Government of Gujarat

A Book on Water Scenario & Vision Plan of Gujarat State

जलम् जल स्थानगतिम्
सर्वथा एव रक्षणीयम् ।

जन्तूनां सुख जीवनं हेतु
जलस्य रक्षणम् नूनं भवतु।

निर्मलं जलं संपादनीयम्
जल संरक्षणम् अनिवार्यम्।

अभोजनेन जीवितुम् भवेत्
विना जलं तु सर्वं हि नश्येत्।

किंचित् जलमपि पीतम्
दाहं कष्टं करोति दूरम् ।
शुष्कं तपनं हाहाकारः
जल संरक्षणम् परिहारकः।।

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Preface

Do you think that what exists today will continue to be so, or the future is going to be different in some respects? It can be said with some certainty that the societies will witness demographic transition, geographical shift of population, technological advancement, degradation of environment and water scarcity. Water scarcity is possibly to pose the greatest challenge on account of its increased demand coupled with shrinking supplies due to over utilisation and pollution. Water is a cyclic resource with abundant supplies on the globe. Approximately, 71 per cent of the earth's surface is covered with it but fresh water constitutes only about 3 per cent of the total water. In fact, a very small proportion of fresh water is effectively available for human use. The availability of fresh water varies over space and time. The tensions and disputes on sharing and control of this scare resource are becoming contested issues among communities, regions, and states. The assessment, efficient use and conservation of water, therefore, become necessary to ensure development. In this books and chapters ahead, we shall discuss water resources in Gujarat India, its geographical distribution, sectoral utilisation, Irrigation potential & its statistics and methods of its conservation and management along with a visionary action plan which can help to fulfil the demands of the future.

Context

The natural resource scenario is changing fast both in terms of availability as well as quality. Looming climate change and urbanization will alter the paradigm of natural resources in which our production system operates. Water is a critical natural resource and is being affected by increasing population, industrialization, urbanization, pollution, deforestation and above all climate change. Certainly, the business as usual will not suffice. Thus, it is essential to visualize the future scenario and prepare strategies for equipping ourselves with technologies which will provide solution for maintaining our food and nutritional security in changing/ projected scenarios. Thus, it was felt necessary to get a glimpse of the shifting scenarios and challenges which we are going to encounter in next 40 years. This will give us an idea of institutional, technological and financial path to be followed to achieve for Gujarat State & its objectives without endangering the sustainability of our production systems. This vision paved the way for a Water Resources Vision 2045 document.

Vision 2045

To achieve the objective of sustainable development of water resources and optimum utilization of this scarce and precious natural resources our vision for the year 2045 regarding water sector is:

- Make Gujarat the foremost in management of water resources.
- Harness all the economically utilizable surface water through improved planning, design and construction.
- Full utilization of created irrigation potential and maximum crop production per unit of water.
- Water conservation in all sectors by optimum utilization, use of water saving devices and improved practices.
- Comprehensive and integrated planning for surface and groundwater resources including conjunctive use sustainability and maintaining quality.
- Environmentally sustainable water resources development, proper treatment and reuse of sewage and industrial effluents and mitigation of environment degradation i.e. water logging and salinity.
- Financially sustainable development of water resources with pricing structure to reflect scarcity value of water and encourage water conservation.
- Effective drought and flood control management
- Participation of users in development and management of water resources.
- Efficient and adequate human resources development, institutional infrastructure and legal support for adopting new technologies/practices and innovative approach.
- Effective management to complete projects with no cost and time overrun and to ensure quality.
- Active private sector participation and management and development of water resource projects.

Chapter - I

Overview of Water Scenarios in Gujarat

1.1 Introduction

Water is universally accepted as a symbol of life as it is the most crucial for maintaining an environment and ecosystem conducive to sustaining all forms of life. It plays a vital role not only in fulfilling basic human need for life and health but in socio-economic development also. The demands for drinking, domestic activities, livestock, agriculture, industries, power generation and other uses are all increasing to meet the requirements of increasing population and also to cater for the enhanced per capita requirement due to rise in living standard. Irrigation, the largest water user sector, is feeling the pressure of increasing demands of other user sectors all over the world because of limited fresh water availability. On the other hand the need to increase agricultural production, for which also water is the most critical input, to meet the food and fiber requirement of increasing population is equally important.

The available surface and ground water resources, part of a larger ecological system, are renewable but limited. India has 16% of the world population where as the water resources are only 4%. Even with all the planning and development, at the end of the 20th century, the country has not even been able to provide safe drinking water to all. The water sector is facing a number of challenges regarding availability, accessibility, use and sustainability of its fresh water resources.

Moreover, the spatial and temporal distribution of water across the country varies significantly. Regrettably, Gujarat stands out as one of the driest states. Illustrated in Figure-1 are comparative statistics between the state and the nation, emphasizing the critical water scarcity Gujarat faces. With a rapidly growing population, per capita water availability is projected to decline further, reaching alarmingly low levels. This underscores the intensified challenges confronting the water sector in the state. Hence, the imperative for development, conservation, and effective management of water resources cannot be overstated.

1.2 Water Resources Scenario in India

India has 2% of the land on earth, 4% of the World's fresh water resources but has 16% of the World's population. In India out of the total precipitation of 4000 BCM, available water is only 1869 BCM, out of which only 1126 BCM is utilizable by conventional development. Out of 1126 BCM of total utilizable water resources, 690 BCM is Surface Water and 436 BCM is Ground Water. Demand for water is satisfied currently but it is inadequate for future demand

Total Precipitation
- **4000 BCM**

Total Water Availability
- **1869 BCM**

Total Utilizable Water Resources
- **1127 BCM**
  - **Surface Water - 690 BCM**
  - **Ground Water - 437 BCM**

Further, the distribution of water in the country is highly uneven over space and time. Unfortunately, Gujarat is the one of the driest states in the country. Figure-1 depicts the comparative statistics of the State and the country which highlights the precarious situation the state has to face regarding water availability. With prevailing high growth rate of population, the per capita water availability is going to further reduce to alarmingly low levels implying that the challenges for water sector are much more and severe in the State.

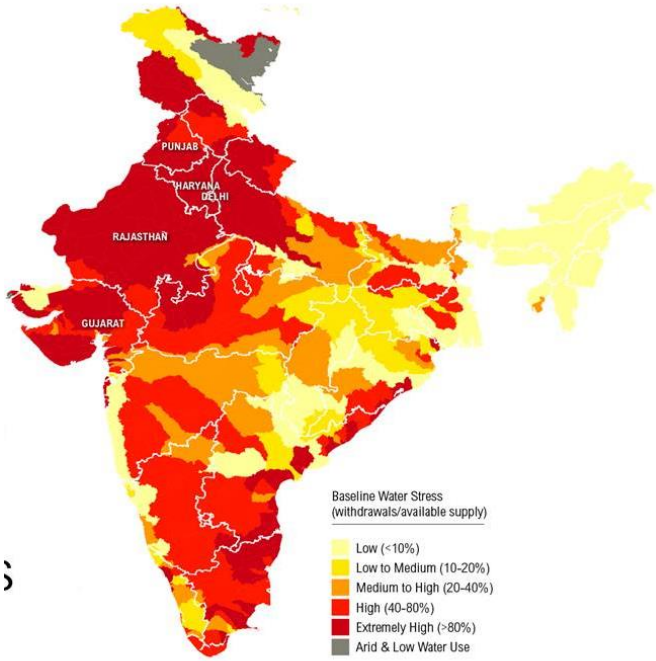


Figure 1-Map showing Water Stressed Area of India

1.3 Water Resources Scenario in Gujarat - Past and Present

Gujarat State comprises of 33 districts and 252 Talukas. The State is inhibited by 60 million people. The total geographical area of Gujarat is 196 lakh hectares, out of which, 124.5 lakh hectare is cultivable land.

- The average annual rainfall over the State varies widely from 485 mm in the Western half of Kutch to 2342 mm in the Southern part of Valsad district and the Dangs. The monsoon usually commences by the middle of June and withdraws by the end of September, about 95 per cent of the total annual rainfall being received during these months. The total number of rainy days varies from one part of the State to another, ranging from a minimum of 16 days in Kutch to a maximum of 48 days in Surat and the Dangs.

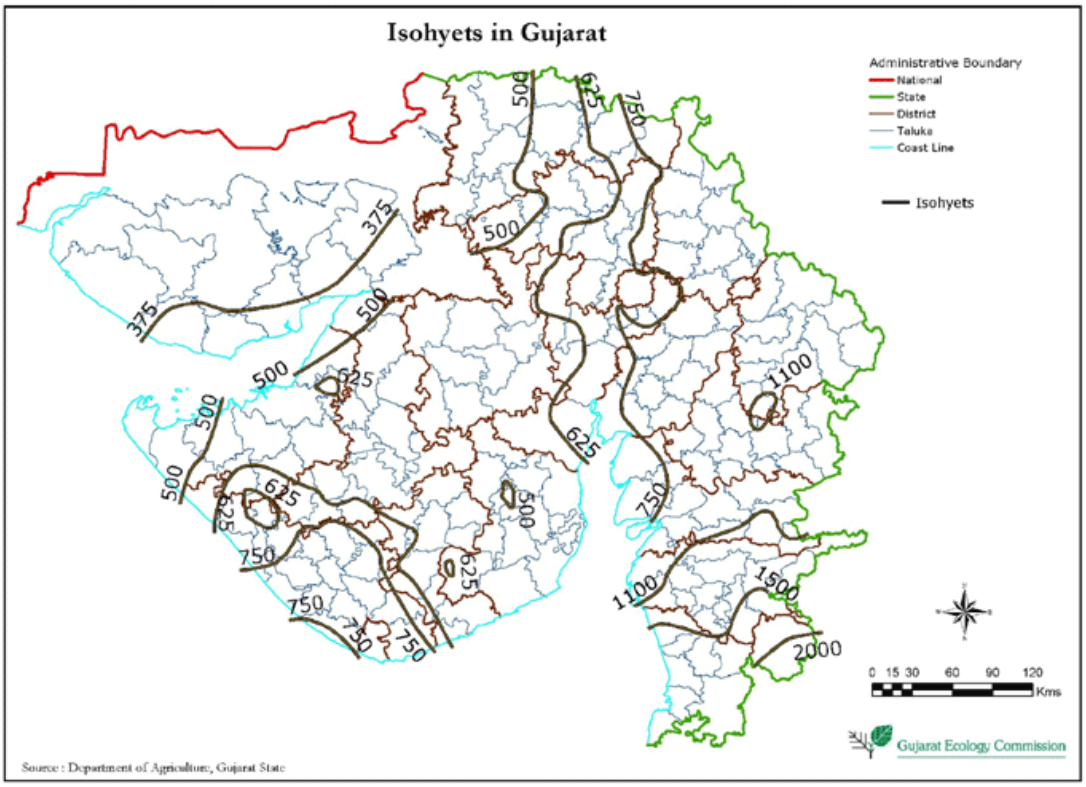


Figure 2-Isohyte map showing rainfall pattern of Gujarat State

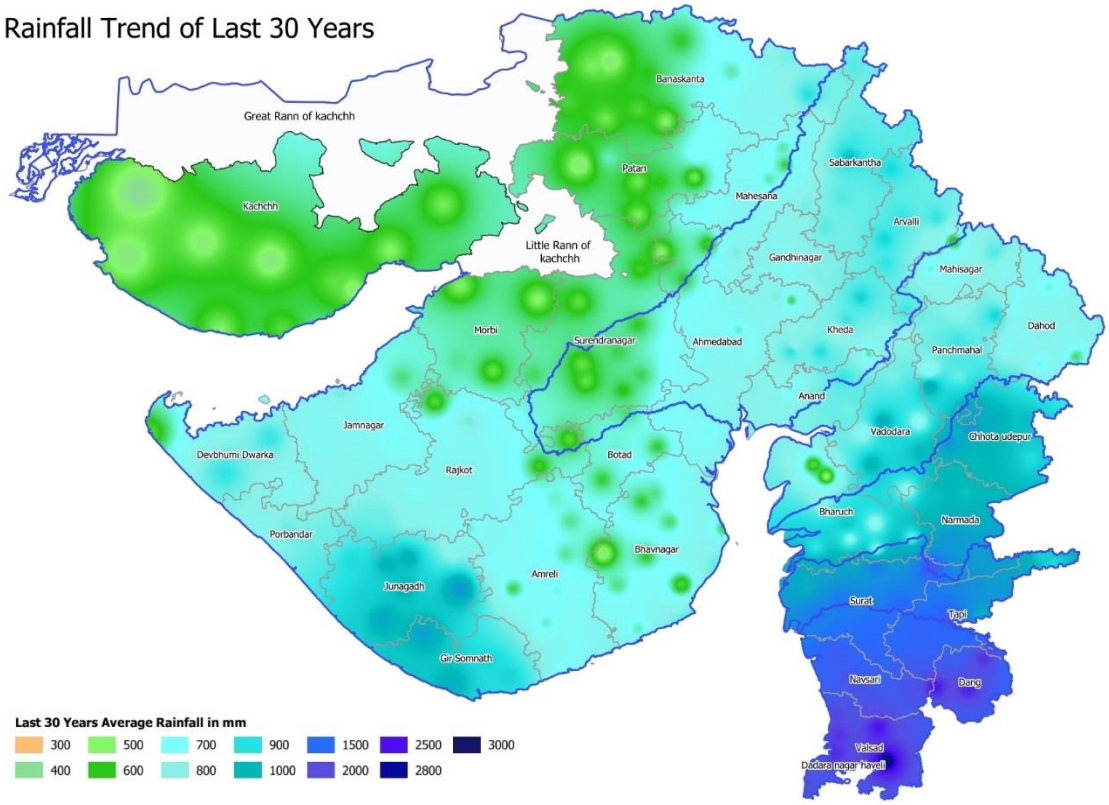


Figure 3-Map Showing Year Region Wise Rainfall Trend of Gujarat for Last 30 Years.

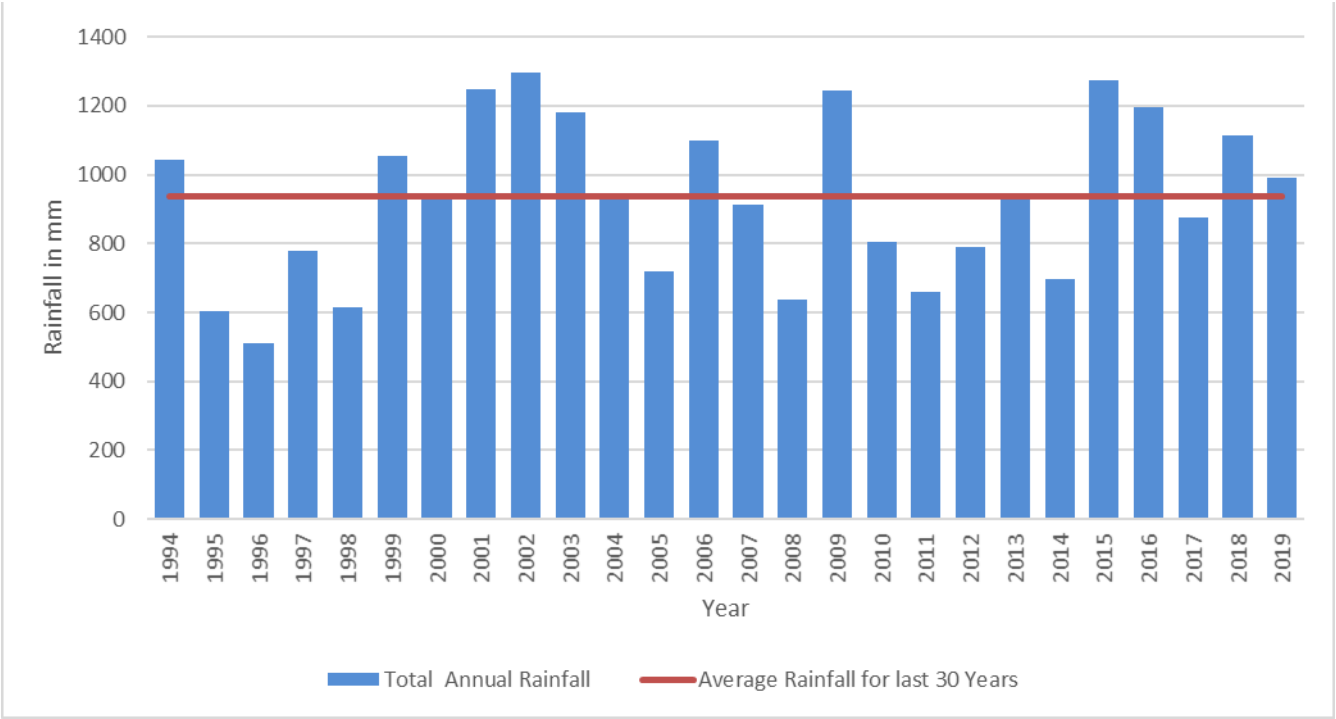


Figure 4 - Year Wise Rainfall Statics of Gujarat

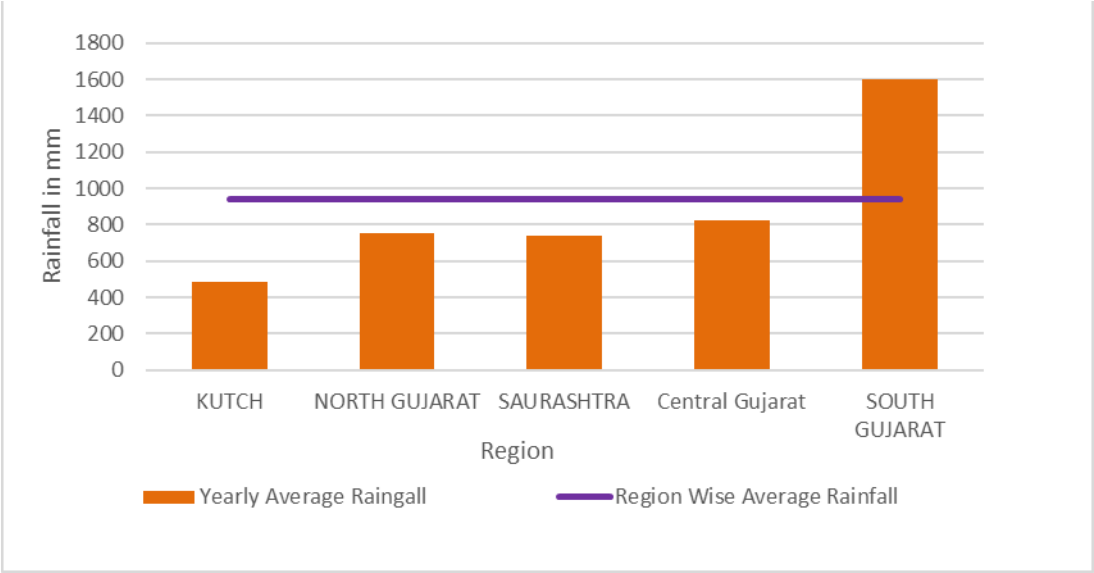
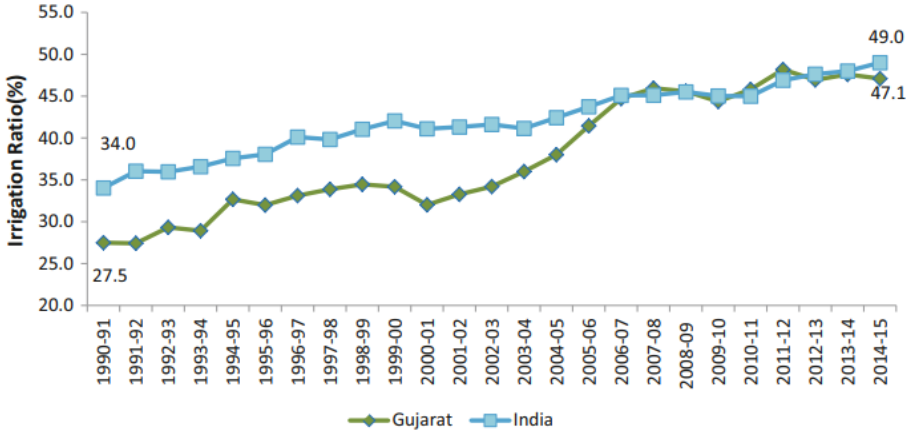


Figure 5 - Region wise rainfall trend of Gujrat for Last 30 years

The analysis of rainfall data shows that during the last 30 years, 50 % of the time i.e 15 years the annual average rainfall of Gujarat is less than the long-term annual average of 938 mm. Also, of the five regions of Gujarat only south Gujarat region has the received average rainfall more than the long-term average rainfall for 30 years in other out of the 33 districts only 9 districts received rainfall more than the annual average , depicting a varied climate throughout the state

- Before independence, only 51000-hectare area of the State was having a facility of irrigation. After Gujarat's formation, at the end of the second Five Year Plan, irrigation was made available to 4.04 lakh hectare of land up to 1960-61. Out of this, the maximum irrigation usage was limited up to 1.77 lakh hectare area. However, after that the State gave priority to the program of irrigation potential creation, which resulted in creation of irrigation potential to the area of almost 51.00 lakh hectare and maximum irrigation usage has reached to 44.00 lakh hectare of land.



Source Directorate of economics and statistics

Figure 6-Gross irrigated area as a percentage of gross cropped area.

- Before independence, irrigation was possible through only two large-scale irrigation projects viz. Hathmati Project and Kharicut Project. Thus, substantial development in water resources sector, considering the financial, geographical and hydrological constraints, has been made and the irrigation potential created has increased by over 80% in the last 30 years.
- Several floods have ravaged the state since historical times with almost four flood events in a decade. The immediate past decade and half has been even worst as six such events occurred starting from the year 2003, 2004, 2005, 2006, 2013, 2015, 2019, 2020 and 2021. The floods are reported almost every two year in the less developed districts of Gujarat, located in Saurashtra, Kutch, Northern Gujarat and South Gujarat. Ahmedabad, Surat and Bharuch cities have also been affected as they are located on the flat alluvial plains for large rivers
- The State has faced severe famines during 1972-73, 1985-88 and 1999-2000. The vagaries of drought thus have been almost a recurrent phenomenon once every three years. The years 1999-2000, 2000-2001, 2002-2003, 2005-2006, 2012-2013, 2016, 2017 witnessed Drought in at least some parts of Gujarat. Substantial portions of the State are arid to semi-arid. With large parts of North Gujarat and Saurashtra having no source of alternate irrigation, groundwater exploitation is leading to increased threats of droughts.
- Studies conducted by the Central Ground Water Board in several regions of the state also draw attention to the severe water scarcity. The rising demand from the urban population as well as from the rapidly growing industries was seen to be responsible for this. The average water table from the confined water tables was 51.86 meters in 2001, and it went to 65.89 meters in 2011. This trend was observed in Central Gujarat, North Gujarat as well as in the Eastern Gujarat. Level of Ground Water Development for the entire state is 75%. According to the assessment of Central Ground Water Board as on March 2009, in 5 out of 26 districts all belonging to North Gujarat, the gross annual drafts has exceeded the available groundwater resources and they are categorized as "over-exploited districts.

