two gulfs, the state is faced with ingress of salinity, which results in water quality problem due to high salinity. The ground water in many areas contains harmful proportions of fluorides and nitrates and about 7,675 habitations in the state are facing water quality problems in terms of high fluoride, nitrate and salinity[12].

Figure 1.2 Rivers of Gujarat



(Source: Patel M.S, 2007)

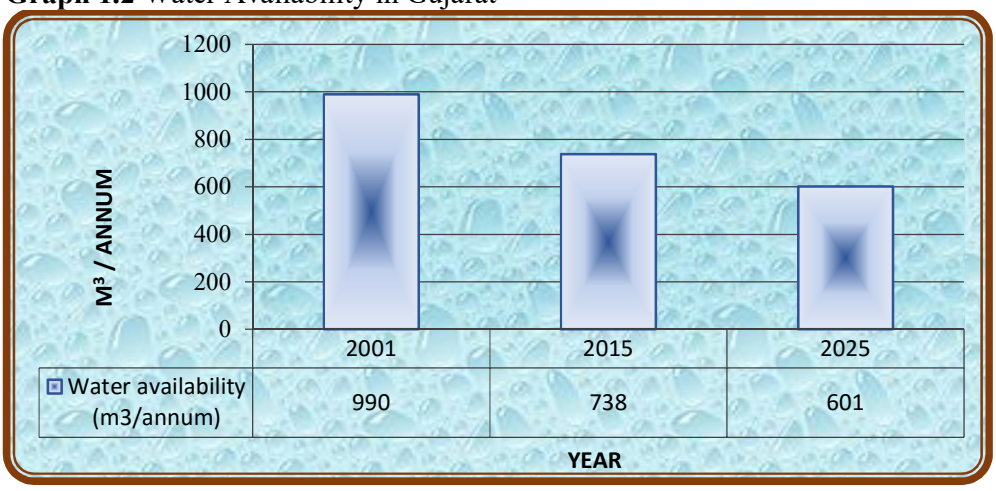
Drinking Water Scenario of Gujarat

Availability of water varies from region to region within the State. North Gujarat, Saurashtra and Kutch face water scarcity. Per capita fresh water availability is about 1,137 cubic meters per person per annum as against the national average of 1,878 cubic meters. Twenty six years were declared as drought years in the past 75 years. Annually, State Government spends about ₹125 to ₹150 crore on making emergency arrangement of drinking water to tide over the scarcity. People also spend about ₹700 to ₹800 crore on water and the social cost of paucity of water is estimated to be ₹2000 crore per annum. 74% percent of the present drinking water supply is being drawn from the ground water resources[13].

Availability of safe and assured drinking water in adequate quantity to rural people has been the priority of the State Government. As discussed in Chapter – 2, 'Conceptual Frame Work' through five year plans an attempt was made to cover up 80.56% - as many habitats as possible to provide the drinking water. The same is also taken up at Gujarat state level. As per instruction of the Government of India a survey was conducted in the year 2003-2004, total 34,845 habitations are found in the State in which 9,628 habitations are found re-emerged into NC (Not Covered-166) and PC (Partially Covered-9,462) category, including 7,675 quality problem (Fluoride- 4,187, Salinity- 2,508, Nitrate- 1,335, Others- 26, Odour -3, Repeated- 384) habitations. Failing rains, poor recharge and excess withdrawal makes the sources and system defunct[14].

In Gujarat, the per capita water availability is considerably low and is likely to go down further by 2015. Therefore, the state needs to focus on the effective planning and management of its water resources. Urban water needs being higher than that in the rural areas and Gujarat being an urbanized state, the demand and supply ratio may get skewed in the future according to the government's own estimate[15].

Graph 1.2 Water Availability in Gujarat



(Source: Mehta K, 2013)

Graph 1.2 clearly indicates that the state's per capita water availability in 2001 was 990 m^3/annum against the country's 1,901 m^3/annum. This is already considered as chronic water scarcity. The per capita water availability is estimated to go down to 738 m^3 / annum by 2015 and 601 m^3 / annum by 2025. In the current era, the per capita availability of water in north Gujarat, Saurashtra, Kutch, South and Central Gujarat is 343, 540, 730 and 1,880 m^3/annum respectively (as per 2001 estimate, Department of Irrigation, Gujarat state)[15].

According to the latest estimate by the state irrigation department, the annual availability of utilizable water resources in the state is about 50.10 billion cubic meters, out of which 38.10 billion cubic meters is surface water. The rest, i.e. 12 billion cubic meters, is available as ground water. As the average per capita availability of water in the state stands at around 900 cubic meters, Gujarat falls in the category of states facing water scarcity as per the norms laid by the UN. In the UN, there are 36 water scarce countries, in India, 22 states face water scarcity and in Gujarat, 10 districts are water scarce.[15]

Need for addressing water scarcity[16]

As per latest data of the census report 2011, Gujarat's latest figure of population is 65,10,5237. Gujarat state has an average population of 308 people per square km. Gujarat's share in nation's population is: 4.99%. Table 1.5 and graph 1.3

shows the increase in population. Between 1950-51 to 2009-10 population has increased in cumulative way while rainfall has not, so the day is not far when water availability is going to be a major concern for survival.

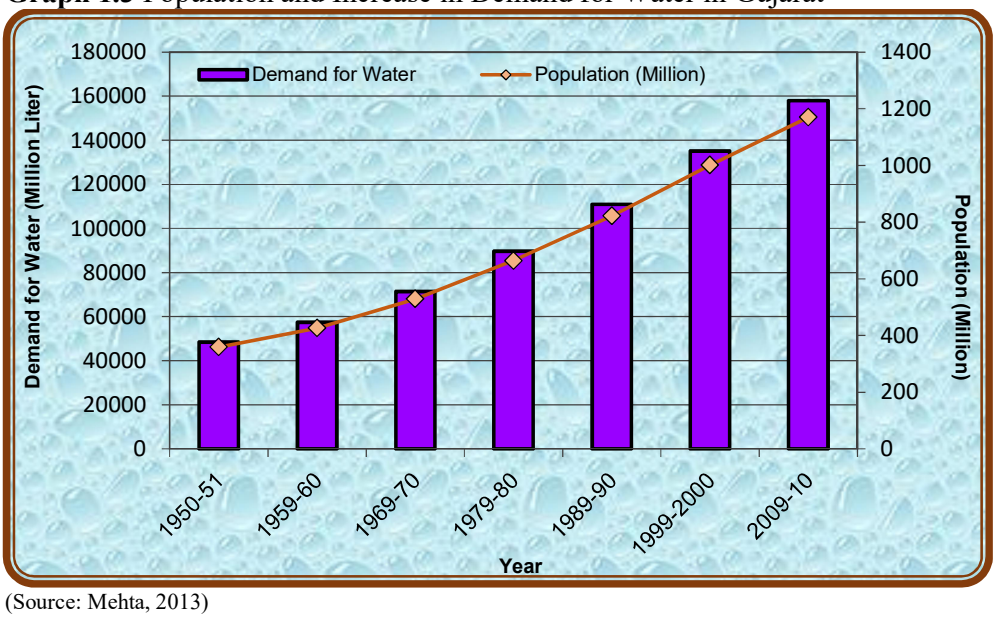
Table: 1.5 Population and Increase in Demand for Water

Year	Population (Million)	Demand for Water (Million Liter)
1950-51	359	48,465
1959-60	426	57,510
1969-70	529	71,415
1979-80	664	89,640
1989-90	822	1,10,970
1999-2000	1,001	1,35,135
2009-2010	1,170	1,57,950

(Source: Mehta, 2013)

The table 1.5 presents population and increase in demand for water. In the year 1950-51 population was 359 million and demand for water was 48,465 million liters. However, in the year 1950-51 to 2009-2010 population as well as demand for water has increasing trend. Global population is rapidly expanding with urban population expected to double in the next 40 years, increasing the demands for food, water resources and waste water infrastructure. The graph 1.3 shows that as per Reserve Bank of India handbook of Statistics on Indian Economy Central Gujarat region, increase in population and the demand for water will have a major gap, which needs to be addressed right now[16].