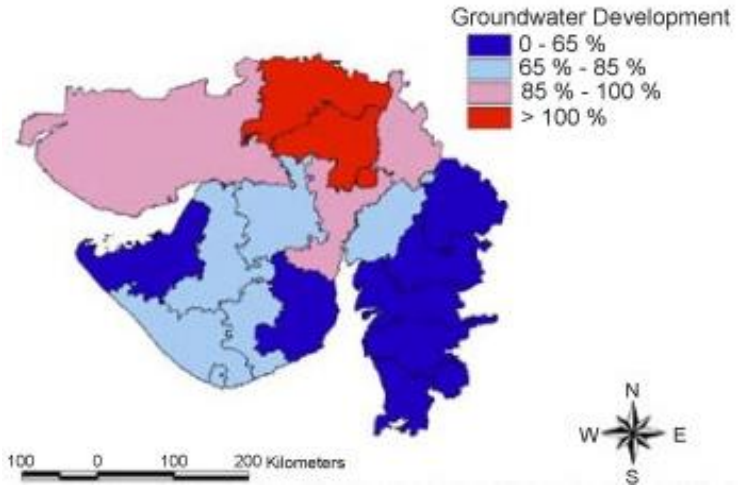


Figure 7-Map Showing Level of Ground Water Development of Gujarat

Kachchh is the only district where groundwater development is greater than 90 percent and is categorized as critical districts. Sabarkantha and Porbandar are categorized as semi-critical while the remaining +7 districts are considered safe as the level of development is less than 70 percent and there is scope for further exploitation in these districts. CGWB has also assessed 248 talukas/units for computing the stage of ground water development. Out of the 223 assessment units (Taluka), 25 have been categorized as "Over-exploited", 4 as Critical, 24 as Semi-critical, 13 as Saline and 182 as safe.

- The State has always been vigilant and sensitive towards the hardship of drinking water being faced by the people of Gujarat from ages during the famine years. The effort has paid dividend and the rural house hold tap connectivity has reached from 26.6 % in the year 2000 to 71.18 % in the year 2020.

Table 1-Comparison of Water Supply Coverage in the year 2000 vs year 2020

Sr. No.	Parameter	Status in Year 2000	Status in Year 2020
1	Coverage of villages through Multi-Village water supply schemes	1910	17843
2	Coverage of towns	26	350
3	Population covered	About 70 lakhs	More than 3.31 Crores
4	House hold Tap Connectivity (Rural)	26.6%	71.18%

Source: Annual Administrative report 2019-20 GWSSB

But in spite of this it has not been possible to keep pace with population growth, increasing requirements, and technological changes. Some of the main challenges being faced by the water sector, as listed below, clearly indicate that a lot more is to be done for integrated water resources development and management.

- Inadequate availability of water for meeting demands of all sectors and uneven temporal and spatial distribution of water.
- Harnessing of remaining of internal surface water resources.
- Inadequate maintenance resulting in deteriorated condition and low efficiencies of existing water supply projects.
- Financial constraints for implementing new projects and for adequate maintenance of existing facilities.
- Inefficient management and reluctance to adopt modern water saving technologies, like pressure irrigation / volumetric measurement / leak detection and control, by developers and users both.
- Ensuring effective groundwater control and management and also conjunctive use of surface and groundwater.

- Environmental sustainability and mitigating environmental degradation in terms of water logging and salinity and deteriorating quality of water due to pollution and over exploitation of groundwater.
- Resettlement and rehabilitation problem of displaced population due to implementation of water resources projects.
- Financially non sustainable water rates.
- Recurring droughts and effective drought management.
- Inadequate institutional infrastructure and human resource development for adopting new technologies and innovative approach.
- Inculcating participatory approach in development and management of water resources.
- Inter-sectoral coordination.
-

1.4 Water Resources of Gujarat

The state can be divided into four distinct units on the basis of water resources endowment namely Kutchh, North Gujarat, South & Central Gujarat and Saurashtra. Kutchh is an arid zone, with scanty rainfall and no perennial rivers. North Gujarat area has rechargeable aquifer but rainfall in this region is very less while ground withdrawal is very high due to excessive irrigation and industrial water demand, leading to the depletion of ground water table. South and Central Gujarat are heavily agricultural and industrial areas, the over use of chemical fertilizer and industrial waste has polluted the ground water; the region near coast is also contaminated because of salinity ingresses. Saurashtra region comprises of rocky formation, it has very low recharging capacity, so ground water replenishment is very low. While North Gujarat, Saurashtra and Kutchh constitute 71% of total geographical area of the State, they account for less than 30% of the water resources. Further, more than 40% rainwater flows into the sea as run off every year due to absence of water conservation structures. The regional imbalances are reflected in the per capita water availability levels also. South and Central Gujarat region's per capita availability is almost double of the aggregate availability of North Gujarat, Saurashtra and Kutchh region.

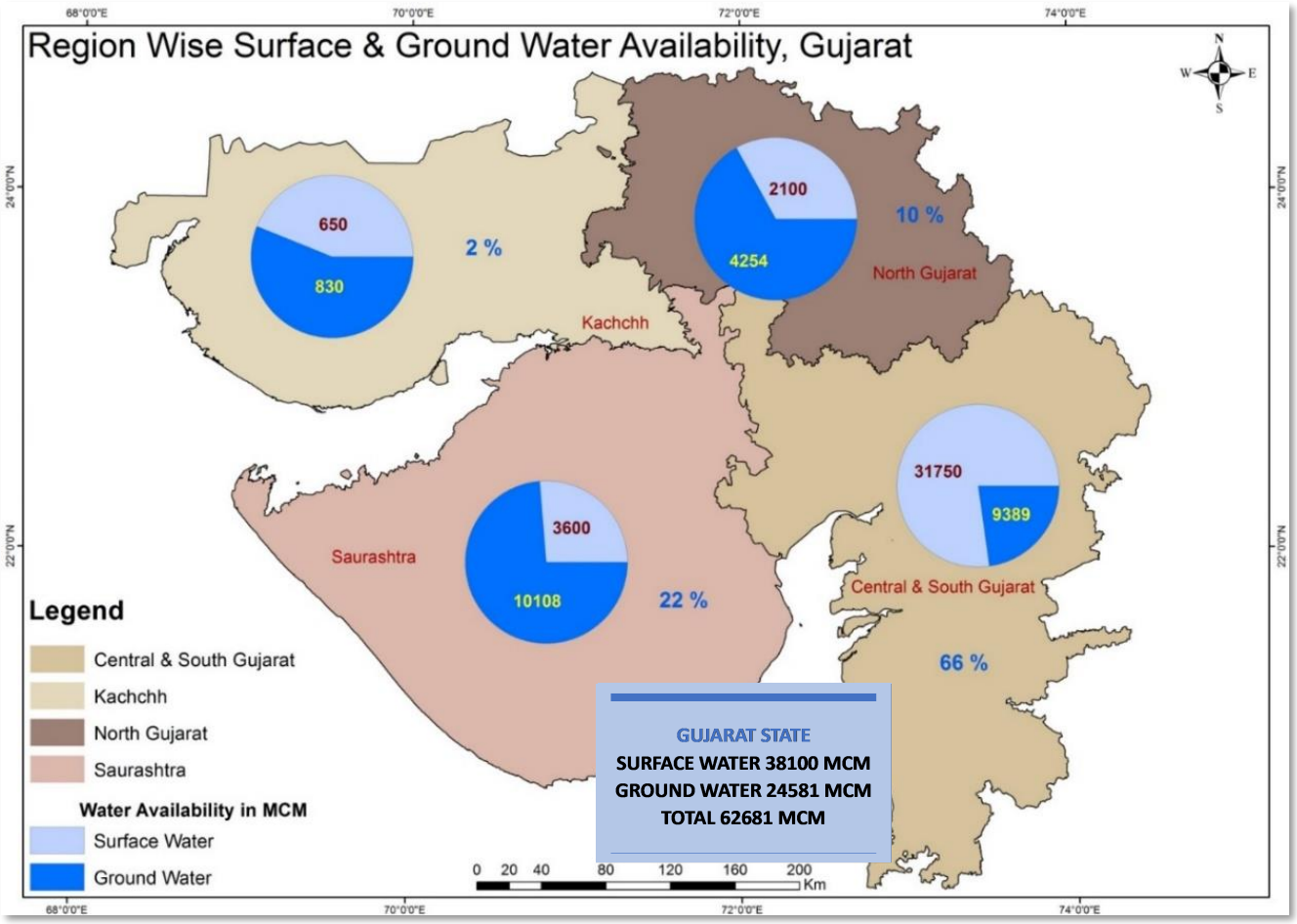


Figure 8-Region wise Surface water and Ground Water Availability of Gujarat

1.4.1 Surface Water Resources

There are very few perennial rivers in the state out of a total of 185 rivers and limited facility of surface irrigation. Perennial rivers are located in 20% area of the state, which accounts for 80% of surface water of the state.

River Basins (185)		
Gujarat	**Saurashtra**	**Kachchh**
17	**71**	**97**

The Surface water resources are only 38100 MCM (Million Cubic Meter), which is only 2% surface water of the country. While the available surface water resources in the south and Central Gujarat regions are 31,750 MCM, 3600 MCM are available in Saurashtra region. North Gujarat region possesses 2100 MCM, while Kachchh region possesses a meagre 650 MCM.

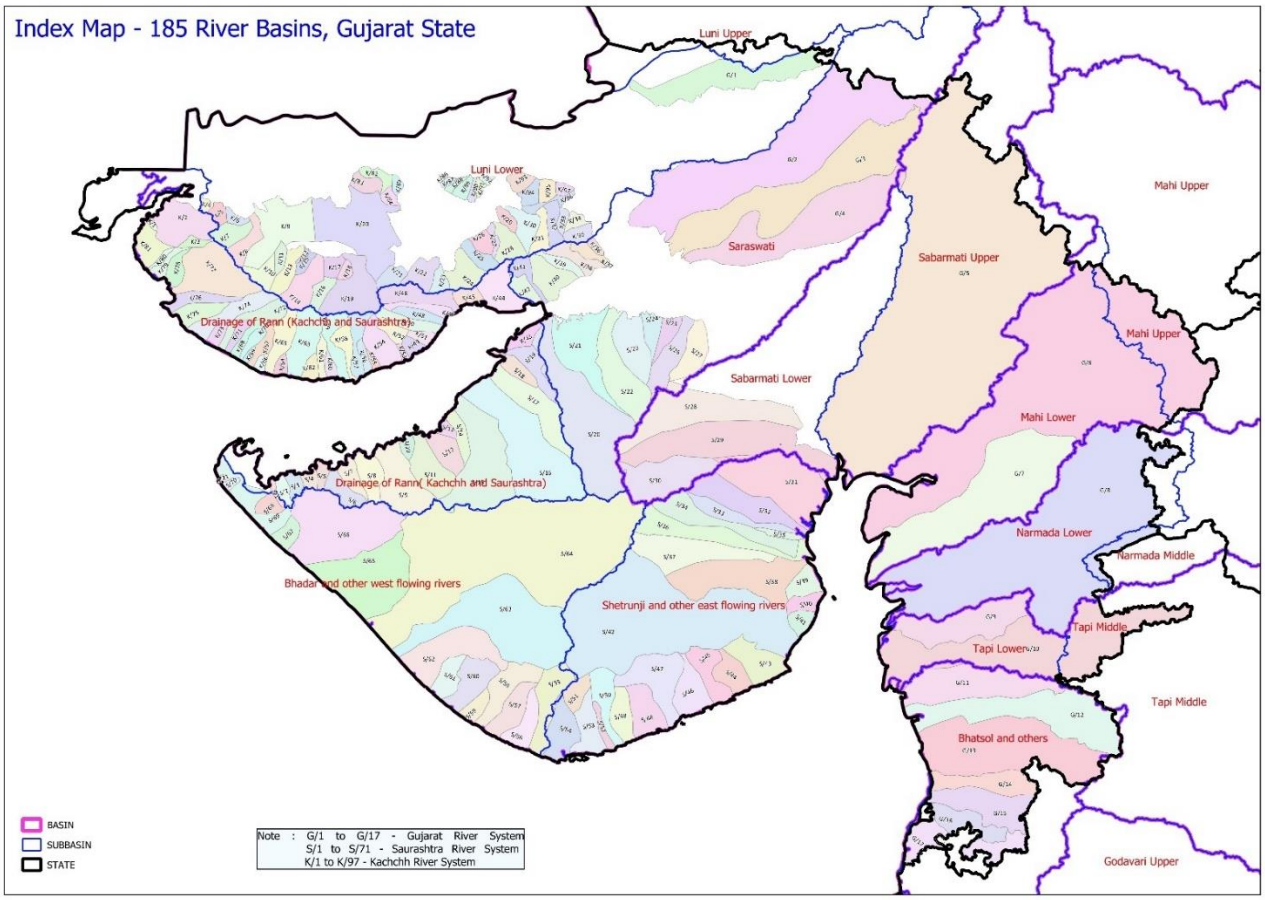


Figure 9-River Basins of Gujarat

The project wise storage of surface water in Gujarat is

Major Schemes - 12980 MCM

Medium Schemes - 1757.58 MCM

Minor Schemes – 1064.64 MCM

As observed from the above details the average per capita availability is 920 m^3/year in the state, while the per capita availability in the South &Central Gujarat regions is 1500 m^3/year. The lowest Per capita availability of 360 m^3/year is observed in the North Gujarat region, while Saurashtra and Kachchh regions have 630 m^3/year and 700 m^3/year per capita availability.

1.4.2 Ground Water Resources

- Total gross groundwater potential of 24581 MCM. The available ground water resources in the South and Central Gujarat regions are 9389 MCM, 10108 MCM are available in Saurashtra region. North Gujarat region possesses 4254 MCM, while Kachchh region possesses a meagre 830 MCM.
- Over last few decades, there has been a paradigm shift in water management as the perception that freshwater is a free and abundant resource has changed to that of water being an economic good in scarce supply, threatened by pollution and warranting its efficient use.

- The challenge of sustainable water use is particularly daunting for developed state like Gujarat grappling with increasing population and industrial activity, change in cropping pattern, and the need to enhance standards of living and economic growth.
- The groundwater plays a very important role in (~ 90 %) agriculture, water supply (~ 9 %) and in Industry (~ 1 %) in Gujarat state. As per Ground Water Resource Assessment 2022.

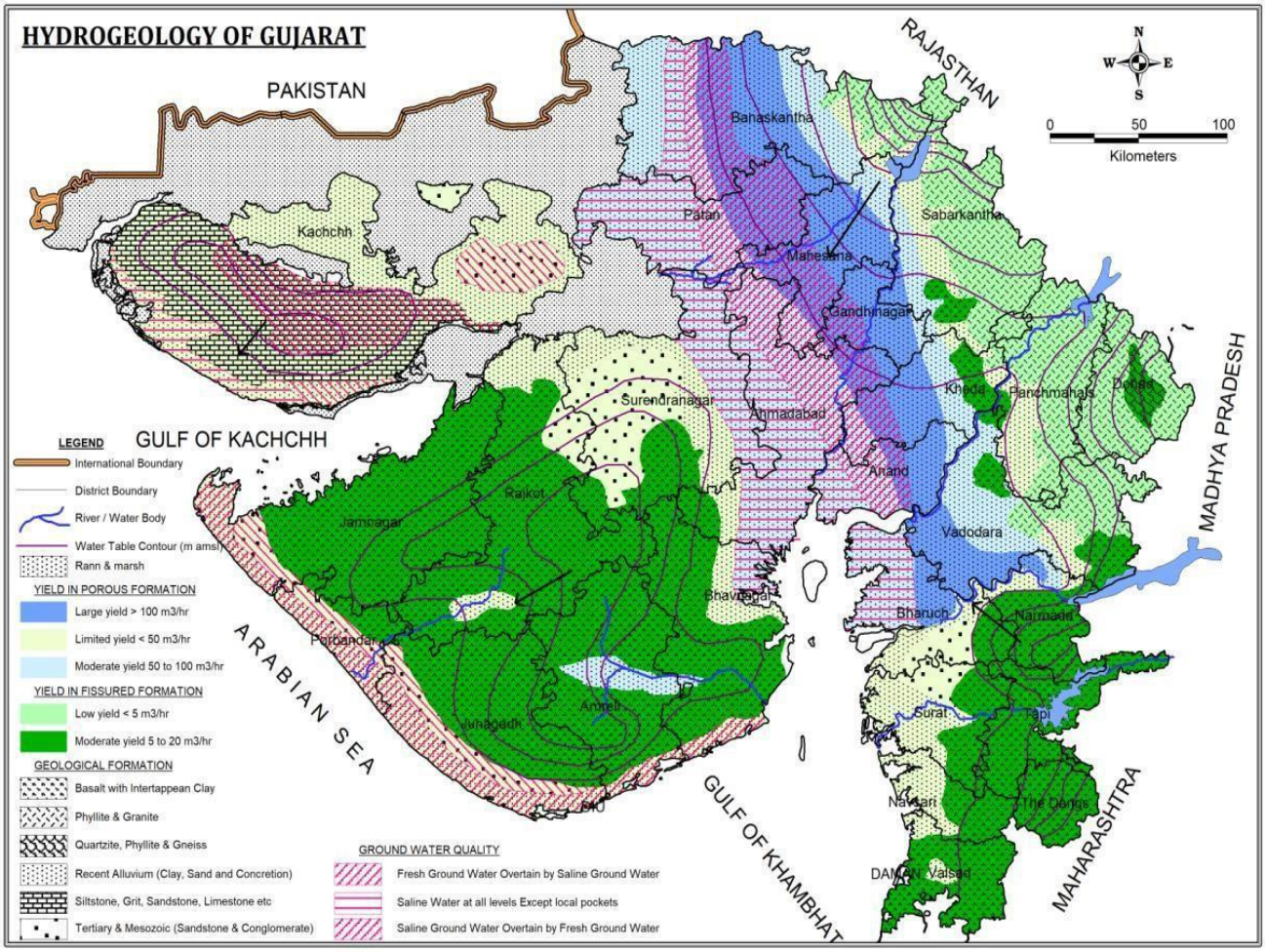


Figure 10-Hydrogeology of Gujarat

- Estimation of ground water resources is carried out by GWRDC jointly with Central Ground Water Board, Regional Office, Ahmedabad. The salient features of ground water resource assessment carried out during 2022 are as follows.
  - Total annual Groundwater Recharge 26.46 BCM
  - Annual Extractable Ground Water Resources 24.58 BCM
  - Annual Ground Water extraction 13.09 BCM
    - Agriculture
    - Drinking and domestic use
    - Industrial use

- Stage of Ground Water extraction 53.23 %.
- Out of 248 assessment units (talukas) 25 Talukas are 'Over- exploited', 4 are 'Critical', 24 are 'Semi-Critical', 182 as 'Safe' and 13 saline.

The district wise status of ground water recharge due to various components like rainfall, recharge from water conservation structures and return irrigation flows and draft due to agriculture, domestic and industrial uses and the stage of ground water development and net availability of ground water resource for future development in Ham are given in the following statement.

S. No.	Name of District	Ground Water Recharge (Ham)					Total Natural Discharges	Annual Extractable Ground Water Resource	Current Annual Ground Water Extraction (Ham)				Annual GW Allocation for for Domestic Use as on	Net Ground Water Availability for future use	Stage of Ground Water Extraction (%)
		Monsoon Season		Non-monsoon Season		Total Annual Ground Water			Irrigation	Industrial	Domestic	Total			
		Recharge from	Recharge from	Recharge from	Recharge from										
1	Ahmedabad	44377.69	9688.35	0.00	10358.61	64424.65	3815.88	60608.76	37210.40	1268.60	676.51	39155.51	2668.36	21359.00	64.60
2	Amreli	137968.04	8043.98	0.00	9991.73	156003.75	7800.19	148203.56	74640.40	5.26	202.83	74848.48	213.21	73344.69	50.50
3	Anand	28882.50	39882.83	0.00	35445.63	104210.96	7150.32	97060.64	22265.10	110.18	3969.68	26344.97	4688.66	70417.45	27.14
4	Arvalli	70906.20	3014.54	0.00	6520.91	80441.65	7690.86	72750.79	32196.30	5.48	1829.47	34031.25	2013.43	38535.58	46.78
5	Banaskantha	82583.48	16242.0	0.00	18448.92	117274.49	10347.7	106926.7	129523.0	62.60	3762.13	133347.78	5092.00	19192.79	124.71
6	Bharuch	63366.21	8169.95	0.00	14870.59	86406.75	8640.66	77766.09	15379.40	36.88	1083.63	16499.90	2032.73	61181.43	21.22
7	Bhavnagar	84934.69	7021.85	0.00	10546.54	102503.08	5125.15	97377.93	42198.40	0.00	64.85	42263.25	71.32	55108.21	43.40
8	Botad	43266.32	2441.28	0.00	3820.15	49527.75	2476.37	47051.37	23049.70	0.00	0.00	23049.70	0.00	24001.67	48.99
9	Chhota Udepur	39945.22	4761.27	0.00	9485.09	54191.58	4894.98	49296.60	18634.60	0.00	1727.58	20362.17	1874.63	28787.38	41.31
10	Dahod	34200.85	6586.17	0.00	10931.19	51718.21	4484.34	47233.87	8267.30	0.00	4576.15	12843.44	5471.59	33494.97	27.19
11	Dang	30173.22	848.43	0.00	925.07	31946.72	3194.67	28752.05	1715.70	61.48	452.40	2229.59	512.56	26462.30	7.75
12	Devbhumi Dw	37488.18	2727.09	0.00	4543.48	44758.75	2237.93	42520.82	24483.80	0.00	1355.95	25839.76	1548.74	16572.46	60.77
13	Gandhinagar	40044.07	5073.64	0.00	7761.33	52879.04	5287.91	47591.13	57109.30	244.37	1384.10	58737.77	1482.08	5393.03	123.42
14	Gir Somnath	52503.68	3210.16	0.00	5115.06	60828.90	3041.45	57787.45	26281.30	0.00	2213.88	28495.19	2767.34	29134.13	49.31
15	Jamnagar	152729.1	6577.36	0.00	11397.39	170703.93	8535.20	162168.7	51496.90	0.00	2122.61	53619.50	2444.32	108379.2	33.06
16	Junagadh	76055.68	5195.42	0.00	8117.83	89368.93	8254.30	81114.63	60211.30	0.00	1904.93	62116.22	2123.43	21912.68	76.58
17	Kachchh	49048.75	18503.5	0.00	17598.75	85151.07	6378.25	78772.82	56933.10	0.90	867.20	57801.20	1554.58	31816.30	73.38
18	Kheda	77455.15	38260.8	0.00	37932.57	153648.53	7682.42	145966.1	52593.70	29.25	3091.16	55714.15	3359.45	90015.92	38.17

19	**Mahesana**	78565.77	11554.3	0.00	22091.97	112212.10	11221.2	100990.8	100905.6	199.66	2980.50	104085.78	3240.03	7824.57	103.06
20	**Mahisagar**	17449.93	4907.18	0.00	9088.11	31445.22	3144.51	28300.71	10135.20	0.00	672.87	10808.07	743.97	17421.54	38.19
21	**Morbi**	48713.01	4137.44	0.00	8088.60	60939.05	3049.69	57889.36	26253.10	0.00	1383.99	27637.10	1830.66	30086.03	47.74
22	**Narmada**	26666.89	4834.60	0.00	8077.01	39578.50	3008.21	36570.29	18038.40	0.25	463.52	18502.16	504.74	18026.91	50.59
23	**Navsari**	52834.87	4380.70	0.00	10687.48	67903.05	5501.69	62401.36	19155.60	67.53	2293.87	21517.00	2504.91	40772.34	34.48
24	**Panchmahal**	22217.36	10692.8	0.00	14646.81	47556.98	4201.20	43355.78	9404.60	27.30	1775.60	11207.50	1969.38	31954.49	25.85
25	**Patan**	20983.87	5857.67	0.00	9733.79	36575.33	2403.15	34172.18	39745.90	17.89	500.63	40264.41	1359.82	2716.81	117.83
26	**Porbandar**	21954.45	1698.08	0.00	2792.89	26445.42	1322.26	25123.16	14133.40	0.15	345.88	14479.44	397.17	10624.81	57.63
27	**Rajkot**	152287.4	14900.5	0.00	23454.28	190642.24	9532.10	181110.14	99844.20	15.50	6381.45	106241.16	7163.96	74086.45	58.66
28	**Sabarkantha**	50308.31	7772.96	0.00	16687.96	74769.23	7476.93	67292.30	49081.10	7.30	1824.53	50912.92	2007.99	17512.26	75.66
29	**Surat**	82120.97	10669.35	0.00	27662.98	120453.30	9415.95	111037.35	29018.00	15.00	3362.62	32395.62	6773.66	77637.64	29.18
30	**Surendra Nagar**	69501.38	4620.63	0.00	6376.66	80498.67	4024.96	76473.70	28902.20	0.00	629.67	29531.87	1150.20	46881.38	38.62
31	**Tapi**	49529.02	3679.08	0.00	10132.92	63341.02	5127.84	58213.18	18137.80	0.00	500.65	18638.45	536.42	39538.96	32.02
32	**Vadodara**	64018.71	10055.28	0.00	31613.19	105687.18	7843.33	97843.85	54911.90	397.50	2179.84	57489.24	2365.37	40314.12	58.76
33	**Valsad**	56234.07	3148.99	0.00	7465.02	66848.08	6046.51	60801.57	13344.80	55.85	5218.47	18619.10	5914.90	41513.84	30.62
	Total (Ham)	**1959315.18**	**289158.4**	**0.00**	**432410.51**	**2680884.11**	**190358.1**	**2490525.91**	**1265201.55**	**2628.93**	**61799.16**	**1329629.65**	**78381.61**	**1252021.38**	**53.39**
	Total (bcm)	**19.5931518**	**2.891584**	**0.00**	**4.3241051**	**26.8088411**	**1.903581**	**24.9052591**	**12.6520155**	**0.02628932**	**0.6179916**	**13.2962965**	**0.7838161**	**12.5202138**	**53.39**

1.5 Urban Gujarat Water Resource

Situated on the west coast of India, Gujarat is one of the most urbanized states of the country. As per census 2011, population of Gujarat State is 6.038 crore (60.38 million), out of which 2.571 crore (25.71 million) people are living in urban areas. This shows about 43% of Gujarat's population resides in cities and towns, indicating that the state's present urbanization level is much higher than the national average of 31.16%. As per projections Gujarat's urban population is expected to increase from 2.57 crore (25.7 million) in 2011 to 3.40 crores (34.00 million) in 2021. This suggests that every year, Gujarat will have to provide water supply infrastructure facilities to additional 1 million people in urban areas just to maintain the current level of service.