Graph 1.3 Population and Increase in Demand for Water in Gujarat



(Source: Mehta, 2013)

Water Resources Scenario in Gujarat[17]

Water resources are divisible into two distinct categories:

(a) Surface water resource

(b) Ground water resource

Each of these categories is a part of the earth's water circulatory system called the hydrologic cycle and is ultimately derived from precipitation. The surface water is considered economical and its development is given more emphasis by the public sector whereas the development of ground water resources being considered costlier and largely developed by the private sector in India.

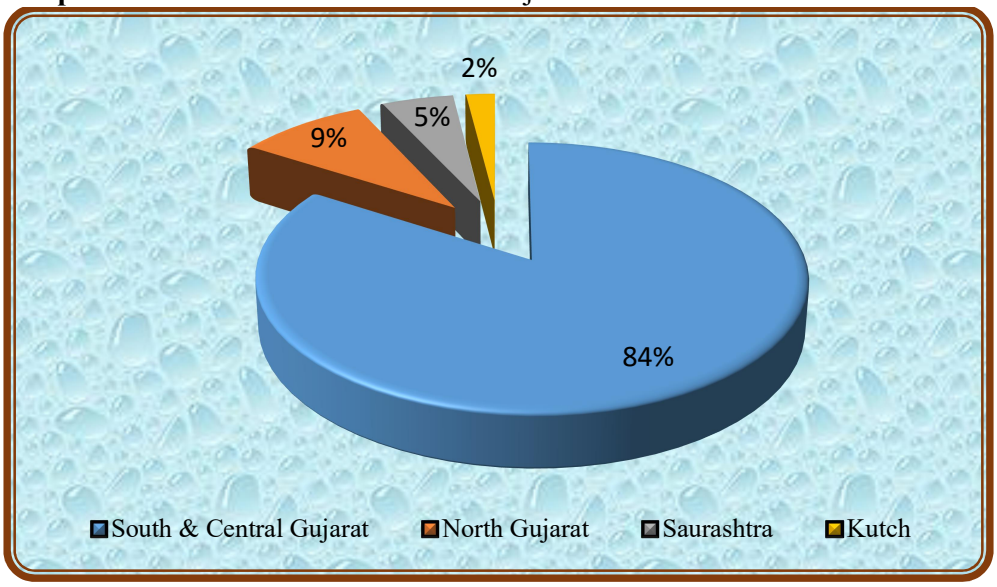
(a) Surface water resource:

From the surface water resources consideration, the state can be divided into three major physiographic regions. There are 185 river basins, of which the details are as under

(1) South Central and North Gujarat	17 Basins
(2) Saurashtra Region	71 Basins
(3) Kutch Region	97 Basins

The total surface water potential of South and Central Gujarat is 84%, North Gujarat is 9%, Saurashtra region is 5% and Kutch region is 2% of the Gujarat state[17] (Graph 1.4).

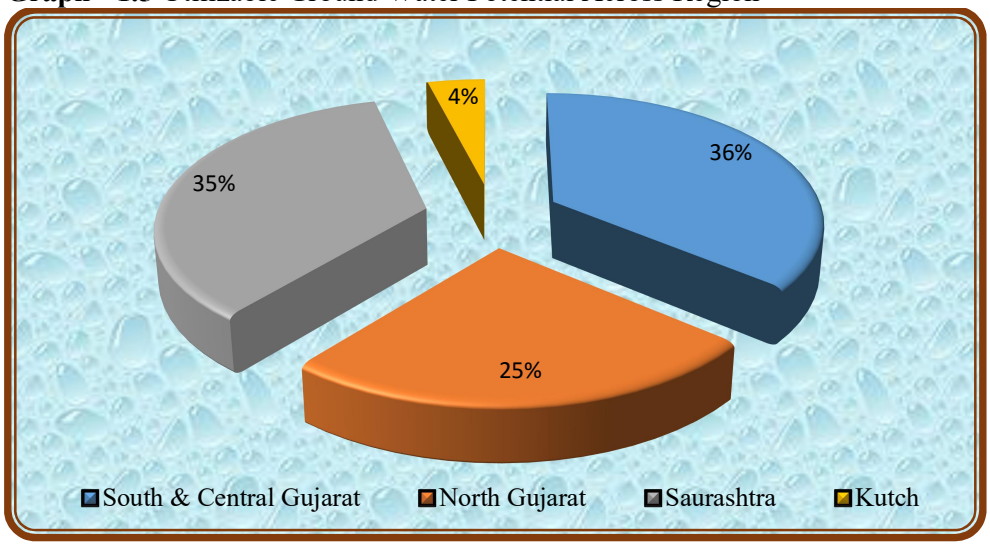
Graph - 1.4 Surface Water Potential of Gujarat