Table 2-Urban Population in Gujarat

Year	Gujarat			India		
	Urban Population (In millions)	% of Urban Population	Decadal Growth Rate	Urban Population (In millions)	% of Urban Population	Decadal Growth Rate
1951	4.43	27.23		62.4	17.29	
1961	5.31	25.74	19.64	78.90	18.00	26.44
1971	7.49	28.06	41.05	109.10	19.91	38.22
1981	10.60	31.10	41.52	159.50	23.70	46.23
1991	14.24	34.47	34.34	217.20	25.71	36.09
2001	18.22	37.67	32.94	285.40	27.78	21.35
2011	25.71	42.58	29	377.20	31.16	27.60

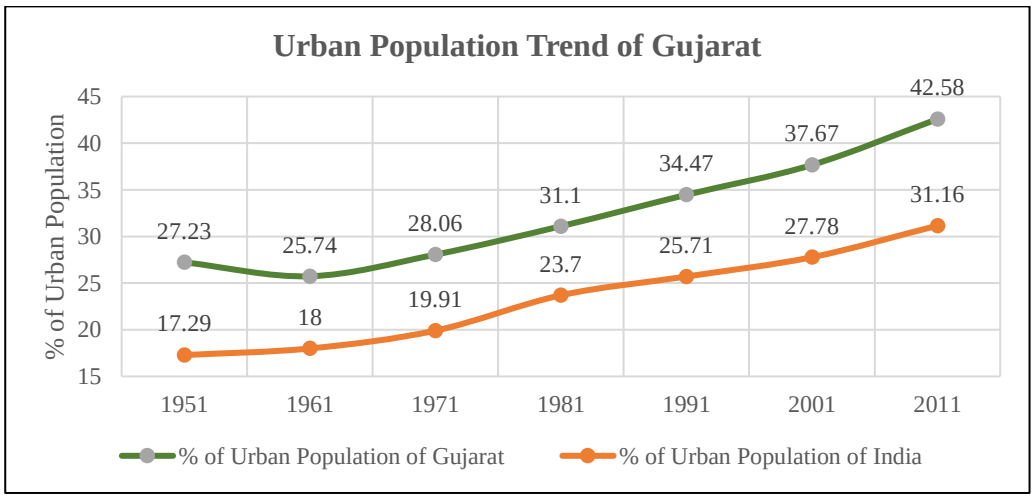


Figure 11-Urban Population Trend in Gujarat

Source: Census of India

In Gujarat, Urban Local Bodies (ULB)s are responsible to provide and manage basic infrastructure services. Administratively, the urban areas are classified as Municipal Corporations and Municipalities classified as 'Class- A to D'. There are 8 Municipal Corporations and 162 Municipalities of 22 "A" Class (Population 100000 and above), 30 "B" Class (population 50,000-1, 00,000), 60 "C" Class (population 25,000-50,000) and 45 "D" Class (population 15,000- 25,000).

Presently, All Municipal Corporations are constituted under the provision of the Gujarat Provisional Municipal Corporation Act, 1949. All other urban areas viz., Class A to Class D municipalities are governed by municipalities constitute under the Gujarat Municipalities Act 1963.

1.5.1 Sources of Water in Urban Gujarat

The major source of water supply in all ULBs of Gujarat is through bulk purchase of raw and treated water from Narmada Canal/pipe line. There are few cities which are having own surface water source through dam, lake or river. It has been also observed that more than 50% of total ULBs have multiple source dependency. ULBs in North Gujarat and Central Gujarat are more dependent on ground water sources. Cities in South area have advantage of local surface water, while cities in Saurashtra and Kutch are mostly dependent on Narmada pipe line or canal-based bulk treated and raw water sources. Gujarat Water Infrastructure Limited (GWIL) and Gujarat Water Supply & Sewerage Board (GWSSB) are executing water grid of Narmada pipeline/canal to cover most of area of Gujarat. Narmada based water supply is an emerging source of water in Gujarat. Summary of source of water in all ULBs of the state is as shown below;

Table 3-. Source of Water in all ULBs (MCs and NPs)

Sr. No	Source of Water	No of cities	%
1	Narmada water through pipeline/canal	**12**	**7**
2	Narmada water and Local Deep well or Bore wells	**61**	**37**
3	Local Surface Water	**22**	**13**
4	Narmada pipeline and Local dam	**50**	**30**
5	Ground water source by Deep wells/wells	**11**	**7**
6	Local dam and Deep wells/wells	**9**	**6**
	Total	**165**	**100**

Source: Details of SLB (2021-22) for 15th FC published in Gazette

1.6 Sardar Sarovar Project & Sardar Sarovar Narmada Nigam

1.6.1 Sardar Sarovar Project at a Glance

- Main Dam - 1,210 m long, 163 m high from the deepest foundation level
- Designed Live Storage Capacity of the Reservoir 5860 MCM (4.75-million-acre feet)
- Irrigation - 1.905 million Ha (1.8 million Hectare in Gujarat benefitting 1 million farmers)
- Drinking Water - 9490 villages and 173 towns (30 million people)
- Hydropower - 1,450 MW installed capacity (1 billion kWh every year)
- Canal Network - Approximately 75,000 km length within Gujarat\

Considering the above benefits, the Narmada. River and Sardar Sarovar Project is defined as the Gujarat State Lifeline's. Hence, Sardar Sarovar Project add major part and plays an important role in water scenario in the Gujarat State.

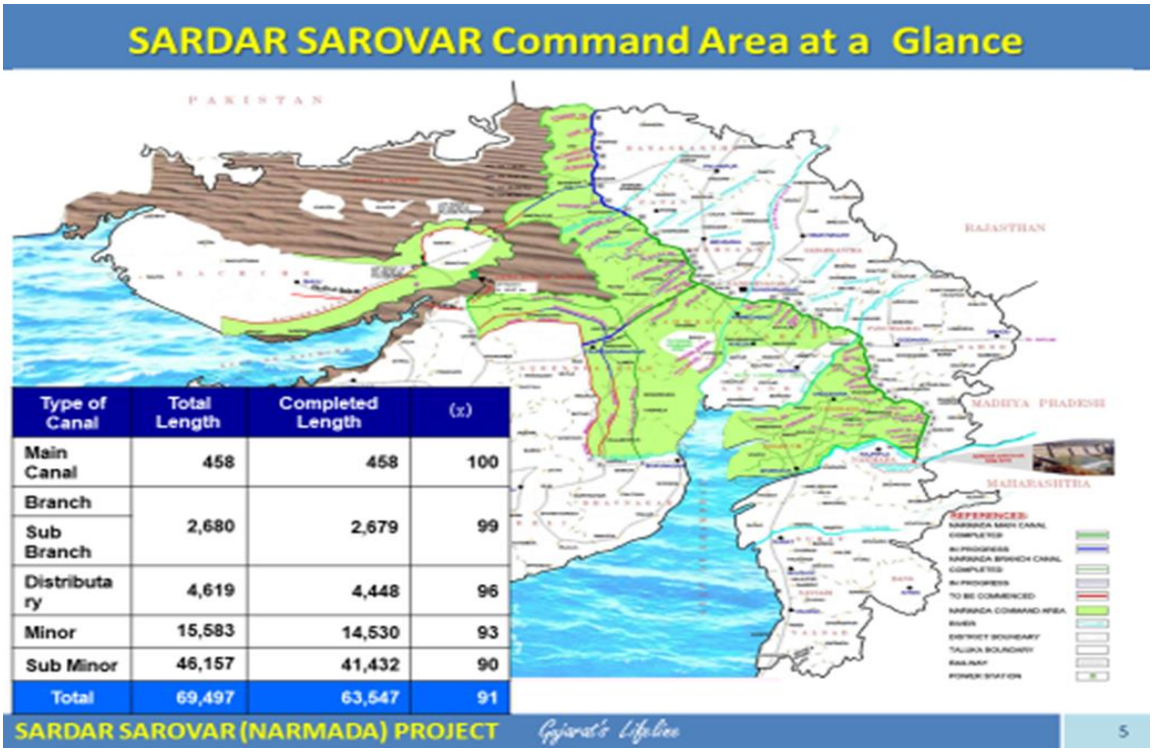


Figure 12-Sardar Sarovar Project Command Area

1.6.2 Status of Sardar Sarovar project

Table 4- Status of Sardar Sarovar Project

Total	Unit	Total	Completed	Remaining
Length of Canal	Km	69497	63547	5950 km
Irrigation Potential created up to Minors	Lakh Ha	17.92	17.04	0.88

Command Area Development up to sub-minors	Lakh Ha	18.31	15.45	2.67 (0.19 de-commanded)

1.7 Water Resources -Demand and Development

1.7.1 Irrigation Demand and Development

Gujarat has 101 lakh hectare of Net Sown Area and 128 lakh hectare of total cropped area with 8 agro climatic zones. More than 40 major crops are grown in the state. There is pre-dominant cultivation of non-food, high value crops i.e. cotton, castor, tobacco, cumin, fennel, mango, groundnut, banana etc. Major Kharif crops in the state are cotton, groundnut, Sesamum, castor, paddy, bajra, maize, tur, green gram, sugarcane etc. and wheat, rice, maize, mustard, gram, groundnut, bajra etc are major Rabi crops.

Agriculture and allied sector contribute about 16% to the GSDP

The annual rainfall ranges from 625mm to more than 1500 mm with an average annual rainfall of 972 mm. 24.94% area falls under arid and 35.56% falls under semi-arid area region. Only 34.4% area is irrigated. Huge area having alkaline soil and saline soil. The state has 19.8 lakh ha cultivable waste land. Almost 70% of the area is rain fed and drought prone.

Table 5-Irrigation Development in Gujarat

Sr. No	Particulars	Details
1.	Geographical area	196 lakh hectares
2.	Cultivable area	124.5 lakh hectares
3.	Ultimate Irrigation potential (UIP) – surface water Ground water	48.45 lakh hectares (includes 17.93 lakh hectares through sardar sarovar project) 22.59 lakh hectares
4.	Potential created as on June – 2020	69.11 lakh hectares
5.	Potential utilized as on June – 2020	52.75 lakh hectares
6	Total irrigation potential of surface water and ground water created up to June-2020	97.29% of UIP

Sr. No	Particulars	Details
	Max. utilization	88.22% of ultimate total irrigation potential created
7.	Projects for enhancement of water sector by WRD	Sujalam Sufalam Yojna, SAUNI yojana and techniques like micro irrigation and its schemes
8.	Check dam construction Total constructed by WRD By other Dept.	Up to March-2021: 93841 During year 2020-21: 189 94030 92577
	Total check dams	186587 up to Sept -2021
9.	Deepening of tanks	48576 at the end of June -2021
10.	Construction of Bori bandh	125377 up to March-2021
11.	Construction of Khet Talavadi	323268 up to March-2021
12.	Sujalam Sufalam Jal Abhiyan Water Storage capacity	56698 works completed includes 21402 ponds deepening 12221 check dam de-silting 61781Lac cubic feet enhanced
13.	Land utilization pattern (from 1994-95 to 2017-18(P))	Gross area sown growth-17% Area sown more than once growth-104%
14.	Area Sown More than Once with respect to Gross Area Sown (In the year2017-18(P))	Anand (52.1%) (highest) BanasKantha (45.9%) Bharuch (2.1%) (lowest)
15.	Cropping intensity	116.35% in the year1994-95 132.52% in the year 2017-18(P) Anand – 209% Banaskantha – 185%
16.	Intensity of irrigated cropping	121.74% in the year1994-95 154.16% in the year 2017-18(P) (highest in Dahod (505.7%)) 154 % in Gujarat 506% in Dahod (highest)

Sr. No	Particulars	Details
17.	Gross irrigated area	56.91% w.r.t. gross cropped area in the year 2017-18(P) Anand – 94.85% (highest) Vadodara – 84.05% Kheda – 81.31% Devbhumi Dwarka – 25.33% (lowest)
18.	Area irrigated	72.50% (in year 2020-21) 160.29% in Mahesana 155.88% in Surendranagar
19.	Van talavadi Checkdam	1075 356 constructed by forest dept. in year 2020-21

1.7.2 Water Supply Demand and Development

Gujarat falls in the semi-arid zone. The long sea coastline along Saurashtra, Kutch and other parts faces the problem of salinity ingress, which affects the ground water quality on coastal belt and because of scanty and uncertain rainfall, the replenishment in dam is also not reliable. Hence these areas are always under water deficiency. Gujarat has just 2.28% of India's water resources and 6.39% of country's geographical area. The water supply service varies at the level of Municipal Corporations and Municipalities.

In North Gujarat, Saurashtra and Kachchh, available water resources are less than the requirements. In absence of perennial sources of surface water, ground water used to be the main source for drinking water. With over exploitation of ground water in these regions, the water table was being depleted at the rate of 3 to 5 meters per year and water had to be abstracted from depth of 300 meters.

This situation has changed significantly since the Narmada canal based drinking water programme has been initiated. In 2009, only 35% of the ULBs depended exclusively on ground water as a principal source of water, while 18% are dependent exclusively on Narmada canal water. Nearly half of the ULBs use both Narmada canal water and groundwater.

The Municipal Corporations, where nearly 60% of the urban population of Gujarat reside, account for 73% of the total municipal water supply. Among the water sources, bulk water

purchase from Narmada accounts for 46% of total water used by ULBs, while groundwater usage has dropped to 21%. However, in terms of quantum of water supplied to the ULBs from the Narmada canal, the Municipal Corporations use 71% percent of it. So far 72 ULBs receive water from the Narmada Canal, and another 19 have already been taken up.

Table 6-Source of water by size class of ULB (2009)

Category of ULB	**Own surface sources (MLD)**	**Ground water (MLD)**	**Bulk water purchase (MLD)**	**Total water (MLD)**
MC	1003.8	300.9	1072.0	2376.7 (72.9%)
A	20.5	86.3	215.9	322.7 (9.9%)
B	27.5	128.5	100.9	256.9 (7.9%)
C	14.8	81.4	63.9	160.2 (4.9%)
D	5.3	94.3	44.8	144.3 (4.4%)
Total (MLD)	1071.9 (32.9%)	691.4 (21.2%)	1497.6 (45.9%)	3260.9

In 2001, about 91% of urban population in Gujarat had access to piped water supply, exceeding the national average by almost 20% and ranking among the first three states in India in terms of access to water services. Access to piped water in Gujarat was improved by about 18% between 1991 and 2001 (Census of India, 2001).

Thus, although Narmada canal has improved coverage and increased supply of water in ULBs, a large number of ULBs in Gujarat are still not secure in terms of their water requirement. With rapid growth of urban population, the quantum of water required from Narmada canal and other sources will have to increase manifold.

Followings are major salient features of Water supply system in Urban:

Table 7-Salient Features of Water supply service delivery in Urban Gujarat

Sr. No	Details	Quantities
Summary WSS in Urban Gujarat		
1	Total No of ULBs= 157 Municipalities+8 Municipal Corporations	**165 ULBs**
2	Total population (as estimated for 2021) in urban towns of Gujarat	**3,18,46,931**
3	Total No of households (as estimated for year 2021) in urban towns of Gujarat	**75,60,183**
4	Total No of households (as estimated for year 2021) connected with water supply tap in urban towns of Gujarat	**64,78,174**
5	Total % coverage of Water supply through Taped connection	**85.69%**
6	Total % of water supply in all ULB (through tanker, borewell & others)	**100%**
WSS in Municipal Corporations		
1	Total Municipal Corporations	**8**
2	Total population (as estimated for 2021) in MC area	**2,10,74,302**
3	Total No of households (as estimated for year 2021) in MC area	**49,17,431**
4	Total No of households (as estimated for year 2021) connected with water supply tap in MC area	**44,83,604**
5	Total % coverage of Water supply through Taped connection in MC area	**91.10% %**
6	Total % of water supply in all ULB (through tanker, borewell & others) in MC area	**100%**
WSS in Nagar Palikas		
1	Total Municipalities (Nagar Palika)	**157**
2	Total population (as estimated for 2021) in NP area	**1,07,72,629**
3	Total No of households (as estimated for year 2021) in NP area	**26,42,752**
4	Total No of households (as estimated for year 2021) connected with water supply tap in NP area	**19,94,570**
5	Total % coverage of Water supply through Taped connection in NP area	**85.69% %**
6	Total % of water supply in all ULB (through tanker, borewell & others) in NP area	**100%**

Source: AMRUT 2.0 State Water Action Plan (SWAP),2022

1.8 Institutional Structure of Water Sector in Gujarat

As per the constitutional provisions water is a State subject and all activities related to protection, regulation and management of water resources are undertaken by the respective States. Various statutory bodies under Government of Gujarat involved with development, conservation and use of the water resources are presented in the table below:

Table 8-Institutional Structure of Water Sector in Gujarat

Agency	**Jurisdiction**	**Role**
Administration and Regulation		
Department of Narmada, Water Resources, & Water Supplies	State Level	Regulatory oversight of the water sector in the State, Oversight of State government owned corporations involved in the implementation and operation of water schemes.
Department of Urban Development	State Level	Oversight of urban local bodies, excluding corporations, in matters of financial, planning and management issues. Regulation of political and administrative appointments in the local authorities.
Municipal Corporations	Major Cities	Provision of retail water supply services for domestic and industrial purposes in the area of their jurisdiction
Municipalities & Nagar Palikas	Smaller Cities	Provision of retail water supply services for domestic and industrial purposes in the area of their jurisdiction
Gram Panchayats	Villages	Provision of retail water supply services for domestic and industrial purposes in the area of their jurisdiction
Gujarat Industrial Development Corporation	State Level	Provision of retail water supply services in industrial estates owned by GIDC.
Gujarat Water Resources Development Corporation	State Level	Ground water investigation, exploration, management & recharge works
Implementation and Operation		

Agency	**Jurisdiction**	**Role**
Gujarat Water Supply and Sewerage Board (GWSSB)	State Level	Mainly Implementing water supply and sewerage schemes for urban local bodies. Operation of some schemes. Inspection of schemes where State government fund is provided.
Gujarat State Drinking Water Company Limited	-	Bulk transmission and bulk supply of drinking water to local bodies, GWSSB, and Industrial estates.
Sardar Sarovar Narmada Nigam Ltd.	State Level	Wholesale supply of water.
Department of Narmada, Water Resources, and Water Supplies	Smaller Cities	Operation and maintenance of some river schemes like the Ukai Dam.

Chapter II

Integrated Approach by Various Departments for developing Water Resources in Gujarat

2.0 Water Resource Department

The State adopted an integrated approach for efficient and sustainable water resources development and management, which is inclusive in scope. This includes:

Figure 13-Integrated Approach for Water Resource Development

2.1 Water Conservation

2.1.1 Sardar Patel Participatory Irrigation Scheme

Check Dams are the most effective tool for water conservation at the minimum investment and minimum maintenance and operational cost. They act as ground water recharge means and they offer facility of lift irrigation in the surrounding directly from the reservoir or from the wells recharged in the surroundings. The government initiated a massive Campaign for construction of Check dams in 185 river basins

In North Gujarat and other area of the State, where suitable sites are not available for the construction of check dams, deepening of existing ponds / tanks with financial contribution of 90:10 (Government: Beneficiaries) are implemented in a big way to store and conserve water and ground water recharging during monsoon.

The project had active involvement of NGO's, Farmer groups and industries in creating check dams, deepening of Ponds and desilting of reservoir

The status of the scheme is presented below:

Table 9- Status of Sardar Patel Participatory Irrigation Scheme

Sr. No	Activity	Quantity
1	Check Dams	186587
2	Talav	16957
3	Khet Talavadi	323268
4	Van Talavadi	1075
5	Deeping of tank	48576
6	Boribandh	125377
	Total	701840

Benefits / Impacts of the Project:

- Assures Kharif irrigation. Rabi irrigation is also possible.
- Conservation and harvesting of surplus monsoon runoff in ground water reservoir.
- Rise in water levels in wells and tube-wells due to additional recharge of ground water and reduction in consumption of energy in over exploited areas.
- Sustainability to the existing ground water structures.
- Changes in cropping pattern due to availability of additional water for irrigation.
- Increase in soil moisture and increase in green vegetation.
- Indirect benefits like decrease in soil erosion and improvement in the SocioEconomic conditions of farmers.

2.1.2 Micro Irrigation

The initiation of drip irrigation in Gujarat dates back to 1991 through the Jal Sanchay Abhiyan. However, until 2004, the total coverage under Micro Irrigation was a mere 2.26 lakh hectares. Under the visionary leadership of the then Chief Minister of Gujarat and the current Prime Minister of India, Shri Narendra Modi, the State Government decided to take a new approach and established a Special Purpose Vehicle (SPV) called the Gujarat Green Revolution Company Ltd. (GGRC). This strategic move led to a quantum jump in the coverage of micro irrigation, and by 2022, the land covered by micro irrigation had expanded to 21.83 lakh hectares (GGRC, 2023). Apart from boosting productivity, this exponential growth in micro irrigation has facilitated crop diversification towards horticulture and enabled cultivation in water-scarce regions. The GGRC model has been widely acknowledged as a success story, with Uttar Pradesh and Chhattisgarh having already adopted it. The Government of India has

also signed a MoU with GGRC and issued an advisory urging other states to follow this successful model.

2.1.2.1 Micro Irrigation Scheme Implementation Scenario during 1991-2005

The benefits of micro irrigation have been well-known to researchers, policymakers, and farmers for a long time. The State Government and Government of India made sincere efforts to promote it through extension services and financial incentives. With a vision to transform the agriculture sector, the State Government initiated the Jal Sanchay Abhiyan in 1991, modifying it over the years to make it more farmer-friendly. However, the smooth implementation of the campaign faced numerous challenges, leading to limited coverage under micro-irrigation until 2005.

During the period from 1991 until April 2005, the Micro Irrigation Scheme in Gujarat was implemented by different government departments. Subsidies were available under various schemes and sub-schemes, with differing subsidy assistance norms, including additional subsidies for tribal farmers from the Tribal Development Department. There was limited availability of information and low awareness among farmers. The varying procedures and norms for granting assistance across different government departments caused confusion and administrative difficulties in implementing the schemes. Moreover, there was no structured monitoring system for disbursement of subsidies.

Due to these scattered efforts and a lack of uniform implementation, awareness, and adoption of micro-irrigation among farmers remained minimal. Until 2004, the total coverage under Micro Irrigation was only 2.26 lakh hectares, benefiting 1.41 lakh farmers. Recognizing the low penetration of the scheme and technology among farmers, the government felt the need for a focused and result-oriented approach.

2.1.2.2 Implementation of the PMKSY- Per Drop More Crop (Micro Irrigation) in Gujarat

Micro irrigation technology is a modern and highly efficient irrigation method that offers multiple benefits, including water, fertilizer, energy, and labor savings, along with increased crop productivity. Recognizing these advantages, both the State and Central Governments are encouraging farmers to adopt micro irrigation technologies in agriculture by providing financial assistance under the flagship scheme Pradhan Mantri Krishi Sinchai Yojana - Per Drop More Crop (Micro Irrigation).

Since May 2005, the Gujarat Green Revolution Company has been implementing the scheme in an integrated manner, following uniform financial assistance norms, and adhering to the Operational Guidelines of the Per Drop More Crop (Micro Irrigation) component of Pradhan Mantri Krishi Sinchai Yojana (PMKSY), a Centrally Sponsored Scheme. The convergence of Central assistance with State resources has facilitated a higher numbers of beneficiary farmers adopting this technology.

2.1.2.3 Micro Irrigation – Remarkable Results achieved through GGRC's Focused Efforts

Some notable initiatives were as follows –

- Creating Awareness through Krishi Mahotsav: During the initial years after the formation of GGRC, the then Chief Minister, Ministers, and Senior Bureaucrats visited villages during Krishi Mahotsav every year in the summer season to encourage farmers to adopt Micro Irrigation, water conservation, and the latest advancements in Agriculture. Audio-visual vehicles called "KRUSHI RATHS" were extensively used for this purpose. Field demonstrations were also carried out simultaneously.
- Synergic Efforts of Agriculture Dept, Agriculture Universities, and Fertilizer Companies: Scheme implementation and field activities were carried out in coordination with GSFC/GNFC depots, Agriculture-Horticulture Officers of the District, Agriculture Technology Management Agency (ATMA) Network, and the Four State Agricultural Universities.
- State Government's Additional Subsidy: The State Government provided additional subsidies from the State budget to make the scheme more attractive. The additional subsidy ranges from 25% to 45%, making the total subsidy available to farmers in Gujarat between 70% to 90% (Annexure-I). This ensures that almost all the farmers in the State can afford the transition from flood irrigation to micro irrigation.
- Continuous and Persistent Efforts: GGRC has made focused efforts to disseminate the technology, resulting in an increase in the annual area coverage from 15,000 hectares in 2005-06 to 21.83 lakh hectares in 2020-22.
- Significant Increase in Micro Irrigation Coverage: Besides the substantial increase in the absolute area under micro irrigation, the percentage of irrigated area covered by micro irrigation increased from 5.78% in 2005 to 41.68% in 2022.

  By promoting and implementing micro irrigation on such a scale, Gujarat has demonstrated its commitment to sustainable and efficient agricultural practices, leading to improved water management and increased agricultural productivity.

2.1.2.4 Benefits of Special Purpose Vehicle (SPV) and Its Impact on Results

The introduction of a corporate governance model has brought significant advantages to the implementation of the Micro Irrigation Scheme. Transparency is maintained at all stages of approval and implementation, and there is absolute independence in execution and policy decision-making. The scheme operates with a single-window approach, streamlining the implementation process. The delegation of authority and responsibility for the implementation of the Social Sector Scheme-MI to a corporate body ensures efficient management. Additionally, the uniform mode of implementation for the entire state, including pricing and MIS suppliers, ensures consistent quality standards and system costs.

Evolving Operational Procedures

One of the unique features of the scheme is its flexibility, allowing farmers to choose the extent of area they wish to cover under micro irrigation technology, the type of micro-irrigation system compatible with their cropping pattern, and the MIS Supplier who will install the system. All micro irrigation components are uniformly priced under the scheme, ensuring adherence to quality standards and cost consistency among MIS suppliers.

The scheme is executed with the assistance of registered MIS Suppliers appointed by GGRC. These suppliers register the application, conduct GPS-based field surveys, design, supply, and install the micro-irrigation systems. They are also responsible for providing maintenance services for five years. To ensure quality, GGRC mandates the use of BI Standards-compliant components, and third-party inspections are carried out periodically.

Strategies for Transformation and Positive Impact:

To expedite the processing of applications and subsidy disbursements, the scheme has standardized procedures, adopted a fast-decision-making process, and implemented a participatory approach. IT plays a crucial role, with a state-of-the-art IT infrastructure, QR Code GPS-based mobile applications, and Geo Tagging to ensure authentication of installations. QR Code GPS-based verification is used to transfer assets to beneficiaries.

The scheme's **high level of transparency** is achieved through a dedicated web-based software module that processes farmer applications, monitors installations, and facilitates subsidy disbursements. Farmers have the option of remote registration through MIS suppliers' offices or farm sites, speeding up the processing. GGRC's website provides detailed information and progress updates on applications.

To ensure the quality of MIS components, technical agencies conduct checks at the manufacturing site, and third-party inspection agencies verify materials and system performance in the field.

A strategic approach has been adopted to scale up micro irrigation, involving **convergence with other departmental schemes**. Agricultural electricity connections are prioritized for farmers adopting MIS, and the MIS Partner Model encourages additional financial assistance from various organizations to promote CSR.

Stakeholder capacity-building is emphasized through training workshops, and agronomical services with MIS maintenance training are provided to beneficiary farmers.

Crop-Wise Coverage of Area under MIS: Micro irrigation has seen remarkable success in groundnut, cotton, potato, and horticulture crops due to their water requirements aligning with drip technology. However, the adoption of micro irrigation in cereals and sugarcane remains limited, offering an opportunity to expand its coverage in these areas.

Socio-Economic impact and concurrent monitoring & evaluation of the Scheme: GGRC has established an elaborate monitoring and evaluation system for the Micro Irrigation Scheme. Prestigious organizations such as the Centre for Innovation Incubation and Entrepreneurship (CIIE) at the Indian Institute of Management (IIM), Ahmedabad, Agricultural Finance Corporation (AFC) India Ltd., State Agricultural Universities, and NGOs conduct regular socio-economic evaluations of the scheme.

Based on the findings of these studies, the adoption of Micro Irrigation has resulted in various benefits for farmers. Apart from saving water, fertilizers, energy, labour costs, and increasing crop yield, the net income per hectare for the beneficiary farmer has increased by Rs. 15,487/- . Additionally, Micro Irrigation technology offers advantages such as efficient irrigation of undulating and non-contiguous fields, minimal land levelling, reduced weed growth, and less weedicide usage. Moreover, in many water-scarce regions of the State, especially in the Saurashtra region, the survival of the farmers has become feasible through successful horticulture.

2.1.3 Interlinking and Inter-basin Transfer

2.1.3.1 Interlinking Project

State has only 2% of surface water of the available water of the country where as it covers 5% population of the country. The aim of the project is to divert surplus water from surplus to deficit basins with the following objectives

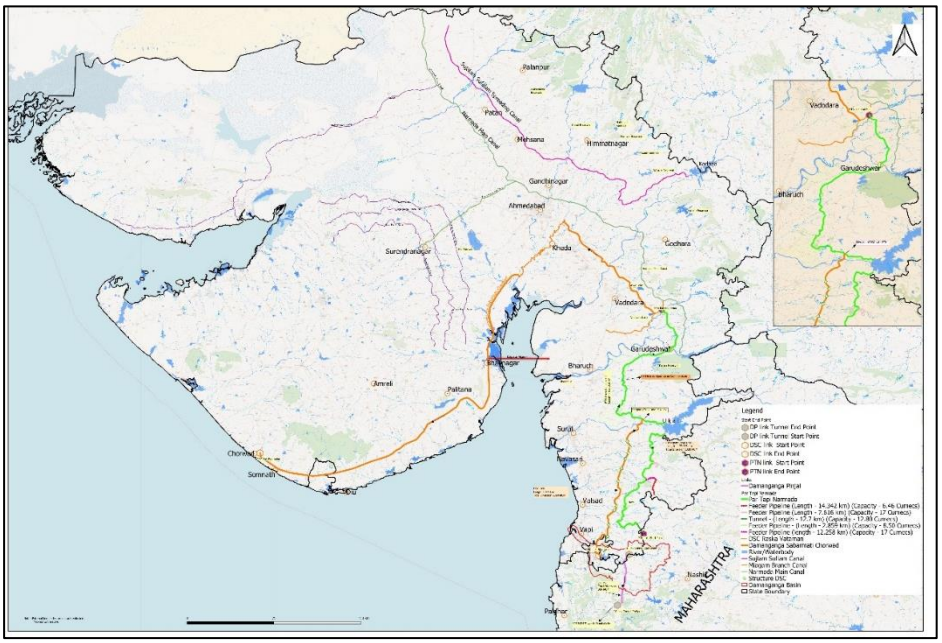
- National Water Policy (Year 2012) emphasis that water should be made available to water short area by transfer from other areas having surplus water.
- An integrated water resources management with equitable distribution of available water resources.
- Providing livelihood and employment opportunities in situ for balanced regional economic development.
- Check migration of population from rural areas to urban areas.
- To increase economic efficiency.
- Some of the interlinking projects taken up are:

Interstate Projects under planning are

- Par Tapi Narmada Link
- Damanganga -Pinjal Link

Intrastate Project under Planning

- Damanganga-Sabarmati-Chorwad link
- Rajasthan –Sabarmati Link Project
-



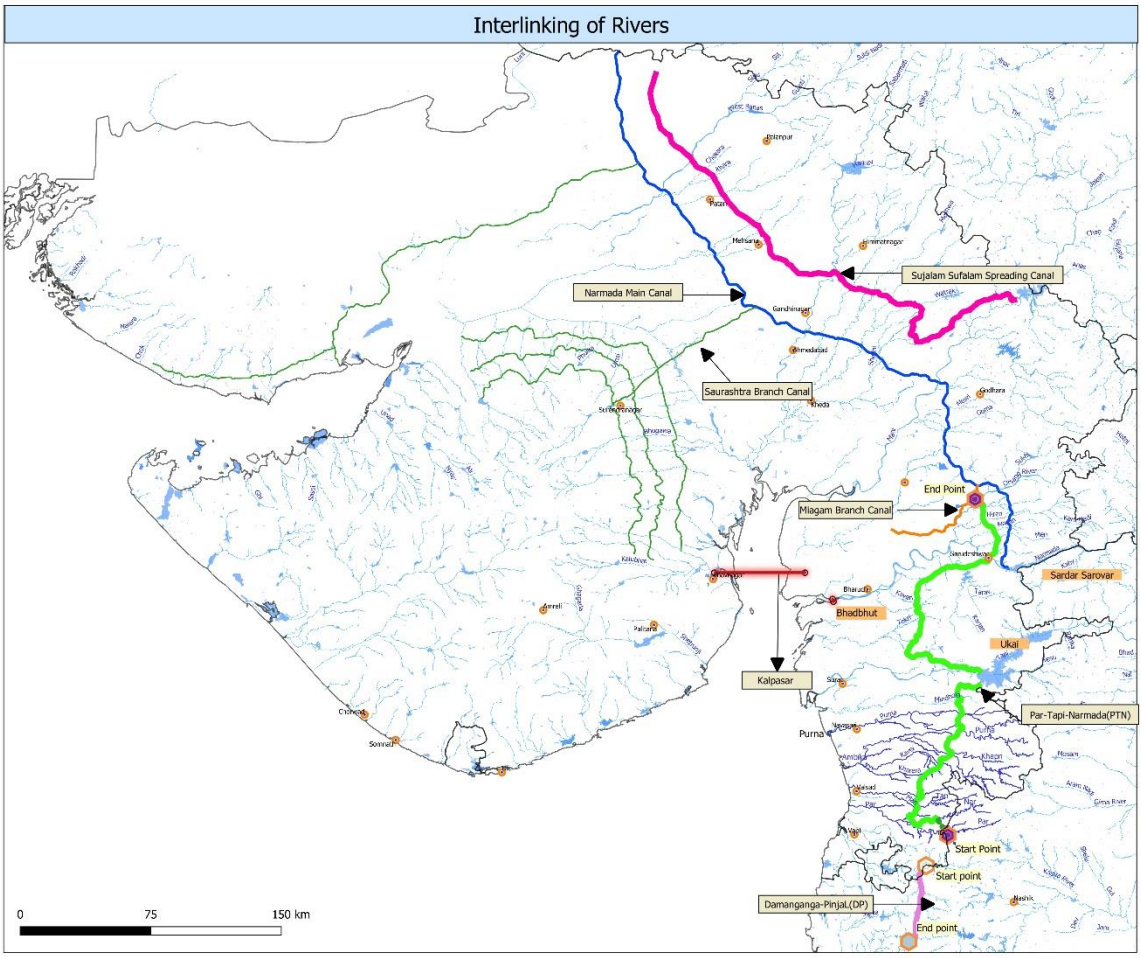


Figure 14-Map of Interelinking of River

2.1.3.2 Inter Basin Transfer of Water

The state has already taken very important and leading steps for interlinking of rivers; a few glimpses are:

A. Work already Completed by the state

1. Inter basin transfer of water from Narmada main canal to En route rivers
2. Sabarmati-Saraswati link
3. Deo-Sukhi Link
4. Harnav - Guhai Link
5. Mukteshwar-Harsoi Link
6. 17 enroute rivers on alignment of Narmada Main Canal
7. 21 enroute rivers on alignment of Sujlam Suflam spreading Canal.
8. Ukai –Purna High level Canal

B. Link works under progress

1. Interlinking of coastal rivers by spreading channel

2.1.4 Sujalam Sufalam Project

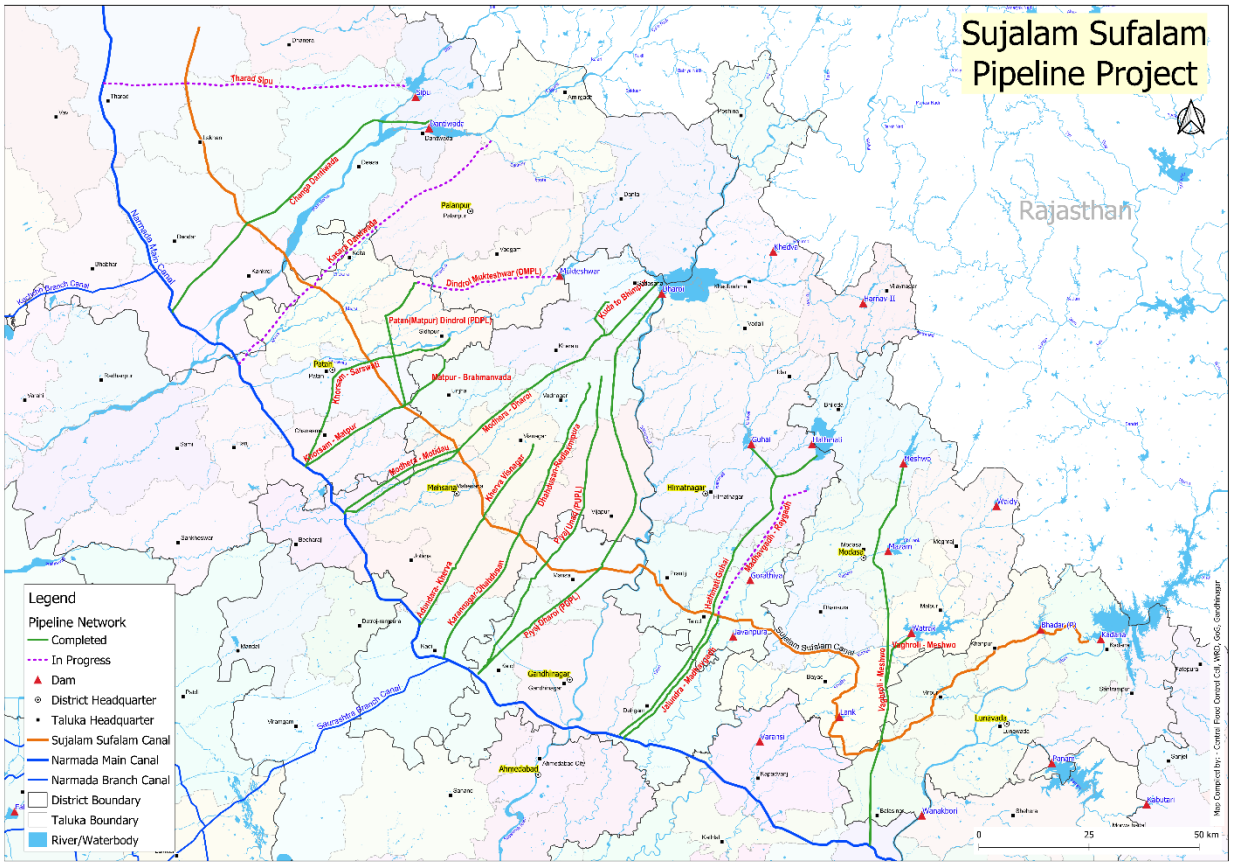


Figure 15-Map of Sujlam Suflam Project

A leading step to divert surplus water from Surplus to deficit basins.

332 km long Spreading Canal to transfer water from Narmada and Kadana river basins to North Gujarat for filling 7 reservoirs and 1111 ponds for augmenting irrigation in 3.7 lakh acres. Drinking water supply to 661 villages and eight towns is possible because of it. Sujalam Sufalam Spreading Canal crosses 21 small/big rivers

Narmada Main Canal based 14 Lift irrigation pipelines are planned to fill up 9 reservoirs and enroot ponds of North Gujarat regions to augment irrigation facilities and drinking water supply to village out of which 12 pipe lines projects are completed

Table 10-Status of Sujlam Suflam Project

Total Pipelines	14 Pipelines (12 Completed)

Total Length of Channel	332 km
Total length of PIPELINE	864.213 km for 12 completed pipelines
Number of Pumping Stations	31 pumping stations
District Benefited	Panchmahals, Gandhinagar, Sabarkantha, Patan, Mehsana and parts of Banaskantha districts.
Area Benefited	**1.** 3.7 lakh acres in Spreading Channel **2.** 2.27 lakh acres in Pipeline
Reservoirs to be Filled with Narmada water	7 reservoirs and 1111 ponds

- The Pipeline from Tharad to Sipu is under progress and alignment of Kasra to Dantiwada pipeline is approved by government. Design and estimation for administrative approval is under progress. Total 13500 Ha. area will be benefitted.
- Hirpura and Valasana barrages work are under progress. Total 10,810 Ha. area will be benefitted
- Due to Sujalamı Sufalam Yojana depletion of groundwater level restricted. As per the official data ground water development has improved from 75 percent (semi critical) to 64 percent (safe) in most of the beneficiary areas. Over exploited blocks reduced from 40 in 1997 to 25 by the end of year 2017. During the same period critical talukas reduced from 12 to 5, semi critical talukas reduced from 63 to 11. Safe blocks increased from 103 in 1997 to 194 in 2017

2.1.5 Saurashtra Narmada Irrigation Avtaran Yojna (SAUNI)

- This is another interlinking project. Under this project, it is planned to divert surplus waters of river Narmada during monsoon and store the same in 115 irrigation projects located in drought prone areas in Saurashtra region of the State.
- The benefits are hereby listed below:

Table 11-Benefits of Sauni Yojana

Total Link	4
Total Length	1371 KM
Estimated Cost	18,563 Crore
District Benefited	11 District (Rajkot, Surendranagar, Junagadh, Bhavnagar, Amreli, Botad, Jamnagar, Porbandar, Devbhumi Dwarka, Gir Somanath)
Area Benefited	8,24,872 Acre
Reservoirs to be Filled with Narmada water	115

- **Project Consists of 4 links (Pipe lines) as under:**

Table 12-Details of Sauni Yojana

S.No	Links	Location	Length
1	Link-1	From Machhu-2 Dam of Morbi District to Sani Dam of Devbhumi Dwarka District	**208 km**
2	Link-2	From Limbdi Bhogavo-2 Dam of Surendranagar District to Raydi Dam of Amreli District	**299 km**
3	Link-3	From Dholidhaja dam of Surendranagar district to Venu-1 Dam of Rajkot District	**299 km**
4	Link-4	From Limbdi Bhogavo-2 Dam of Surendranagar District to Hiran-2 Dam of Gir Somnath District	**565 km**

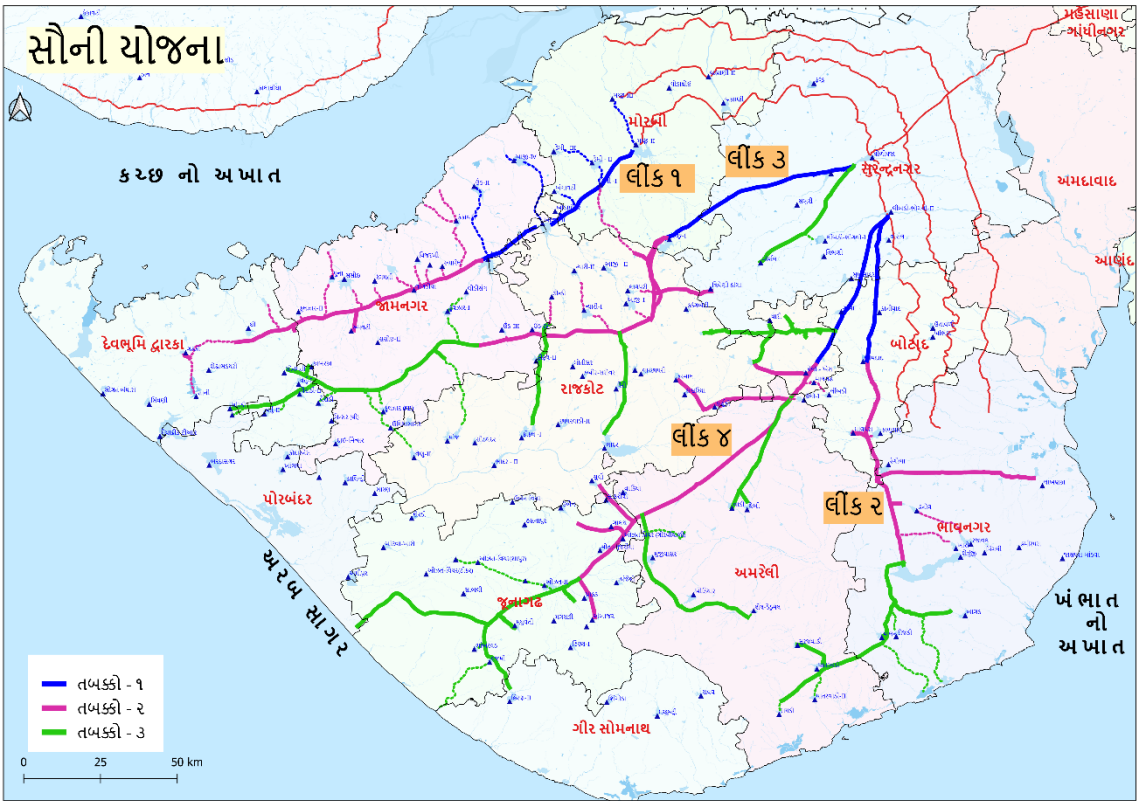


Figure 16-Map of Sauni Yojana

- Also, 85 reservoirs, 165 ponds and 963 Checkdams were filled with 56502 MCft Narmada water till December 2022. The drinking water problem of Rajkot, Jamnagar, Morbi, Surendranagar, Botad, Bhavnagar, Gondal, Jetpur, Palitana, Gariyadhar etc. cities solved too many extents.