(Source: Evaluation Report, 2007)

Annual utilizable recharge is 4539.23 Million Cubic Meter (MCM) in Saurashtra. Whereas the utilizable groundwater potential across South and Central Gujarat region is 36%, North Gujarat region is 25%, Saurashtra region is 35% and Kutch region is 4%. As compared to the other states, Gujarat is 35% of the total[18] (Graph 1.5).

Graph - 1.5 Utilizable Ground Water Potential Across Region



(Source: Evaluation Report, 2007)

The net annual ground water availability is 7,465 Million Cubic Meter (MCM). Against this the annual ground water table from all sources is 6,765 Million Cubic Meter (MCM) including allocation for domestic and industrial requirement supply, up to next 25 years. Thus, the stage of ground water development for the state as a whole, works out to be 80%. The areas are categorized as "over exploited" where the stage of ground water development exceeds the annual replenishable limit[18].

1.1.4 Need for Regional Water Supply Schemes

Adequate and potable drinking water is being supplied through Regional water supply schemes comprising of more than one village, where local drinking water sources yield insufficient water or water is non- potable in this situation water is fetched from remote water sources. Regional water supply schemes are taken up under rural water supply programme. The regional water supply schemes are based on reliable sources like tube wells (underground sources) or Surface water sources[19].

Gujarat occupies 5.96% of India's land, 5% of the country's population and only 2.63% of the water resources. The availability of the water resources is about 800m^3 per capita as compared to all India average of 1,820 m^3 per capita. Thus the state is water stressed. It is apprehended that with economic development, rapid industrialization and population growth, Gujarat's water scarcity is certain to become more serious. Appropriate and balanced planning of the state's water resources is critical to sustain current rate of growth in the state's economy[20].

Regional water endowment is also at great variance. The fresh water availability per capita per annum is 730 m^3 in Kutch region, 540 m^3 in Saurashtra region, 323 m^3 in North Gujarat region, and 1,880 m^3 in Central and South Gujarat region. Thus nearly 70% fresh water resources in the state is concentrated in Central and South Gujarat region. The rainfall pattern is widely distributed in nature. Gujarat receives much of its rainfall from South West monsoon during the period from June to September. The southern most portions receive annual rainfall as high as 2,000 mm. The rainfall gradually decreases North Wards and extreme North West as low as 300 mm[20].

1.2 RATIONALE OF THE STUDY

The rural water supply schemes depend upon the groundwater source or well in a surface water source. Due to excessive ground water withdrawal, the source fails in summer season. The North Gujarat and Saurashtra regions face a lot of difficulties in the summer. All rivers of these regions are seasonal and dry of potable water in summer. Crores of rupees are spent for tanker water supply in summer. In a normal year it is up to ₹50 crores and it increases to more than ₹500 crores in a drought year.

To control the intensity of the problem of water availability Government of Gujarat (GOG) implemented regional water supply schemes based on sustainable sources like Sardar Sarovar Narmada dam, Kadana dam on Mahisagar and Ukai dam on Tapi River. Drinking water source is from the canal of these big irrigation schemes. The Departments involved in R_nWSS are:

1. Irrigation Department of the Government of Gujarat.
2. Gujarat Water Infrastructure Ltd (GWIL) - a government undertaking company for the liaison of irrigation and Gujarat Water Supply and Sewerage Board (GWSSB).
3. Gujarat Water Supply and Sewerage Board – a government undertaking.
4. Water and Sanitation Management Organization (WASMO) - semi government organization.
5. Village *Panchayat / Panisamiti* body at village level.

The Government of Gujarat supplies water on chargeable base. The tariff rate charged varies, depending on the user. The minimum and maximum rates charged by the industry, NGO, *Mahanagar Palika*, *Nagar Palika* or rural area. The remaining maintenance and repair charges are borne by Government of Gujarat. GWIL, a Government of Gujarat under taking company is formed to facilitate the water supply for irrigation.