2.1.6 Kutch Region

- It has been decided by Government of Gujarat to allocate additional flood water of Narmada to the deficient areas of Kutch. Various link / pipeline schemes based on Kutch branch canal have been planned for the use of 1 MAF of water allotted for Kutch district. Principle Approval for Phase-I has been accorded and administrative Approval for Phase-1 of 4(Four) links of Rs. 4,369.25 is under approval process. Details of 4(Four) links of Phase-1 is as under:

Table 13- Details of Pipeline/ Links in Kachchh Region

Sr. No.	Name of Link	Benefited Talukas (Nos.)	Benefited Villages (Nos.)	Benefitted Area (Ha.)	Estimated Amount (Rs. in Crore)
1	**Saran Link**	**1**	**7**	**17,000**	**750**
2	**Southern Link (Phase-I)**	**4**	**35**	**30,350**	**1675**
3	**High contour Storage Link (Phase-I)**	**2**	**20**	**15,380**	**418**
4	**Northern Link (Phase-I)**	**3**	**32**	**32,370**	**1526**
	Total	**10**	**94**	**95,100**	**4369**

- Under phase-1, 38 Medium/ Minor irrigation schemes will be filled with surplus flood water of Narmada River of Kutch District. 77 villages of 6 talukas (Rapar, Anjar, Mundra, Bhuj, Mandavi, Nakhtrana) of Kutch District will get irrigation benefits in 1,13,883 hectares of land.

2.1.7 Salinity Ingress Prevention

The State has longest sea coast line of 1600 kilometer which is about one third of total coastline of India: Owing to rapid depletion in ground water, ingress of salinity in coastal part has been a major threat rendering the land infertile. Realizing the danger lying ahead, the Government has taken up measures to arrest further advancement of salinity by taking up series of steps. These are construction of bandharas, check-dams, tidal regulators, recharge reservoirs, recharge tanks, recharge wells, nala plugging, spreading channel and afforestation.

Measures taken up so far to prevent salinity ingress include constructions of

- 101 tidal regulators/ bandharas
- 18 recharge reservoirs
- 43 recharge tanks
- 294 km Spreading Channel.

The following benefits have accrued upon completion of aforesaid works of Salinity Ingress

- The advancement of saline tidal water has been prevented due to the tidal regulators and weirs which have been completed.
- The damage occurring to the fertile agricultural land has also been stopped and the underground water being affected by Salinity earlier has also been prevented due to this.
- 132816 lands have directly to indirectly have been benefited for irrigation.
- Quality of underground water has increased and an average rise of 2.50 meters has been observed in the underground water surface.
-

2.1.8 Sujalam Sufalam Jal Abhiyan Yojana (SSJAY)

In spite of developing all the feasible sites for large, medium and minor irrigation dams, the surface water sources are stressed and huge challenges like availability of storages, distribution efficiency, quality are persistent.

Hence, an Intervention for water resource management by creating an exemplarily storages and ground water recharge in a definite time frame with direct involvement of the local people and public institutions is initiated known as **"Sujalam Sufalam Jal Abhiyan Yojana"**

A state wide initiative for Water Conservation, Sujalam Sufalam Jal Abhiyan-2018 was first initiated and taken up during 1st May 2018 to 8th June 2018.

Objectives

- Enhancing storage capacity of existing water bodies like reservoirs, Check Dams, Village Tanks, Forest Ponds, Farm Ponds; de-silting and construction /repairing of existing check dams
- Rejuvenation of Rivers
- Recharging ground water
- Enhancing agricultural productivity
- Reducing line losses from water supply systems

Utilization of excavated Soil in Agricultural land and Public Places.

Table 14-Achievement of Sujalam Suflam Jal Abhiyan

Sr. No.	Details	Achievements					
		2018	**2019**	**2020**	**2021**	**2022**	**Total**
1	Works Completed (No.)	18515	11901	11072	15210	17811	74509
2	Deepening of Ponds / New Ponds (No.)	7552	4727	4309	4814	6397	27799
3	Checkdam Desilting (No.)	4009	1766	2332	4114	4070	16291
4	Checkdam Repairing (No.)	240	949	1050	1196	1073	4508
5	Excavated Quantity (Lac Cubic Feet)	13500	10053	18511	19717	24415	86196
6	Cleaning of Drains & Canals (Km.)	6681	32600	4155	6917	6425	56778
7	Maximum Utilised Machinery in a Single Day (No.)	4699 Excavator	2621 Excavator	2817 Excavator	3007 Excavator	4943 Excavator	4993 Excavator
		15280 Tractor / Dumper	11699 Tractor / Dumper	13330 Tractor / Dumper	4555 Tractor / Dumper	18629 Tractor / Dumper	18629 Tractor / Dumper
8	Generated Mandays (No.)	77.30 Lac	22.70 Lac	30.47 Lac	26.46 Lac	20.81 Lac	177.74 Lac

Glimpse of Activities

	
Work in Progress Deepening of Pond	**Filled up pond**
	
Built up check dam Water storage in Check dam	**Check dam Construction**
	
Cleaning of Drain - Before	**Cleaning of Drain - After**

2.1.9 Participatory Irrigation Management (PIM)

- Besides providing irrigation facilities, steps need to be taken to ensure that irrigation water be distributed efficiently and equitably in the command area and that it be used efficiently through Participatory Irrigation Management (PIM).
- Where irrigation Co-Operatives maintain the canal network and field channels, expand irrigated area and distribute and provide tail enders their fair and just share of water.
- The Government has taken up initiative to involve beneficiaries and stakeholders in irrigation management by enacting PIM Act in 2007. Under the provisions of this Act, Water Users' Association (WUA) is formed from amongst the beneficiary farmers in command area of an irrigation project. 90% of cost for community mobilization is borne by the Government. Rehabilitation of canals is completed by the Government before handing over to WUAs. The WUA contributes 10% of the rehabilitation cost. Preference is given to WUA to carry out rehabilitation by them.
- Total registered WUA are 3638 Nos. provided irrigation benefits in 8.52 lakh hectare area. (As per the details of PIM Walmi)

2.1.10 Sardar Sarovar Project (SSP)

- Sardar Sarovar Narmada Nigam Ltd. (SSNNL) has been set up in the year 1988 by the State Government to implement the Sardar Sarovar (Narmada) Project.
- The Sardar Sarovar project is an intrastate multipurpose project which comprises a concrete-gravity Sardar Sarovar Dam across the Narmada River, two power stations with a total installed capacity of 1450 MW, 458km long main canal upto Gujarat-Rajasthan border and a vast canal network of 69497.40km revised estimated length for water distribution system for irrigation.
- The project is expected to provide irrigation benefits to about 18.00 lakh Ha. command area of 77 talukas of 17 districts in the state. It is also envisaged to provide water in approximately 9490 Villages and 173 Towns for domestic and industrial use. Out of which drinking water is being provided to 9104 villages, 169 cities and 7 Municipal Corporations at present

2.1.11 Vanbandhu Kalyan Yojana

- Ten Point Programme "Vanbandhu Kalyan Yojana" is launched in 43 taluka of 12 District since April, 2007 for economic, social and overall development of tribal people of the State. "Irrigation" is included as Point No. 7 in Ten Point Programme Technology oriented projects

can be taken up in areas where opportunities exist on account of higher rainfall, its inclusion in the command area of an existing project or any other potential by offering best method of irrigation to specific areas.

- Under Vanbandhu Kalyan Yojana-1 (April-2007 to March-2021) following 21,349 works shown in table has been completed and 1,56,312 Ha. area is benefitted. Due to ERM and PIM works 2,51,677 ha. area is benefitted. 5 bulk pipelines lift irrigation projects also completed and 32,907 Ha. area is benefitted.

2.1.11.1 Vanbandhu Kalyan Yojana-1

Table 15-Details of Vanbandhu Kalyan Yojana-1

Sr. no.	Name of Work	Work carried out from 4/2007 to 03/2021	
		Number	Benefitted area (Ha.)
1	Small Check dams	14,352	145650
2	Big Check dams	521	61840
3	Deepening of existing Ponds	3,548	42570
4	Lift Irrigation schemes	1,346	122720
5	Community well based Irrigation schemes	1,528	12630
6	Water shed Development schemes	54	670
	Total	21,349	3,86,080
ERM & PIM Works of canal			
1	Extension, Renovation and Modernization of Canal system	3,093	4,04,500
2	Participatory Irrigation Management	2,509	2,17,140
	Total	5,602	6,21,640
1	Big Lift Irrigation Schemes	5	32,907
	Grand Total	26,956	4,40,896

- As the tribal area is mostly high level and hilly area, most of the areas could not be supplied with water from existing irrigation schemes for irrigation.
- Hence, in order to make water available for irrigation in such inaccessible and heterogeneous areas, 13 major lift irrigation projects have been sanctioned at a cost of Rs. 5042 crores, out of which 7 projects have been completed and implemented and 6 projects are in progress.

2.1.11.2 Vanbandhu Kalyan Yojana-2

- Vanbandhu Kalyan Yojana in tribal area was started in April-2007 and under this scheme irrigation department has done significant works in tribal area and created irrigation facilities. The benefits of which are getting to tribal farmers.
- Now Vanbandhu Kalyan Yojana-2 has been planned to cover more area under irrigation in the near future. Brief details of the works included in this preliminary plan are as follows

Table 16-Vanbandhu Kalyan Yojana-2

Sr. No.	Name of Work	Detail of Work		
		Number of Work	Estimated Cost	Benefited Area (Acre)
1	Big Lift Irrigation Scheme (Running Works)	8	1999	267530
2	Big Lift Irrigation Scheme (New Works)	5	460	20200
3	Big Lift Irrigation Scheme (10 years repair and maintenance of complete works	12	600	0
4	Weir/Barrage/Big Hydraulic Structure Work construction work	75	500	25000
5	L.I. Scheme (New and Revival Works)	341	428	59700
6	Small-Big Check dam, Check dam cum Cause-way Works	1000	408	24000
7	Heightening and repair works of existing check dam	4900	400	35000
8	Dug Well / Bore Well (Group Well) works	2150	163	5375
9	Deepening of Ponds / Pond Embankment Strengthening Works	2837	280	15000
10	Canal improvement works	120	425	72000
11	P.I.M. Works	150	120	15000
12	Pazar Lake (New and Repair Works)	200	70	12000
13	Farm Pond	4000	50	5000
	Total	15798	5903	555805

2.2 Gujarat Water Resources Development Corporation

2.2.1 Ground Water Management

In order to conserve, augment and achieve judicious use of groundwater, various remedial measures on Demand side and Supply side have been taken up by Government of Gujarat. The efforts have been initiated to focus on demand side management of water in irrigation which is the largest consumer of ground water, accounting for nearly 90% of the total ground water draft in the state. Further for supply augmentation, conservation of runoff and its recharge to ground water have been taken up in an aggressive manner.

2.2.2 Monitoring Network

National Hydrology Project is being implemented in Gujarat through the World Bank assistance (2016-24) and Atal Bhujal Yojna (2020-2025). The state installed Digital water level recorders at more than 1300 sites (purpose-built piezometers) from which transmission of data has already begun to WIMS portal maintained by NWIC. For the remaining 1147 piezometers installation of DWLR are under progress. The real time information on ground water levels is being made available in public domain.

GWRDC is monitoring the ground water regime through water level monitoring and water quality sampling and providing this information to empower people informed decision making the status of monitoring network is given in the table below:

Table 17-Status of NHP Monitoring Station

Agency	**Piezometers**		**Open wells**	**Piezometers With DWLR and Telemetry**	
	Existing	Proposed			
GWRDC	1625	1147*	1418	1536	
CGWB	264	0	836	0	

*** 1147 proposed piezometers will be fitted with DWLR with telemetry**

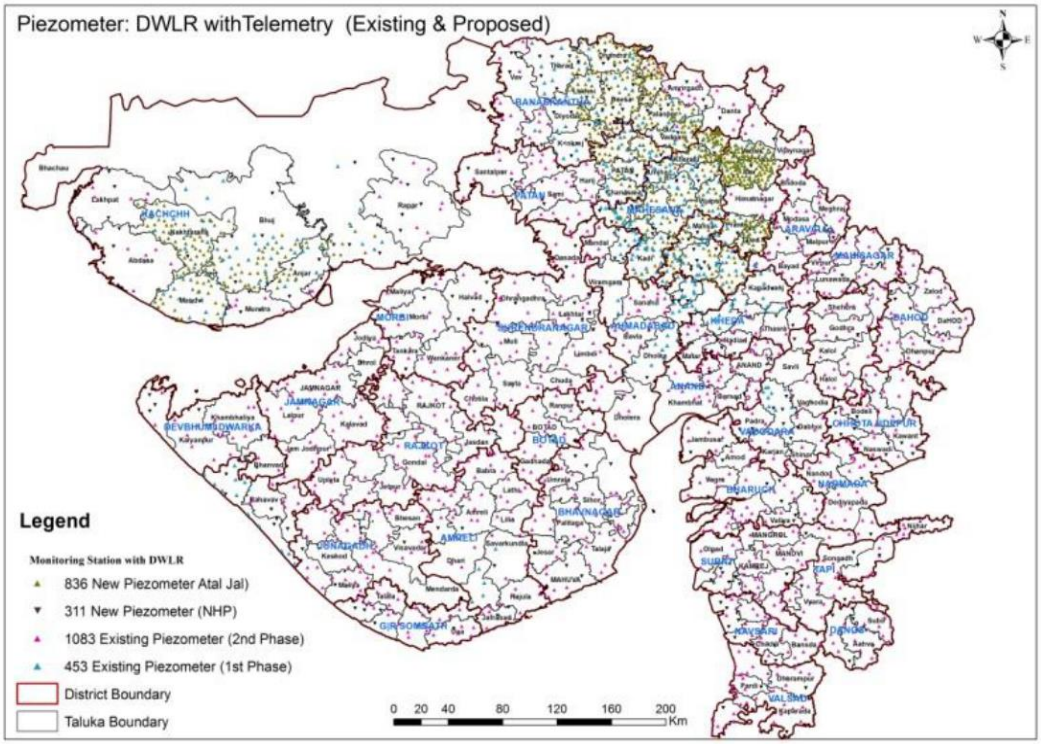


Figure 17-Exisitng and Proposed Piezometer locations

2.2.3 Demand side management

Promotion of micro-irrigation techniques such as sprinkler and drip systems for improving water use efficiency and reduce ground water withdrawal.

The micro-irrigation techniques are made mandatory from 27/03/2012 for new electric connection for withdrawal of Ground water for Agriculture purpose.

Government of Gujarat is providing 100% subsidy for introduction of micro-irrigation in the command of all the 1293 GWRDC tube wells run by various beneficiary societies.

Gujarat Green revolution Company (GGRC) is providing subsidy to the farmers

- Up to 75% - for General Farmer: Small and Marginal farmer (Land holders of less
- than 2 Hectares),
- Up to 60% - for General Farmer (Land holders of more than 2 Hectares) and o Up to 85% for SC/ST farmer for implementation of micro-irrigation.
- About 22, 04,000 Ha area is covered under Drip / Sprinkler benefitting about 13 lakh farmers. (By GGRC and GWRDC)

Under Atal Bhujal area for promoting demand side management following new initiatives have been implemented:

- Enhanced subsidy to GGRC limited at 15 % of Unit cost of the micro–Irrigation System and the total GST component.

- To encourage Crop Diversification an incentive of Rs.10, 000 per hectare has been approved for shifting high water intensive to low water intensive crop.

The department of Agriculture provides incentive for introduction of Underground Pipeline in place of existing open channel for conveyance of water in farmer's fields.

2.2.4 Supply Side Augmentation

- By promotion of rainwater harvesting and artificial recharge systems suitable for local Hydrogeological conditions, the state launched a massive drive for water conservation and ground water recharge along with watershed conservation programme. As a result of the initiatives taken by the state, construction of nearly 6 lakh water harvesting structures has been completed to harvest runoff and recharge ground water, so as to progressively enhance water resources.
    - Construction of Sujalam Suflam Spreading canal, diverting surplus water to North Gujarat Region of the state in 332 Kms length
    - Construction of 101 Tidal regulators (Bandharas) along the coastline of Saurashtra and Kachchh, preventing sea water intrusion in the river and checking river flow to the sea waters
    - Construction of 1,86,649 Check dams across the state o Construction of 3,23,268 Khet Talavadi (Farm Ponds) o Deepening of 27,799 ponds
    - De-siltation / Repair of 20799 Check Dams
    - In Sujalam Suflam Jal Sanchay Abhiyan in last Five years total 74,509 works- (Check dam, deepening of Ponds/ tanks etc.) completed.
- Surplus water from Narmada River during flood time is diverted each to North Gujarat and Saurashtra Region for filling up of ponds. 768 Ponds area filled up in North Gujarat.
- In addition to above scientifically designed recharge tubewells (~ 280 structures ongoing) are being constructed in Atal Bhujal Area by transfer of surplus surface water /canal water to water stressed Aquifers

Figure 18-Artificial Recharge System under construction - Atal Bhujal Yojana

2.2.5 Impact of Measures on Ground Water Availability

- As a result of various measures implemented by Government of Gujarat, the ground water recharge has significantly increased and there is a remarkable improvement in the status of ground water category of many talukas in the State during the last two decade.
- The utilizable Ground Water Recharge has increased by about 9500 mcm/yr in 2022, which is about 63 % increase as compared to 2002 and the overall stage of ground water development has improved from Semi-critical (75%) to safe (53 %) for the state.

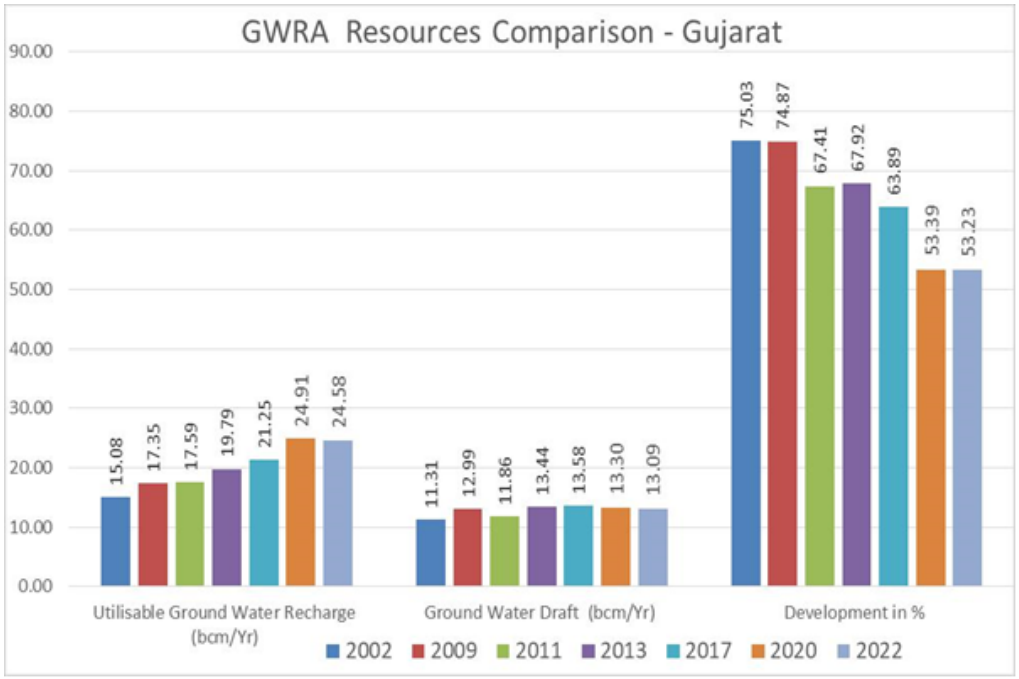


Figure 19-GWRA Resources Comparison

An analysis of the number of talukas under different categories of stage of ground water development reveals an Improvement during the period 2002-2022.

- **"Over Exploited"** talukas are reduced from **30** to **23,**
- **"Critical (Dark)"** talukas are reduced from **12**to **7**,
- **"Semi Critical (Grey)"** talukas are reduced from **63** to**20**
- **"Safe"** talukas are increased from **104** to **189** and
- **"Saline"** talukas are reduced from **14** to **13**

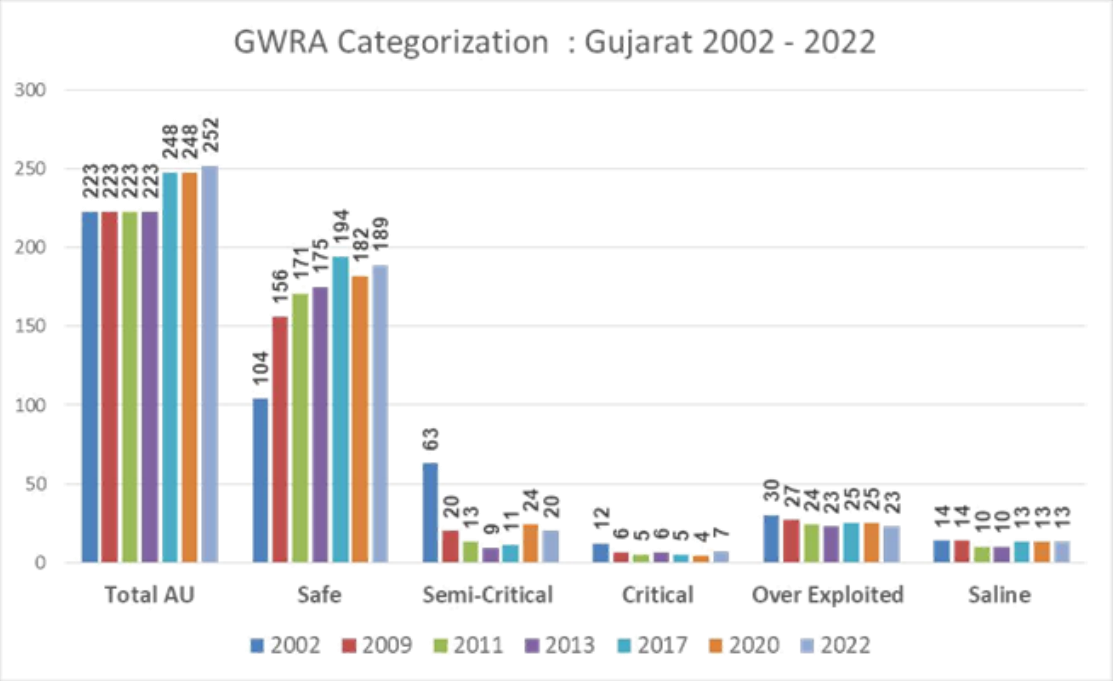


Figure 20-GWRA Resource Categorization

2.2.6 Investigation of Salinity Ingress along Coastal Area of Saurashtra & Kachchh

- In order to study the extend and degree of salinity in Ground Water in Coastal Area of Saurashtra and Kachchh Monitoring of Ground Water condition and Ground Water Quality is carried out by GWRDC (Ground Water Resources Development Corporation Ltd.) since 1985 as per recommendation of HLC-II high Level Committee appointed by Govt. of Gujarat in the year 1978 under the chairmanship of Shri K. Sivaraj, the then Chief Secretary, Govt. of Gujarat.