Various aspects of schemes like its quality satisfaction, awareness, adequacy of water, impact on health and components of operation and maintenance cost of water have been analyzed through academic research. These research studies can be classified as relating to water tariff, cost recovery, affordability of water charges, and role of community or users in water supply services as well as developing the performance indicators. Various performance indicators are developed by different researchers. The study of World Bank with reference to India has divided performance indicators in to Reliability and adequacy, Affordability, Environmental sustainability and financial sustainability. Realizing the high prospects and considering the vital role that RRWSS financial Performance Indicators can play in economic growth, present study is under taken. The operation and maintenance of RRWSS are from different agencies. The tariff recovery rates are also different and recovery also varies from 100% to almost nil. Thus, the need was felt for detailed study of RRWSS. The present study is related to a study of Financial Performance Indicators and critical evaluation of RRWSS of Gujarat. This study mainly focuses on the finance

aspect and for this purpose the study is carried out of four schemes selected carefully from different geological status and sample also being selected from head, middle and tail regions of the schemes. The present study is done with the main intention of providing suggestions to the policy makers with respect to the functionality and sustainability of the RRWSS with the inclusion of financial aspects. In addition to the study based on primary data, a need was also felt to analyze the data published by NRDWP, regarding operational and financial aspects at national level and state level as no detailed study could be located for the same during literature review.

Thus the present study is a combination of analysis of secondary data as well as primary data.

1.3 OBJECTIVES OF THE STUDY

In the back ground discussed in 1.2 the present study intends to know the position of RRWSS in India and especially in Gujarat Region. Precisely the objectives of the study are:

1. To examine the relationship between allocation of central funds, release of central funds and expenditure by states out of central funds.
2. To examine the position of each state regarding ongoing, new, achieved schemes, habitations covered, cost per schemes and per habitations.
3. To examine reasons of satisfaction and dissatisfaction for Government water sources, if any, between different schemes and geographical region.
4. To examine the proportion of respondents paying water charges for selected scheme, regions and economic activities.
5. To examine the proportion of respondents paying water connection charges for selected schemes, geographical region and economic activities.
6. To examine the proportion of respondents regarding affordability for water charges for selected schemes, geographical region and economic activities.

7. To examine the proportion of respondents satisfied about the 'water supply' and 'water charges' for selected schemes, geographical regions and economic activities.

1.4 ORGANIZATION OF THE STUDY

The present study is organized as follows:

1. Introduction
2. Conceptual Frame work
3. Literature Review
4. Research Methodology
5. Analysis of Secondary Data
6. Analysis of Primary Data
7. Conclusions and Recommendations

Chapter-1 is introductory in nature and provides a brief background of the water resources scenario of India and Gujarat state, details of surface water and ground water resources of Gujarat, population growth and water necessity for future, water distribution in different regions of Gujarat, rationale of the study, objective of the study, and organization of the study. The major contributions of the study have also been discussed over here.

Chapter-2 is a conceptual framework including some of the important studies carried out at International, National, State level. The chapter also discusses the measures initiated at National level in various five years plan to improve the availability of water. The chapter identifies the various schemes by surveying the various extension works conducted after the pioneering study of World Bank. The chapter contains theoretical background of the water supply and its issues and challenges.

Chapter-3 gives the reviews about the articles published in journals and online published articles. The review is mainly divided into: (1) Water Tariff, Cost Recovery and Affordability (2) Role of community or users in water supply services. (3) Performance Indicators- Development as Need for studies carried out with reference to India and foreign countries.

Chapter-4 presents the details of the research methodology. It will focus on analysis of secondary data collected from NRDWP and GWSSB. Further it presents discussion on methodology followed for analysis of the selected Regional Rural Water Supply Schemes of Gujarat. A detailed discussion on the Research methodology and the statistical tools and techniques to be adopted for the analysis are also discussed in this chapter.

Chapter -5 presents analysis of the Secondary data of water supply schemes at all India level. It provides detailed discussion about the State and district level ongoing schemes, new schemes, achieved scheme, the total cost, total habitations covered etc. Cost per scheme as well as cost per habitation is also derived. The analysis with reference to financial aspect relating to allocation, release and expenditure by various states over a period of time will also be presented.