Table 18-Details of Salinity Ingress Study in Kachchh

Sr.No	Reach	Linear distance in km.	Profile	No. of Monitoring Stations
1	**Bhavnagar-Una**	180	31	242
2	**Madhavpur -Okha**	187	21	113
3	**Okha-Malia**	238	08	39
4	**Malia-Lakhpat**	360	12	72
	Total	**965**	**72**	**466**

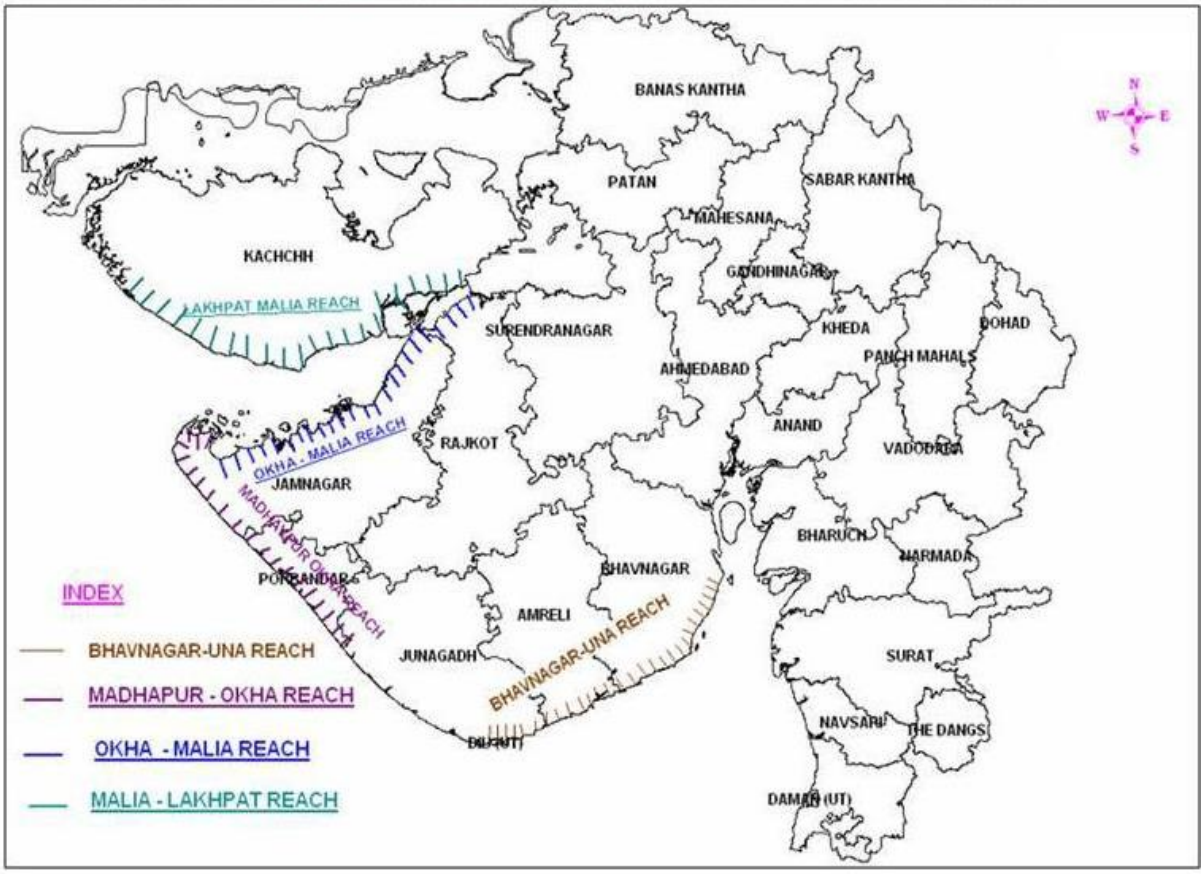


Figure 21-Reaches Covered for Investigation of Salinity Ingress along Coastal Areas

Measures taken up so far to prevent salinity ingress include constructions of

- 101 tidal regulators/ bandharas
- 18 recharge reservoirs
- 43 recharge tanks
- 294 km Spreading Channel.

The following benefits have accrued upon completion of aforesaid works of Salinity Ingress

- The advancement of saline tidal water has been prevented due to the tidal regulators and weirs which have been completed.
- The damage occurring to the fertile agricultural land has also been stopped and the underground water being affected by Salinity earlier has also been prevented due to this.
- 132816 lands have directly to indirectly have been benefited for irrigation.
- Quality of ground water has increased and an average rise of 2.50 meters has been observed in the ground water surface.

2.2.7 Atal Bhujal Yojna (2020-2025)

Under Atal Bhujal Yojana a comprehensive plan with emphasis on use of scientific inputs from aquifer mapping in watershed development for supply as well as demand side interventions through scientifically, holistically, demand driven and yet with public participation and involvement of NGOs has been taken up for implementation in a mission mode in Gujarat for the period 2020-2025.

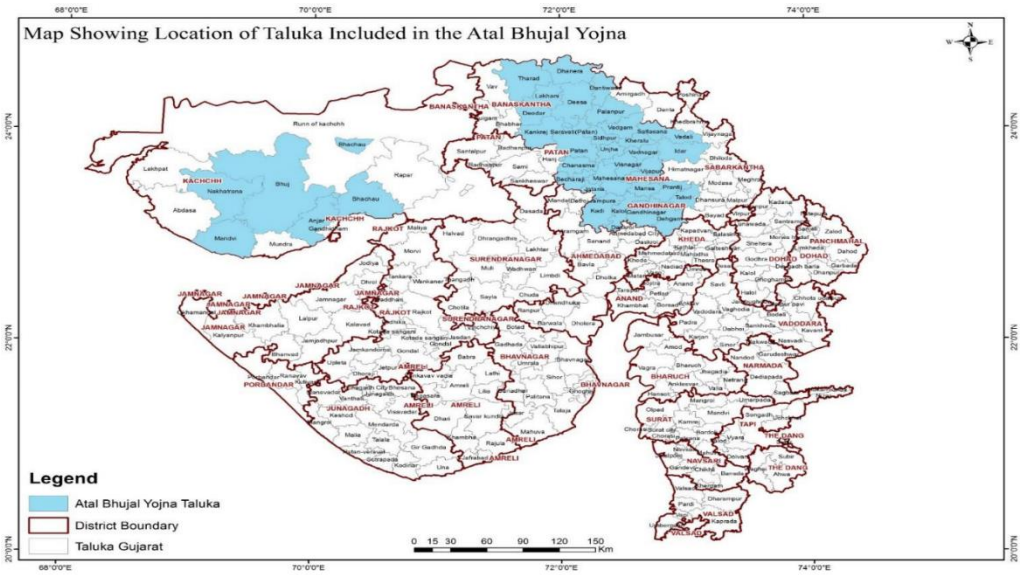


Figure 22-Map Showing Location of Taluka included in the Atal Bhujal Yojana

- This plan has a mechanism of incentivizing convergence of on-going schemes increase in area under water efficient crops and water efficient technologies in addition to data disclosure of water level, water quality and preparation of GP wise water security plans and to encourage competition for achieving targets within the stipulated time-frame.
- The scheme envisages community participation in planning, implementation and monitoring as well as to build capacity of the communities through awareness creation, training & institutional strengthening for behaviour change to ensure informed decisions & manage groundwater resources efficiently and sustainably.
- Micro-irrigation is being aggressively introduced to effect 30-70% savings in the applied irrigation water from ground water sources in more than 50,000 ha. We are proposing to scale it up. And this is the only way ahead, as we cannot possibly police lakhs of wells and tube wells through licenses and permits in Gujarat.
- Under the DLI#3 (Convergence of funds from ongoing schemes) and DLI#4(Increase in area under efficient irrigation practices) the status of achievement till date is as follows:

Particular	**FY 2021-22**	**FY 2022-23**
DLI #3	Rs.30.67 Cr	Rs144.42 Cr
DLI#4	3242 ha	15161 ha

- For awareness various activities like Nukkad, Natak, distribution of brochures , Rally, Atal RathBhraman, Mahila meeting, Prabhat Ferry, broadcasting on Government transport buses, Preranapravas, short films etc are being implemented.

2.2.8 Enactment of Ground Water Legislation:

- The Government of India has circulated a model bill in 1970 for enactment of Ground water legislation by the states and has been regularly emphasizing upon the need to enact a bill for "Conservation, Regulation, and Management of Groundwater Resources" in Gujarat. Recently in 2016, a revised model bill has been circulated for enactment by the state with a view to control and regulate the indiscriminate drawl of Ground water leading to over exploitation in certain parts of State.
- So, far 19 states and UTs have already enacted the bill.

- There has been indiscriminate development of ground water resources during the last three decades in certain parts of the state, leading to a situation of heavy ground water stress in major part of north Gujarat and Kachchh region.
- For regulation and control of Ground water extraction, CGWA is controlling the grant of NOC for Ground water withdrawal for infrastructure and industrial projects in Gujarat. 5113 industries have registered with CGWA for Ground water withdrawal.
- It is under consideration of Government of Gujarat to enact a bill for "Conservation, Regulation, and Management of Groundwater Resources".

2.2.9 Constraints

- There is a gap between the irrigation potential created and the irrigation potential utilized. As a result, even in command areas, there is significant ground water development. Apart from the underutilization of the potential, the efficiency of the irrigation systems is low at 30 percent to 40 per cent for surface water and 55-65 per cent for ground water.
- The aggressive promotion of micro-irrigation and change from more water intensive to less water intensive crop needs to be supplemented by a fundamental change in our agriculture policies, which continue to incentivize the growing of water-intensive crop like wheat, as this is the only crop on which procurement operations focus on. We cannot expect farmers to shift to less water-intensive crops like millets, mustard and pulses if they are not assured of a market at remunerative prices.
- Despite clear evidence of rising water stress, water is still used inefficiently and indiscriminately, particularly in agriculture. There is need for improvement in implementation and maintenance of projects, encouraging participatory ground water management and alignment of cropping patterns to the agro climatic zones etc.
- The Easement Act, 1882, which grants groundwater ownership rights to the landowner is one of the reasons for water over-use and depletion of groundwater levels
- Inadequate infrastructure for treatment of waste water generated from urban areas and its inefficient utilization. There is a huge opportunity for the use of nearly 1500 mcm/year of waste water generated from urban areas through recycling for use by industries and agriculture, reducing the stress on fresh ground water.
- The sustainability of the source and growing contamination of ground water in newer areas are constraints in ensuring safe drinking water supply in rural and urban areas.

2.2.10 Policy for use of Sewerage and Waste Water

Government of Gujarat has launched a Policy for Reuse of Treated waste water on 28thMay 2018, with a vision of maximizing the collection and treatment of sewage and treatment of sewage generated and reusing the treated waste water on a sustainable basis, thereby reducing dependency on fresh water resources and to promote treated waste water as an economic resource.

As per the policy, the prospective users of waste water are as follows:

- Thermal Powerplants (within a distance of 50 km from STP or city limits)
- Industrial Units (GIDC, SIR at units which are using minimum 1 lac litre of water per day for non-potable purpose)
- Construction activities
- Parks and Gardens, rejuvenation of ponds, lakes and rivers, firefighting etc.

GoG has passed a resolution for generic pricing of raw sewage and secondary treated waste water to be charged from the user which are as follows:

- Raw sewage at a token price of Rs.1.00/ KL
- Secondary treated waste water at STP outlet at 25% of prevailing fresh water rate.
- Secondary treated waste water at intermediate point or to a central point in a cluster or to GIDC at 45 % of prevailing fresh water rate.
- Secondary treated waste water at doorstep of consumer at 60 % of prevailing fresh water rate.
- To promote reuse of Treated waste water in state; GoG, has passed a resolution to provide financial aid in terms of grant of an amount up to 50 % of the cost of the reuse project shall be provided to Municipal Corporations and Urban Development Authorities.
- Projects for reuse of about 109 MLD TWW are in various stages of tender and execution. Further, projects for reuse of about 860 MLD TWW in various Municipal corporations and Municipalities are under feasibility stage.

2.4 Urban Development & Urban Housing Department of Gujarat

2.4.1 Assessment of Water supply in all ULBs

- It has been observed that there is considerable disparity in form of coverage, supply in LPCD,duration, no of days in a month etc. Municipalities' class wise summary of all important aspects of water supply can be highlighted as under:

2.4.1.1 Water supply Coverage

- Coverage of house hold level water supply network and connections in all ULBs and class wise varies from as low as 21. More than 92 ULBs out of total 165 are having coverage more than 80%. It has been noted that, areas which are not covered by pipelines in all ULBs are provided water through non pipeline means (e.g., tankers). Class wise details can be summarized as shown in below Table.

Table 19-Water supply coverage in % in all ULBs

ULBs	MC/NP	**Min**	**MC/P**	**Max**	**Coverage in % Average**
MC	Junagadh	49 %	Vadodara	100 %	85.63
Class A	Navsari	41.36 %	Vapi	100 %	73.74
Class B	Halol	38.71 %	Dabhoi	100 %	81.01
Class C	Mundra	20.56 %	In 8 cities	100 %	76.02
Class D	Thasara	35.93 %	In 7 cities	100 %	83.20
Average in all ULBs…					**79.92%**

Source: Details of SLB (2021-22) for 15th FC published in Gazette

2.4.1.2 Water supply in LPCD

- CPHEEO benchmark suggests desirable water supply level should be in range of 135 to 150 LPCD. The state average water supply per capita per day is observed 113 litres per day. There is disparity in level of water supply, in 76 ULBs water supply is less than 100 LPCD while only 32 ULBs are able to supply water supply of more than 135 LPCD. Because of the high level of dependency on Narmada water and semi-arid

zone of the state minor seasonal variations of level of water supply are also observed.

Summary of water supply in LPCD in different categories are tabulated as ahead:

Table 20-Level of Water Supply (in LPCD) in all ULBs

ULBs	MC/NP	**Min – LPCD**	**MC/NP**	**Max-LPCD**	**Average-LPCD**
MC	Junagadh	65	Gandhinagar	186	143
Class A	Porbandar	23	Deesa	157	108
Class B	Okha	39	Palitana	150	107
Class C	Umargam	28	Mehmadabad	192	97
Class D	Chorwad	57	Mandvi-Surat	193	111
	Average in all ULBs				**113**

Source: Details of SLB (2021-22) for 15th FC published in Gazette

2.4.1.3 Duration of Water Supply

- In all ULBs water supply is on intermittent type. None of ULBs supplies water on 24x7 days continuous system. More than 102 ULBs are supply water with average of 1 hour per day. Only 39 ULBs are supplying water more than 1 hour per day. Water supply duration varies from 20 minute/day to 6 hours /day. Normally, it is practice to supply once in day, however in some ULBs morning and evening water supply is also observed. There are disparities in duration of water supply across the state. The average number of hours of water supply in the state is 89 minutes (about 1.5 hours). ULB wise details of duration of water supply is shown in below table:

Table 21-Duration of water supply at all ULBs

ULBs	MC/NP	Min – in minutes	MC/NP	Max- in minutes	Average-Duration in minutes
MC	Rajkot	20	Surat	240	90
Class A	Porbandar	25	Navsari	240	95
Class B	Anjar	25	Petlad	300	69
Class C	Jafarabad	20	Chaklasi, Kadodara,Pardi	240	71
Class D	Batwa, Jamraval	20	Kanjari, Mandvi_ Surat	360	118
Average in all ULBs.					89

Source: Details of SLB (2021-22) for 15th FC published in Gazette

2.4.1.4 Frequency of Water Supply

- The average number of supply days per month is 24 days/month in all ULBs. Municipal Corporations provide water supply with an average of 25 days in a month. However, daily water supply in 5 Municipal Corporations while two municipal corporations, Jamnagar & Junagadh supply water on alternate day while Bhavnagar supplies 5 days/week. In case of municipalities, Out of total 157 municipalities, 100 municipalities have daily water supply, however, 25 cities has less than 10 days/month water supply. Details of frequency of water supply in days/month in all ULBs are as shown in Table:

Table 22-Frequency of Water Supply

ULBs	Minimum	Maximum
MC	Five days/ week- in one city	Daily - in Five cities
Class A	Every Fourth day – **in two cities**	Daily -in 11 cities
Class B	Every fifth day in Four cities	Daily -in 18 cities
Class C	Every fifth day -in Three cities	Daily -in 22 cities
Class D	Every fifth day -in Two Cities	Daily in 24 cities

Source: Details of SLB (2021-22) for 15th FC published in Gazette

2.4.1.5 Actual Water Supply

- There is not any scientific water audit is done for all ULBshowever, based on the tax data/no of connection and calculation of non-Revenuewater Unaccounted for Water (UFW) in major ULBs can be listed as below. This impacts actual supply of water reaching the consumer.

Table 23-Level of Non-Revenue Water (NRW) in all ULBs

ULBs	MC/NP	**Min – NRW %**	**MC/NP**	**Max- NRW%**	**Average-NRW**
MC	Jamnagar	7.20%	Vadodara	26.51%	18.54%
Class A	Nadiad	9.37%	Gandhidham	29%	17.83%
Class B	Himatnagar	12.67%	Borsad	29.64%	18.31%
Class C	Mundra	10.47%	Ranavav	44.12%	19.49%
Class D	Oad	12.13%	Thara	36.78%	19.93%
				Average in all ULBs.	**19.08%**

Source: Details of SLB (2021-22) for 15th FC published in Gazette

2.4.1.6 Water Treatment Facilities in all ULBs.

- In Gujarat about one third of ULBs are getting treated water from Narmada pipe lined base bulk water. For which, GWIL & GWSSB executed 181 Water Treatment Plan with total capacity of 3000 MLD at different locations more than 162. Out of eight Municipal Corporations, seven have Water Treatment Plant. Similarly, out of total 157 municipalities 48 municipalities have own functional WTPs.

Table 24-Water Treatment Facilities in all ULBs

Status	No of ULBs
Existing Functional WTPs	55
WTPs which need Up-gradation	7
ULBs without WTPs	14
Ground Water supply	13
Bulk treated Water supply	76
Total	**165**

Source: AMRUT 2.0 State Water Action Plan (SWAP),2022

2.4.1.7 Waste Water in all ULBs

- In addition to the sewerage network, Sewerage management service delivery include facets like treatment, re-use & recycle of treated sewage, redressal of customer complaints, cost recovery and adequacy to charge user charges. Together, these parameters form an integrated part of the sewerage management system.

2.4.1.8 Assessment of overall Sewerage system in all ULBs

- Status of Sewerage system in Gujarat is not very good. Out of total estimated 75,60,183 HH (year 2021) of all cities of Gujarat 58,23,996 HH are covered with underground drainage connection which amounts about 77.05% of coverage. Capacity Treatment of Sewage varies in Municipal Corporations and Municipal areas. Though total STP capacity is 4724 MLD against total generation of Sewage 4696 MLD, actual treatment is given to 3246 MLD, which is about 70% of total generation of sewage in all ULBs In Gujarat, reuse and recycling of waste water is also started with new policy in place. Presently, about 7% of total waste water collected through sewerage network is being recycled or reused.

Table 25-Salient Features of Wastewater service delivery in Gujarat during 2022-23

No	Details	Quantities
Wastewater Service in all ULBs		
1	Total No of ULBs= 157 Municipalities+8 Municipal Corporations	**165 ULBs**
2	Total population (as estimated for 2021) in urban towns of Gujarat	**3,18,46,931**
3	Total No of households (as estimated for year 2021) in urban towns	**75,60,183**
4	Total Sewerage Connected HH (as estimated for year 2021) in urban towns of Gujarat	**58,23,996**
5	Total Sewerage connection HH in % (Year 2021)	**77.05%**
6	Total Sewerage/ Sullage/ Septic tank connected HH	**71,04,924**
7	Total Sewerage/ Sullage/ Septic tank connected HH in %	**93.97%**
8	Total generation of Sewage in MLD	**4696**
9	Total Capacity of STPs in all ULB in MLD	**4724**
10	Total Treatment of Sewage in all ULBs in MLD	**3246**

Source: AMRUT 2.0 State Water Action Plan (SWAP),2022

2.4.1.9 Assessment of Sewerage network & treatment of Sewage in MC area

- Status of Sewerage network system with pumping station and allied work is good in 7 Municipal Corporations out of 8 Municipal Corporation in the State.
- Junagadh has comparatively poor performance for Sewerage system largely due to topography of the city.
- Over all status of sewerage system in Municipal Corporation can be summarized as under:

Table 26-Salient Features of Wastewater service delivery in Municipal Corporations

No	Details	Quantities
1	Total No of Municipal Corporations	**8**
2	Total population (as estimated for 2021) in MC area	**2,10,74,302**
3	Total No of households (as estimated for year 2021) in MC area	**49,17,431**

4	Total Sewerage Connected HH (as estimated for year 2021) in MC area	**44,55,433**
5	Total Sewerage connection HH in % (Year 2021)	**90.6%**
6	Total Sewerage/ Sullage/ Septic tank connected HH	**48,20,510**
7	Total Sewerage/ Sullage/ Septic tank connected HH in %	**98.02%**
8	Total generation of Sewage in MLD	**3296 MLD**
9	Total Capacity of STPs in all ULB in MLD	**3993 MLD**
10	Total Treatment of Sewage in all ULBs in MLD	**2996 MLD**

Source: AMRUT 2.0 State Water Action Plan (SWAP),2022

2.4.1.10 Assessment of Sewerage network & treatment of Sewage in Municipalities

- Status of Sewerage network system with pumping station and allied work is good not very good aera falls under Municipalities area, particularly in C and D class area. In terms of treatment, the situation is not up to the mark across the all Municipalities. However, the State has planned and started construction work to cover all municipalities to have functional STPs across all municipalities by end of 2024. Over all status of sewerage system in Municipalities can be summarized as under:

Table 27-Salient Features of Wastewater service delivery in Municipalities

No	Details	Quantities
1	Total No of Municipalities	**157**
2	Total population (as estimated for 2021) in NP area of Gujarat	**1,07,72,629**
3	Total No of households (as estimated for year 2021) in NP area	**26,42,752**
4	Total Sewerage Connected HH (as estimated for year 2021)	**13,68,563**
5	Total Sewerage connection HH in % (Year 2021)	**51.80%**
6	Total Sewerage/ Sullage/ Septic tank connected HH	**22,84,414**
7	Total Sewerage/ Sullage/ Septic tank connected HH in %	**86.45%**
8	Total generation of Sewage in MLD	**1400**
9	Total Capacity of STPs in all ULB in MLD	**731**
10	Total Treatment of Sewage in all ULBs in MLD	**250**

ource: AMRUT 2.0 State Water Action Plan (SWAP),2022

2.4.1.11 Reuse of Treated Waste Water

Urban Development Department, has launched a policy for reuse of Treated Waste Water during year 2017 which was reframed by the state on 28th May, 2018; with a vision of maximizing the collection and treatment of sewage generated, and reusing the treated waste water on a sustainable basis, thereby reducing dependency on fresh water resources; and to promote treated waste water as an economic resource. As per the Policy, the prospective users of treated waste water are as follows:

- Thermal Power Plants (within a distance of 50 km from the STP or city limits)
- Industrial Units (GIDC, SIR, all units which are using minimum 1 lac litre of water perday for non-potable purpose)
- Construction activities
- Parks and Gardens, rejuvenation of ponds, lakes and rivers, firefighting etc.
- Generic pricing for Treated Waste Water

2.4.1.12 Present status of reuse of treated waste water in the state

- Presently in the Gujarat, reuse of about **800 MLD** treated water has already started, which is being reused in irrigation, thermal power plants, gardening and industrial purpose. Projects for reuse of about **108 MLD** treated water are in tender and execution stages and projects forreuse about **860 MLD TWW** are under planning; which are implemented by various urban local bodies.

2.5 Sardar Sarovar Narmada Nigam Limited

2.5.1 Planning to complete Canal works under AIBP

Year	Physical Target (Ha)	Length (km)
Remaining	**88000**	**1224**
2023-24	81838	1140
2024-25	6162	84

2.5.2 Planning to complete sub minors under CADWM

Table 28 - Allocation v/s Utilization of Narmada Water

Year	Physical Target (Ha)	Length (km)
Remaining	**267711**	**4725**
2023-24	95000	1677
2024-25	86000	1517
2025-26	86711	1531
Total	267711	4725

Allocation v/s Utilization (During 5-Years) (MAF)								
Year	Allocation to Gujarat	Kharif	Rabi	Summer	Total	Drinking Water	Industries	Total
2017-18	5.02	1.48	2.93	0.00	4.36	1.02	0.03	5.41
2018-19	6.27	1.86	3.34	0.01	5.21	1.25	0.07	6.53
2019-20	10.73	1.17	3.52	0.46	5.15	0.98	0.06	6.19
2020-21	10.08	2.45	4.86	0.77	8.08	1.18	0.08	9.34
2021-22	7.69	1.79	4.33	0.04	6.16	1.29	0.08	7.53
2022-23	11.27	0.53	3.59	-	4.12	0.07	0.07	5.39

2.6 Gujarat Water Supply & Sewerage Board (GWSSB)

- GWSSB is a statutory body set up by the State Government for Development, Regulation and Control of the Drinking water sector in the State. The jurisdiction of the GWSSB (Board) extends to the whole state. The Board largely works for putting in place rural water supply system as well as operational management of Rural Regional water supply schemes covering cluster of villages. In this area the main function of the Board is to prepare, execute, promote and finance the schemes for supply of water for drinking purposes. The Rural water supply systems include Installation of hand pumps, mini water supply system, etc. in small habitations and piped water supply system for individual villages including large water supply system covering several villages.

2.6.1 Duties And Functions of GWSSB

The duties and functions of the Board as identified by the GWSSB Act No.18 of 1979 are identified as under:

- To prepare, execute, promote and finance the schemes for supply of water and for sewerage and sewage disposal.
- To render all necessary services in regard to water supply and sewerage to the State Government and local bodies and on request to private institutions or individuals also.
- To prepare draft State Plans for water supply, sewerage and drainage on the directions of the State Government.
- To review and advise on the tariff, taxes fees, and charges of water supply and sewerage systems, in the areas comprised within the sphere of operation of the water supply and sewerage services of the Board and in the areas of the local bodies which have entered into an agreement with the Board.
- To assess the requirements of materials and arrange for their procurement and utilization.
- To establish State standards for water supply and sewerage services.
- To review annually the technical financial, economic and other aspects of water supply and sewerage system of every scheme of the Board or the local bodies which have entered into an agreement with the Board.
- To establish and maintain a facility to review and apprise the technical, financial, economic and other pertinent aspects of every water supply and sewerage scheme in the State.
- To operate, run and maintain any water works and sewerage system, if and when directed by the State Government, on such terms and conditions and for such period as may be specified by the State Government.

- To assess the requirements for man-power and training in relation to water supply and sewerage services in the State.
- To carry out applied research for efficient discharge of the duties and functions of the Board.
- To perform such of the duties and functions, which are being performed by the Gujarat Public Health Engineering Service, as may be specified, from time to time, by the State Government.

Chapter III:

Visionary Action Plan developed by the Various Statutory State Bodies

3.0 State Water Resource Department

3.1 National Water Policy

National Water Policy is formulated by the Ministry of Water Resources of the Government of India to govern the planning and development of water resources and their optimum utilization.

3.1.1 Need of NWP

- The foremost cause is the rapid increase in population, rise in demand, urbanization and dynamic lifestyle are the challenges to water security.
- Administration and management of water resources are not addressed adequately.
- Climate change also affects the water resources in India and in the World.
- The recharge zones of groundwater are also blocked.

3.1.2 Objective of NWP

- To take cognizance of the existing situation
- To propose a framework for the creation of a system of laws and institutions
- To prepare a plan of action with a unified national perspective

3.1.3 Salient Feature of National Water Policy 2012

- Water, after meeting the pre-emptive needs for safe drinking water and sanitation, achieving food security, supporting poor people dependent on agriculture for their livelihood and high priority allocation for minimum eco-system needs, be treated as economic good so as to promote its conservation and efficient use.
- Ecological needs of the river should be determined recognizing that river flows are characterized by low or no flows, small floods (freshets), large floods and flow variability and should accommodate development needs.
- Adaptation strategies in view of climate change for designing and management of water resources structures and review of acceptability criteria has been emphasized.
- Water Users Associations should be given statutory powers to collect and retain a portion of water charges, manage the volumetric quantum of water allotted to them and maintain the distribution system in their jurisdiction.
- Removal of large disparity in stipulations for water supply in urban areas and in rural areas has been recommended.

- Water resources projects and services should be managed with community participation. Wherever the State Governments or local governing bodies so decide, the private sector can be encouraged to become a service provider in public private partnership model to meet agreed terms of service delivery, including penalties for failure.
- Adequate grants to the States to update technology, design practices, planning and management practices, preparation of annual water balances and accounts for the site and basin, preparation of hydrologic balances for water systems, and benchmarking and performance evaluation etc.

3.1.4 Priorities for Water allocation:

Ultimate goal is to preserve and enhance the availability of water resources of the State appropriately and to utilize the available water optimally. Priorities shall be allocated for utilization of water for various uses so that the same may become a guideline for all actions for planning, development and utilization of water resources. Details are as given below.

1. Drinking water
2. Irrigation
3. Hydro-power and thermal power
4. Agro- Industries and non-agricultural industries
5. Ecology
6. Navigation, Fisheries and other uses

3.2 Water Resource Data Collection and Monitoring of All departments

- **Water Resources Department (WRD)**

  For optimum utilization of available water, it should be freed for creating maximum benefits for the society. In addition, least damage should be made to the environment. Since water is required for irrigation, for man and animal, for industrial development and looking to its ever-increasing demand, water sources are required to be harnesses

  The mission of the Water Resources Department is to manage, develop, conserve and protect water and related resources in an environmentally and economically sound manner in the interest of the public of Gujarat.

- **Gujarat Water Resources Development Corporation Ltd (GWRDCL)**
  - Aims to increase Ground Water Resources through Artificial Recharge in Gujarat State
  - Micro level geohydrological investigation for each taluka considering village as a unit.

- Detailed geophysical and geohydrological investigations along coastal areas of Saurashtra and Kutch to study and suggest remedial measures to check salinity ingress in groundwater
- Groundwater study in command area of Sardar Sarovar Projects.
- GWRDC has taken up the works of L.I.Schemes considering availability of water and other irrigation facilities in particulars area.

- **Sardar Sarovar Narmada Nigam Limited. (SSNNL)**

  The Sardar Sarovar Project provides irrigation facilities to 18.45 lac ha. of land, covering 3112 villages of 73 talukas in 15 districts of Gujarat. It will also irrigate 2,46,000 ha. of land in the strategic desert districts of Barmer and Jallore in Rajasthan and 37,500 ha. in the tribal hilly tract of Maharashtra through lift. About 75% of the command area in Gujarat is drought prone while entire command in Rajasthan is drought prone. Assured water supply will soon make this area drought proof.

- **Gujarat Water Supply & Sewerage Board. (GWSSB)**

  Ensuring sustainable water supply and sanitation services in the State of Gujarat State for accomplishing the basic health and hygiene levels leading to Socio-economic Development, Communal harmony and Peace in the society.

  - To plan and implement the Drinking Water Supply and Sanitation policy.
  - To plan and implement Annual and Five-Year Programmes.
  - To co-ordinate and review all Water Supply and Sanitation programmes.
  - To co-ordinate the Water and Sanitation programmes with Govt. of India.
  - To support Water Conservation and Harvesting Programmes.
  - To formulate tariff policy and recover the water charges.
  - To decide and implement the Water Supply & Sanitation service standards.
  - To operate and maintain the Water Supply & Sanitation service standards.
  - To operate and maintain the Water Supply Schemes to develop human resources for the effective implementation of programmes.
  -

3.3 Monitoring of Water Resources

The above all the boards and department mentioned is directly causing the public benefits but not in a systematic synchronized managerial manner. The data and information regarding the served command area via various bodies is not wholly synchronized at the State level. Also, various other aspect other than command area like quantum of water supplied for various purposes like domestic, Industrial, Irrigation via these statutory bodies is not synchronized monitored. Sometimes the

command and the benefits are overlapped by the bodies and sometimes eliminated. Therefore, a complete synchronization of the data at the state levels must be attained in order to have a systematic timeline of water distribution, management and conservation.

3.4 State Water Informatics Centre

NWIC is encouraging and supporting states to establish State Water Informatics Centers (SWIC) as a state water resources data repository. The Government of Gujarat has taken up the formulation of SWIC which is in progress.

For proper analysis of data & development of analytical tools as required by the states, the requirement of demand side data and micro level data is also required. Water being state subject, the data as above is available with the respective states. However, the data available with the States is fragmented and stored in various forms across many departments/organizations of concerned states which are supposed to act as a hub for coordination, collection and validation of data pertinent to the state & its seamless integration with NWIC for carrying out meaningful analysis &development of knowledge products. NWIC & SWICs are proposed to work in a collaborative manner wherein the data available with NWIC in India WRIS & WIMS, computation resources, hardware, software and hosting infrastructure can be made available to SWIC apart from generic applications & analytical tools developed by NWIC.

The SWIC helps in providing a single window solution for comprehensive, authoritative and updated data on State's water resources and allied themes. The SWIC is responsible for the collection of data from different state departments/organizations, validating it and disseminating it through the State Water Resources Information System (State-WRIS) and developing state-specific tools and applications. NWIC shall handhold states in the endeavor by providing technical and IT infrastructure support. The SWIC coupled with India-WRIS will form a National Water Resources Data Network.

NWIC shall also support the SWICs in development of state specific applications related to water standards & software would lead to ease of data flow, seamless sharing across the nation leading to quick roll out of applications and common knowledge-based products in the most cost-effective manner. Therefore, the SWIC would not only act as hub for State Water Resources Information System but also would transform itself into Water Knowledge centers for the States.

3.5 Data Collection

1. **Temporal Data:**

Temporal data are those data related to a particular point in time or period of time. Examples of temporal data include stream flows, groundwater levels and precipitation data.

2. Water Rights Database:

The database includes information on place of beneficial use, point of diversion, allowable diversion rates and volumes, and other ancillary data

3. Well Logs Database:

These well logs include a variety of information such as: well location, drilling method, proposed use, well depth, and depth to water

4. Groundwater Levels:

Collection of groundwater level data

5. Water Use Data:

Compilation and developing a variety of water use data.

6. Spatial Data:

Spatial data governing the GIS database must be encouraged.

3.6 Measures to develop monitoring of Water Resources and its Data Collection

1. The State should encourage and support agencies and local governments in the development of electronic databases for data currently stored on paper copies and in electronic spreadsheet files, and for future data collected.
2. Data stored in spreadsheet files are more useful than data on paper, however the spreadsheet format does not lend itself to the types of manipulations possible with databases.
3. The State should create a new GIS task force of local, state and federal interests to evaluate in detail GIS issues and management needs. Their main task should be the development of a strategic plan which would address data coordination, collection and sharing needs, staffing and funding considerations, and provide recommendations to address these issues.
4. The Division of Water Planning should develop and maintain a detailed inventory of water resource datasets with Internet access to the inventory and access information. State agencies should develop and provide Internet sites for data sharing to the extent possible. If possible, a website or a separate web portal must be designed to access real time data.
5. The State should support efforts by all groups to provide GIS data information.
6. The State should encourage the development of metadata (information about the dataset) so that potential users can more easily determine the appropriateness of the data for their particular purpose.

7. The Department of Water Resources should develop and implement a groundwater quality and level monitoring network for priority basins. In some basins, water level information collected more frequently than once a year would be useful.

3.7 Sedimentation in Dams

- Sedimentation is a process whereby soil particles are eroded and transported by flowing water or other transporting media and deposited as layers of solid particles in water bodies such as reservoirs and rivers. Reservoirs created by dams on rivers lose their storage capacity due to sedimentation. As water enters a reservoir, its velocity diminishes because of the increased cross-sectional area of the Channel.
- High rates of sedimentation in many reservoirs and better care of long-term sustainability have emphasized the importance of reservoir sedimentation. The main impacts of reservoirs sedimentation are:

1. Loss of storage capacity

2. Damages to turbines and loss of hydropower production

3. Downstream impacts

4.

3.7.1 Measurements of Sedimentation

There are broadly two methods for measurement of sedimentation in reservoirs.

i) Stream flow analysis and

ii) Capacity survey

i) Stream flow analysis:

The analysis consists of two main parts:

1. Measurement of water inflows and outflows and

2. Simultaneous measurement of sediment concentration.

ii) Capacity survey:

1. Conventional method

2. Modern technique Hi-tech system

The system consists of the following components:

- Positioning System: This includes GPS Unit in differential mode
- Depth Measuring Units: This consists of Echo-sounder and Transducers
- Computer System: This includes Plotter, Printer, Disc Drive, Monitor etc.

3. Remote sensing

Currently Sedimentation analysis of 197 Dams is ongoing, out of which Sedimentation survey data of some of the major dams of state is stated in the table ahead

Table 29-Scenario of Sedimentation in major dams

Sr. No.	Dam	Gross Storage At the time of Impounding Year (in MCM)	Gross Storage 2021 (In MCM)	Silt /Erosion Index (In ham/100 sq.km. /year)	%age loss/increase in Gross Storage capacity since impounding	Annual %age loss/increase in Gross Storage Capacity
1	Dharoi	907.88	819.51	3.545	9.73	0.22
2	Dantiwada	464.39	399.06	4.076	14.07	0.25
3	Machhu-1	83.1307	81.777	0.3	1.63	0.03
4	Machhu-2	100.75	92.013	2.29	8.67	0.27
5	Panam	735.8	660.79	7.366	10.19	0.23
6	Karjan	630	581.4	9.356	7.71	0.208
7	Sipu	177.8	148.77	7.85	16.32	0.54
8	Watrak	176.202	168.493	1.87	4.38	0.12
9	Hathmati	161.31	148.753	4.221	7.78	0.16
10	Meshwo	82.12	72.368	7.104	11.87	0.22
11	Damanganga	567	521.553	6.775	8.02	0.22
12	Bhadar-1	237.86	213.172	1.8	10.38	0.18

- By department, under Sujlam Suflam Jal Abhiyan Scheme, about 21,402 ponds deepening and 12,221 check dam de-silting works are completed.

3.8 Minor Irrigation Scheme Improvement

The minor irrigation majorly comprises of Check dams, Khettalavdi,Vantalavdi,Talav etc. The improvement works of this scheme includes

- Repairs and restoration of check dams.
- Enhancement of the storage capacity.
- Deepening of the reservoir

- Increasing height of Checkdams
- Earthwork i.e., increasing height of embankment.
- Minor patch repairing works.

3.9 New Lift Irrigation Scheme with Micro Irrigation

- Micro irrigation is an irrigation method with lower water pressure and flow than a traditional flow system. Micro irrigation applies the water only to the plant's root zone and saves water because of the high application efficiency and high-water distribution uniformity.
- If managed properly, micro irrigation can increase yields and decrease water, fertilizer and labor requirements. So, by using micro irrigation system we can get more crops with less water in water scarce states like Gujarat.
- Hence in future Water resources department of Gujarat will be emphasizing on implementing new lift irrigation schemes with built-in micro irrigation in the command area which ultimately results in increasing the irrigation efficiency and thereby using water more effectively.

3.10 Annual Water Auditing

The department do take this opportunity to enhance the water auditing scenario in the state after the implementation of the Water data collection & its monitoring. The implantation strategy along with the basic concept of auditing is described below: -

- A water audit is a study of the water use of an entity. It starts at the point where water enters the premises and goes up to the point where the waste water is discharged, critically examining all aspects of use.
- The audit establishes the quantity/volume of water being used, wastage if any, leakages existing, excess use etc., and identifies areas where consumption can be reduced. It critically examines existing treatment systems and practices and recommends changes to improve efficiency and reduce usage.
- Water audit is a systematic process of objectively obtaining a water balance by measuring flow of water from the site of water withdrawal or treatment, through the distribution system, and into areas where it is used and finally discharged. Conducting a water audit involves calculating water balance, water use and identifying ways for saving water.
- Water audit involves preliminary water survey and detailed water audit. Preliminary water survey shall be conducted to collect background information regarding plant activities, water consumption and water discharge pattern and water billing, rates and water cess.

- After the analysis of the secondary data collected from the industry, detailed water audit shall be conducted, involving the following steps:
    - On-site discussion with facility manager and personnel
    - Water system analysis
    - Quantification of baseline water map
    - Monitoring and measurements using pressure and flow meters and various devices
    - Quantification of inefficiencies and leaks
    - Quantification of water quality loads and discharges
    - Quantification of variability in flows and quality parameters
    - Strategies for water treatment and reuse or direct use
- A detailed water balance shall be finally developed. Water quality requirement at various user areas shall be mapped, which helps in developing 'recycle' and 'reuse' opportunities.

3.11 Action Plan for 10 Years and 2047

Gujarat Water Vision: In the upcoming 10 years and most importantly for the year 2047, Government aims on the various objectives mentioned below:

1. To Assure to every citizen adequate and good quality water resource on sustainable basis for all usage needs.
2. To ensure per capita water availability of 1700 cubic meters Per person or sustained basis.
3. Resource adequacy
4. Supply Side Management
5. Demand Side Management
6. Source sustainability

3.11.1 Resource Adequacy

- To increase per Capita water availability from 855 cum/person to 1700 cum/person
- 100% Saturation in treatment and development of Basin and Commands (catchment).
- Encourage R&D and Capitalize on economies of renewable power to create capacity to generate desalinated water at below Rs. 15/kl cost.
- 100% recycling and reuse of waste water and effluent water.
- Additional Harvesting of excess runoff during rainy season of 1,00,000 Mcft capacity
- Desilting of all water bodies on continued basis
- Capacity building of villages as self-contained unit for water resources management.

3.11.2 Supply Side Management

- Ensure water availability for all development needs e.g., Infrastructure, Industrial, Domestic, Agriculture etc. at every village level.
- Provide 24/7 water supply for domestic water needs.
- Ensure access to a clean water body within 5 Km of residence to every household

3.11.3 Demand Side Management

- Reduce water requirement from current 6.25 Mcft to 3.25 Mcft for every 100 MT crop production.
- 100% adoption of Micro Irrigation in irrigated areas.
- Shift in cropping pattern and crop diversification through incentive and disincentive structures.
- Building Smart water transmission and distribution water system with auto heal feature.
- 100% Metering for domestic, industrial and Institutional water use.
- Incentive system for use of water metering and water audit in agriculture sector.
- R&D in technological intervention to economies use of water across all use cases.

3.11.4 Water Sustainability

- Total elimination of critical, semi-critical, over exploited zones from ground water assessment zone map in Gujarat through circular water lifecycle management.
- Integrated water security plan for state, district, block and village level.
- Rejuvenation of all existing wells/ vavadi and other water structures.
- Ensure water use audit by all users using above 10 Kl /Day water in all sectors other than agriculture. For agriculture sector, incentivize use of metering.
- Rejuvenation and pollution abatement for 100% river/streams/nala in the state.
- Behavioral change and corresponding technological interventions to economize water use.

3.12 National Hydrology Project, DSRP, DRIP & Dam Safety

3.12.1 National Hydrology Project (NHP)

- The work under NHP is carried by the department which will improve and expand hydrology data and information systems, strengthen water resources operation and planning systems, and enhance institutional capacity for water resources management.
- National Hydrology project thus strengthen the information base and institutional capacity for evidence-based decision making in water resources planning and operational management at the basin scale across India using the latest technology and tools.

- NHP contributes to the Government's Digital India initiative by integrating water resources information across state and central agencies.

3.12.2 Dam Safety Review Panel (DSRP)

- The State also deals with the work under Dam Safety inspection which is an important and integral part for sustained safety of the important structures. Guidelines for Dam Safety Inspection published recently, cover all aspects related with dam safety inspections which are required to be conducted by dam owners at regular interval by Dam Safety Review Panels (DSRPs) for comprehensive inspections.
- Ministry of Water Resources (MoWR) has taken an initiative and directed CWC to empanel dam safety experts for assisting all dam owners. DSRPs comprising experts in different disciplines associated with dams are being constituted by each State and other dam owners.

3.12.3 Dam Safety Act 2021

- On December 13, 2021, the Dam Safety Act was implemented by Government of India by notification in the Official Gazette dated 14th December 2021.
- State Dam Safety Organisation (SDSO) has to be formulated in order to carry out dam inspection related services in the State. The Government of Gujarat has formulated the same. It facilitates & provide for surveillance, inspection, operation and maintenance of the specified dam for prevention of dam failure related disasters and to provide for institutional mechanism to ensure their safe functioning and for matters connected therewith or incidental thereto.

3.13 Gujarat Water Resources Development Corporation

- Gujarat needs to aggressively promote rainwater harvesting and recharge to ground water as well as watershed development based on scientific inputs from National Aquifer Mapping Program through convergence of the activities of various agencies in the state implementing water conservation programs under MGNREGA, PMKSY(IWMP), SSJA etc.
- Gujarat needs to aggressively promote MIS through use of drip and sprinkler irrigation as a demand side intervention to effectively reduce the indiscriminate ground water application through conventional irrigation methods of flooding. In addition, shifting from more water intensive to less water intensive crops in water stressed areas of North Gujarat and Kachchh regions for sustainability of ground water resources.
- Of course, this needs to be supplemented by a fundamental change in our agriculture policies, which continue to incentivize the growing of water-intensive crop like wheat, as this is the only crop on which procurement operations focus on. We cannot expect farmers to shift to less water-

intensive crops like millets, mustard and pulses if they are not assured of a market at remunerative prices. The best way would be to make millets and pulses, the nutritionally superior options, an integral part of the ICDS and MDMS programs for children and focus our procurement operations more and more on these crops, creating a win-win for all.

- Promoting FPOs (Farmers Producer organizations) holds an important promise in facilitating gaps in value supply chain for grading, processing, packaging and sale of crops of farmers at remunerable prices. The agri-value chain integrates small holder farmers with other value chain actor that allows an access to quality input, technology and technical assistance, better quality standards as well as hassle-free credit linkage. Within an agree-value chain, a series of actors are linked by flow of products, finance, information and other related services. The support of FPOs can be considered for implementation through agriculture department working as a nodal expert agency for proper utilization of funds.
- Use of huge quantities of waste water from urban areas after treatment. Presently Sewage generation in urban areas is about 5013mld (1829 MCM/yr.), while the installed treatment capacity is 3378mld (67 %) with 70 STP's but the operational STP's are 69, treating about 3358mld of the sewage generated (99%). The untreated sewage constitutes 1635mld (597 MCM/yr. ~33 %). Industries are being encouraged to meet a major share of their demand through recycled water. Besides, programs for smart water meters and tradable permits for use of recycled water may be launched.
- We must not continue to place groundwater and surface water in separate silos. we cannot manage water like that. Water is one and needs to be understood in all its integral inter-connections. For example, one of the biggest tragedies faced in recent times is the progressive dwindling of flows/ drying up of its rivers. When we look at our major rivers, we realize that their post-monsoon water flows come from the base-flows provided by groundwater. One of the largely unnoticed consequences of over-extraction of groundwater has been to completely dry up these base flows, which used to feed our rivers after the monsoon was over.
- The main focus of the work should lay particular emphasis on aquifer management. The professionals must work shoulder to shoulder with other partners, in a multi-disciplinary perspective, to devise solutions to water problems, in a citizen-friendly manner.

- Urgent need to enact ground water legislation for ground water management in the state as large parts of the state are under ground water stress.

- The CGWB will complete coverage of all the 33 district of Gujarat under National Project on Aquifer Management (NAQUIM)phase–I. Under this project identification and mapping of Aquifers on 1:50,000 scale, three-dimensional Aquifer maps, quantifying available resource potential and plans appropriate to the scale of demand and Aquifer management plan has been prepared.