Chapter-6 presents analysis of primary data in two sections: Section-I Presents the discrete statistics on respondents' profile, Infrastructure, water collection and storage, water shortages and coping mechanism and water charges. Section-II presents analysis on testing of Hypotheses.

Chapter-7 summarizes the major findings of the study and gives final conclusions of the research. It attempts to provide some important recommendations based on the findings of the study. The scope of the future study is also discussed here.

This is followed by bibliography, webliography and appendix for Questionnaire monitored on the respondents.

1.5 CONTRIBUTION OF THE STUDY

India is not a nation with only diversity of culture, religion and language but also geographic conditions, altitudinal and agro-climatic conditions make it a mega diverse. Further, in India, constitutionally, drinking water supply is a State subject and hence, drinking water to rural habitations are provided by state governments. India being a country constituted of multiple states, every state

with mega diversities of social, political and economic conditions, the water supply approaches and policies also change from state to state.

Regional Rural Water Supply Schemes implemented in the state of Gujarat has witnessed major transformations in the last two decades or so from its supply-driven to demand-driven or combination of both for bulk water Supply as supply-driven and distribution as demand-driven, shift of local source to sustainable and reliable surface water source, etc. makes this an issue to be discussed.

Therefore, efforts are made to carry out this comprehensive study for the critical evaluation and development of Performance Indicators which are applicable for such Regional Rural Water Supply Schemes. The study will be useful to derive the future strategies for the development of water policies to endeavor the needs of water supply for rural habitations.

REFERENCES

1. Narmada, Water Resources, Water Supply & Kalpasar Department Report (2009), To Increase Ground Water Resources Through Artificial Recharge in Gujarat State, Government of Gujarat, (p.15).
2. Vinod M. A. (2008), Water Supply System Control, *Indian Water Works Association*, 40th Annual Convention, 7th - 8th - 9th Feb. 2008, Indore, (pp188-190).
3. Patel M. S. (2007), Impact of Check Dams on Ground Water Regime and Existing Irrigation Project of Rajkot District, Saurashtra Region of Gujarat State, Ph.D. Thesis Water Resources Engineering and Management Institute, M. S. University of Baroda, Vadodara, (pp.1-6).
4. Patel M. S. (2007), *Ibid*, (p.2).
5. Mehta Komal (2013), Critical Evaluation of Effluent Treatment Plants and Development of Analytical Models for Reuse of Waste Water in Central Gujarat, Ph.D. thesis, (pp.1-248) the Faculty of Technology & Engineering, The Maharaja University of Baroda, Vadodara.

6. Patel M. S. (2007), *Ibid*, (pp.4-6).

7. Mehta Komal, (2013), *Ibid*, (p.6).

8. Patel M. S. (2007), *Ibid*, (pp.7-8).

9. Horticulture Mission Action Plan (2006-07), http://nhm.nic.in/ActionPlan/ ActionPlan_Gujarat0607.pdf, Accessed on 15-3-2013.

10. Narmada, Water Resources, Water Supply & Kalpasar Department Report (2009), *Ibid*, (p.15).

11. Overview of Kalpasar Project, http://kalpasar-dhaval.blogspot.in/p/kalpasar. html, Accessed on 13-1-2015.

12. GWSSB Report (2013-14), Annual Administrative Report, (p.13).

13. Ajwali G. K. (2012), A Study of Water Management Practices in Valsad, Navsari and Dang District, Ph.D. Thesis Business and Industrial Management, Veer Narmad South Gujarat University, Surat, (p.22).

14. GWSSB Report (2013-14), *Ibid,* (p.7).

15. Mehta Komal, (2013), *Ibid*, (p.7).

16. Mehta Komal, (2013), *Ibid*, (p.8).

17. Narmada, Water Resources, Water Supply & Kalpasar Department Report (2009), *Ibid*, (p.18).

18. Evaluation Report (2007), Regional Water Supply Scheme, (pp.13-14).

19. GWSSB, Rural Water Supply Program, https://gwssb.gujarat.gov.in/rural-water-supply-programme, Accessed on 03-11-2015.

20. Narmada, Water Resources, Water Supply & Kalpasar Department Report (2009), *Ibid*, (p.15).