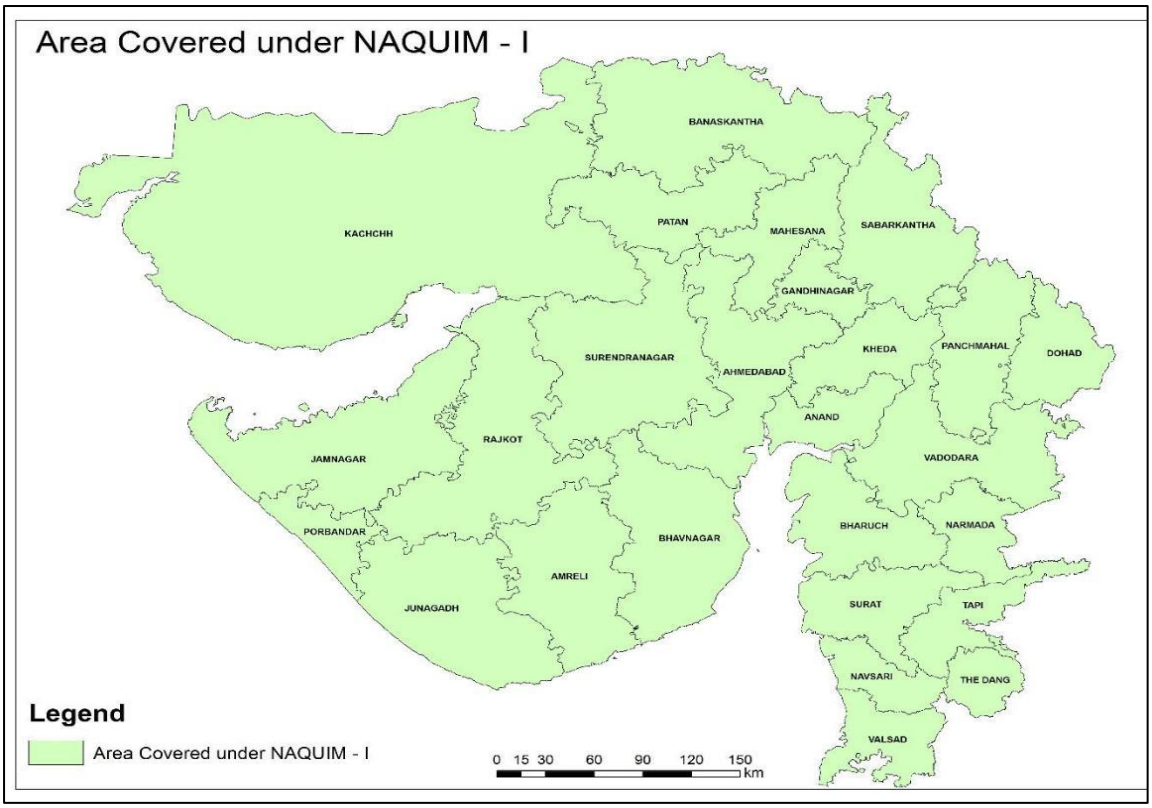


Figure 23-Map Showing Area Covered under NAQUIM-I

- Under NAQUIM phase-II,which aims at providing scientific inputs for ground water management at Panchayat Level on 1: 10,000 or larger scale with higher granularity, the GWRDC has suggested taking up of following work programs on priority in Gujarat by CGWB from Field Season Program 2023-24 onwards.

Table 30- GWRDC Suggese Work Programs

Priority Areas	**Objective**	**Suggestions from GWRDC**
Over-exploited Areas	Village wise ground water resource assessment, categorization and	Banaskantha, Deesa taluka

Priority Areas	Objective	Suggestions from GWRDC
	development of implementable management plans	
Urban	Identification and protection of Recharge	Ahmedabad &
Agglomerates	Areas, Identification of potential aquifers for drinking water supply and source sustainability	Gandhinagar Urban area
Coastal Areas	Protection against saline ingress	Vedha Tidal Regulator, Gandevi Block, Ambika River basin efficacy
Industrial Clusters and Mining Areas	Declining water levels. Changing ground water quality	Padra **Taluka,** Vadodara district
Areas with Deeper Aquifers	Annual/Seasonal recharge and discharge of the aquifers, Potential for drinking water supply, Potential for carbon sequestration, Management of confined aquifers	North Gujarat Aquifers (Banaskatha district)
Ground Water Quality Hotspots	High density mapping of ground water quality	Padra Taluka , Vadodra district
Areas with poor ground water availability	Identification of potential aquifers Zones, Identification of Sites for aquifer recharge, Scope for hydro-fracturing	Hydro-fracturing Study-Hard rock terrain in Eastern and Southern Gujarat (Dang), Arid part areas Western of Banaskantha Mehsana and Kachchh
Area identified by States for detailed mapping	Demand driven studies like-development of new cities, waste disposal sites etc.	Gift City Gandhinagar for development of new cities.
Command Areas	Conjunctive use planning	Ukai-Kakarapar Canal in Surat and Bharuch districts.

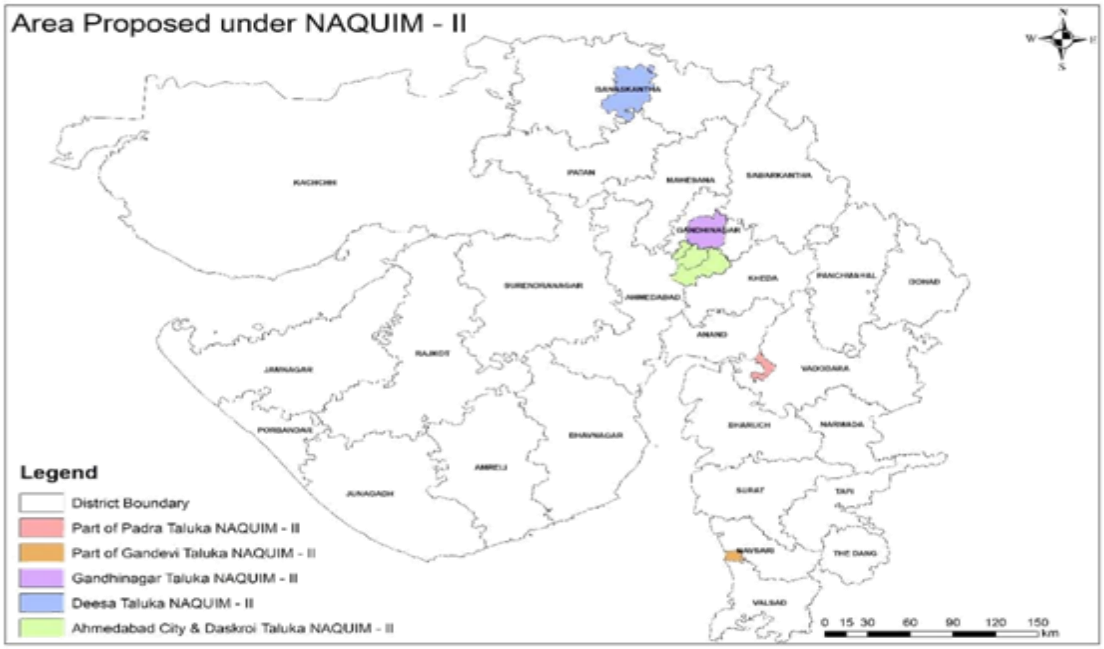


Figure 24-Map Showing Area proposed under NAQUIM-I

3.13.1 Expansion of Atal Bhujal Yojana

- Based on the experiences of water budgeting and formulation of water security plans and implementing the demand and supply side interventions in Atal Bhujal Yojana in Gujarat, it is under consideration of the state Govt.to implement a scheme of Ground water management on a similar pattern in another 15 water stressed talukas in parts of Central Gujarat and Saurashtra during 2024-2029 at an estimated cost of Rs. 128.17 Cr. The details of the talukas are as follows:

Table 31-Taluka Wise Details of Atal Bhujal Yojana

Sl.No.	District	Water Stressed Assessment Unit	Stage Of Development	Stage Of Development
1	Amreli	Rajula	92.14	Critical
2	Junagadh	Keshod	66.66	Safe
3	Junagadh	Bhesan	71.22	Critical
4	Rajkot	Dhoraji	78.02	Critical
5	Porbandar	Porbandar	64.61	Safe
6	Vadodara	Sinor	78.93	Semi-Critical
7	Rajkot	Jasdan	96.10	Critical
8	Vadodara	Padra	94.31	Critical
9	Rajkot	Vinchhiya	82.35	Semi-Critical

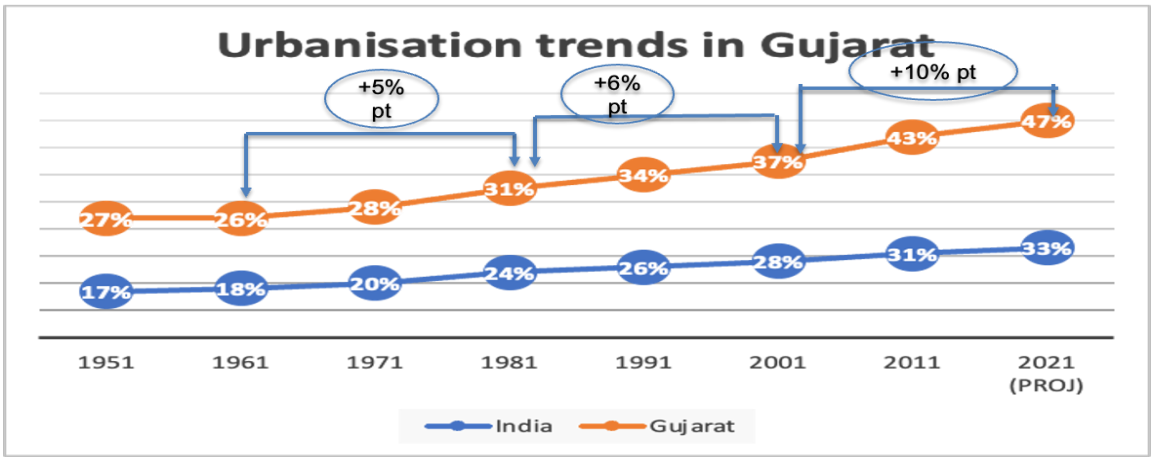
Sl.No.	District	Water Stressed Assessment Unit	Stage Of Development	Stage Of Development
10	Vadodara	Desar	79.16	Semi-Critical
11	Gir Somnath	Una	65.91	Safe
12	Sabarkantha	Himmatnagar	75.28	Semi-Critical
13	Junagadh	Visavadar	36.06	Safe
14	Vadodara	Vadodara	96.73	Semi-Critical
15	Kheda	Galteshwar	72.81	Semi-Critical

3.14 Water Supply & Waste Water in Urban Gujarat

3.14.1 Future Requirements of Water supply in all ULBs:

The State of Gujarat is urbanizing at a rate higher than the national average; The share of urban population has grown from 22% in 1901 to 47% in 2021, making it the third most urbanized state in the country. If we analyze the trends, it found interesting pattern at every two decades. During first two decades i.e., in between 1961- 1981 urban population increased by 5% point, which was seen at rate of 6% point during the second two decades means between 1981-2001. With having risen of 10% point in third spans of two decades i.e., 2001- 2021 it is being observed rise of 10% point. Trends over next two decade suggest rise of 20% that means of 67%. This forecasts, urban population of Gujarat will have about 67% urban with 3,83,00,000 urban resident in 2041 and 4,08,91,000 urban resident in year 2047.

Gujarat Urban population projection can be forecasted as under



Therefore, total water demand in all ULBs of Gujarat , considering 140 LPCD and 15% losses, can be assumed as under:

Year	Population	Coverage in %	Losses in %	Water supply in LPCD	Total Water demand in MLD	Remarks
2021	**3,18,46,931**	85%	22%	110	3633	Present Estimated population
2025	**3,34,39,278**	100%	15%	140	5384	Forecasted Population with 100% Coverage & 140 LPCD WS
2031	**3,50,31,624**	100%	15%	140	5640	
2041	**3,82,16,317**	100%	15%	140	6153	
2047	**4,08,91,459**	100%	15%	140	6584	

3.14.2 Strategies for Water Supply System:

The Strategic Plan for the year 2025 envisages to ensure daily water supply with minimum 140LPCD in all cities of Gujarat. The target is to achieve assured water supply to the residents in adequate quantity, quality, at sufficient pressure.

The focus will be on –

- Creation of alternate sources of water for ensuring reliability and sustainability
- Reduction in Non-Revenue Water through better maintenance of connections to reduce losses due to leakages and through monitoring and metering to reducerevenue loss due to water theft.
- Up-gradation of existing assets
- 100% metering to ensure efficient billing
- Provision of professional operations and management to ensure efficient billing and revenue collection.
- Effective recharging of ground water
- Promote rainwater harvesting

This will be achieved through following Strategies.

3.14.2.1 Integrated Water Management & Augmentation Plan for the State

Preparation of Long-term detailed Water Management Plan covering all ULBs ofGujarat. The management plan shall be designed so as to ensure water supply infrastructure

provision's matches need of all citizens of all Cities of Gujarat. It shall envisage extension, augmentation and refurbishment of the system in an effective and efficient manner.

3.14.2.2 Water Supply Operation & Maintenance Plan and Standards Operating Procedure

The plan will be designed largely by involving Private Sector for O & M operations. It is also suggested to have Sop for all ULBs. This ensures equal level of standard in all ULBs

3.14.2.3 Improving water use efficiency and reducing UFW in water supplysystems

It is proposed to ensure to reduce UFW & illegal connections across allULBs of the State. By 2025, total UFW in all ULB shall not be more than 15%

3.14.2.4 Preparation of technical & financially viable options

Water is the main issue for Urban Gujarat and people of Gujarat aways put it at the first priority, this shows the sector must be addressed in very much planned manner particularly in OG area around all cities. Simultaneously, preparing an integrated technical & financially feasible sectoral Water plan for all OG area will fulfil this.

3.14.2.5 Institutional Strengthening & Capacity Building

In order to cost effectively and customer focused manner the officials & Officers must be trainedfor Project Planning, Implementation, Monitoring and Evaluation programs. It is recommended for strong database and making strong redressal system in all ULBs of Gujarat and minimizing unaccountable losses

3.15 Sardar Sarovar Narmada Nigam Limited for the upcoming years.

3.15.1 Next 10 years plan

It is considered most effective to adopt GIS based Software suit like ArcGIS Enterprise with needful extensions for effective water management in the SSNNL command area. Detailed activities considered are as under:

3.14.1.1 Supply Side Interventions:

- Installation of gate sensors and flow-meters at strategic locations along the canal network.
- The Narmada main canal and branches at their HR will first be covered within 1 year.

- To gather information on water being supplied in each village (and then for each survey number) to do better water management at the lowest level to have overall effective water management.
- Using the GIS information in strategizing canal maintenance and/or rehabilitation /ERM planning.
- Sardar Sarovar Reservoir water storage variation, inflow pattern analysis and preparing best water use plan in scare water year.
- Sardar Sarovar Reservoir sedimentation analysis and deposition area identification for action plan to take mitigation measures.
- Complete water accounting & water auditing through compilation of water release data for industrial, domestic and irrigation purpose
- Use of data available in accurate billing.

3.14.1.2 Demand Side Interventions:

- GIS based actual irrigated area assessment and corresponding irrigation water usage.
- Identifying crop wise area sown and yield projection for crops.
- Use of GIS in predicting command area that can be served with available water.
- Monitoring stressed crop areas to plan water release to save crops using NDVI (Normalized Difference Vegetation Index) index.
- Assessment of water logging areas to decide irrigation strategy in those areas and to divert saved water to needy areas.
- Identification of non-agricultural areas and areas with non-irrigated agriculture in practice to assess the water saving for these areas. The saved water can be planned to be used elsewhere.
- Continuous monitoring of land use change patterns to identify water needs assessment in domestic, industrial and irrigation sectors.

3.14.1.3 Water User Association Related Activities

- Incentives to WUAs which have taken up PIM effectively:
- Increasing rebate to WUAs from present 50% to 75%
- In the form of Cash prizes
- Salary to Office Bearers
- To form Irrigation Advisory Committee for Distributary level canals to decide irrigation scheduling and PIM matters
- Jalmitra cadre staff may be deployed from the concerned villages to help do PIM

- Effecting encumbrance to 7X12 records for outstanding irrigation water charges by giving powers to Ex. Engineers to pass an order
- Giving Voting writes to WUAs as an entity in local elections of self-government institutions
- Irrigation Water charges to be kept with Narmada Dept. for supporting WUAs and PIM
- Priority allocation of solar pump related subsidy to WUAs
- To make Agricultural Universities to include WUA functioning and PIM awareness in curriculum

3.15.2 New practice Plan

- Implementing pilot project in 8 pockets of north Gujarat for micro-irrigation systems to conserve soil productivity.
- Making the canal network ready to impart pressurized irrigation or micro-irrigation as per policy decisions taken
- Advising command area farmers in organized agriculture using predictive output of GIS datasets for water availability and meteorological parameters in each area.

3.15.3 Water Management for increasing irrigated area

- The actions mentioned above collectively would provide better water management to avail more water for covering more irrigated area.

3.15.4 Piped Network Benefits

- States like Madhya Pradesh, Karnataka and Andra Pradesh are implementing pressurized irrigation networks using SCADA to have more crop per drop and lesser water wastage compared to the traditional flooding irrigation technique.
- It is considered to wait for at least 3 years to get the systems in place for proper assessment of the actual benefits reaped and issues observed in that system.
- In the Sardar Sarovar Project command area, the network in Kutch branch canal command is largely piped network. It is planned to provide irrigation through Kundis at 8 to 10 Ha outlet (Sub-chak) of each sub minor serving 40 to 60 Ha area. It would be very useful to study the performance of this piped network vis-à-vis performance of pressurized irrigation network in other states, before adopting that in Gujarat.

3.16 Gujarat Water Supply and Sewerage Board

The state's vision for drinking water sector is based on three priority areas aligned with the blueprint of India@100 of Government of India. These priority areas are

1. Inclusive & sustainable development

2. Water security
3. Digital transformation

The state will rely on technology-driven and knowledge-driven planning & development to achieve the following objectives:

1. To ensure safe, reliable and affordable drinking water for all and provide stable water supply through a pan Gujarat water supply bulk pipeline grid.
2. To create systems and policies towards effective, efficient and sustainable use of water to reduce poverty, improve human health and promote economic development.
3. To ensure that water is managed in an environmentally responsible and sustainable manner.

3.16.1 Growth areas of Gujarat

The government, in recent years provided an increased impetus for infrastructure development and investment through the enhancement of capital expenditure. Increasing economic activities, new industrial clusters/ parks and higher urbanization together have been significantly contributing to the growth story of Gujarat.

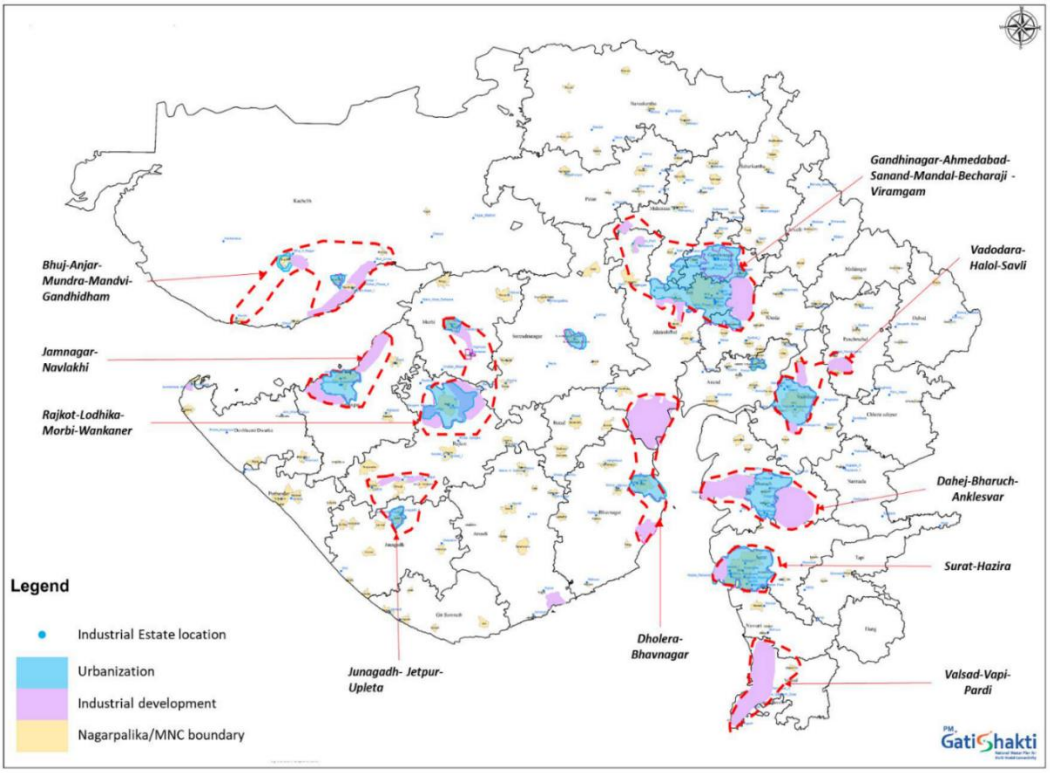


Figure 25-Map showing Urban and Industrial Corridor of Gujarat

Further, the Government of Gujarat enacted the SIR Act in 2009 in its initiative to create large size Investment Regions/Industrial Areas and develop them as Global Hubs for economic

activity supported by world class infrastructure. Gujarat is the only state in India to have enacted a Special Investment Regions Act. Twelve SIRs were proposed later with an extent of 2,62,400 Ha of development.

Clusters such as Dholera SIR, Mandal Becharaji SIR, PCPIR Dahej, Refinery Park near Jamnagar, Halol- Savli SIR will catalyse the formation of growth corridors across the state. The following corridors have been identified as potentially high demand areas by 2047:

- Gandhinagar- Ahmedabad- Sanand- Mandal- Becharaji- Viramgam
- Dahej- Bharuch- Anklesvar
- Dholera- Bhavnagar
- Bhuj- Anjar- Mundra- Mandvi- Gandhidham
- Surat- Hazira
- Vadodara- Halol- Savli
- Jamnagar- Navlakhi
- Rajkot- Morbi- Wankaner- Lodhika
- Junagadh- Jetpur- Upleta
- Valsad- Vapi- Pardi

3.16.2 Norms adopted for Water Demand Projection for Gujarat

- **Metropolitan Areas:** 150 LPCD has been adopted for urban areas with population more than 1 million.
- **Urban Areas:** 135 LPCD has been adopted as per the benchmark suggested by MoHUA & WHO.
- **Rural Areas:** The Jal Jeevan Mission's mandated a minimum of 55 LPCD of water supply in rural areas. However,
- Gujarat has adopted a higher water supply rate of 100 LPCD in rural areas.

Metropolitan and urban areas will witness rapid increase owing to migration for better economic opportunities and the effect of proposed Special Investment Regions. It is estimated that the **population will increase by 2.1%, 1.6% and 0.2% CAGR** in Metropolitan, Urban and Rural areas respectively. Further, **Industrial areas will increase at a blended rate of 8.4%** CAGR till 2047.

The projections for water demand as per the norms (Metro- 150 LPCD, Urban- 135 LPCD, Rural- 100 LPCD). By 2047, Gujarat's **total water demand is estimated to be 1.5-1.6 times** the demand in 2022. The Urban (including metro cities) will account for more than 60% of this demand and Industrial demand will account for ~20% of the state's total water demand.

3.17 Micro Irrigation (GGRCL)

While the GGRC model has proven to be highly successful, there are still some challenges that need to be addressed. Firstly, despite the significant progress, there is scope for further increasing the adoption of micro irrigation, especially in cereals and sugarcane crops. Awareness campaigns targeted at these crops' water-efficient practices and financial incentives could encourage more farmers to switch to micro irrigation.

Secondly, timely and adequate maintenance of the micro-irrigation systems is crucial for their long-term sustainability and optimal functioning. Farmers should be educated about the importance of regular maintenance and be provided with the necessary training and support.

Thirdly, as climate change becomes more pronounced, there might be variations in rainfall patterns, leading to increased demand for efficient irrigation methods. The GGRC should be prepared to adapt to such changes and continue promoting sustainable agriculture practices.

The success story of micro irrigation in Gujarat, driven by the Gujarat Green Revolution Company Ltd. (GGRC), showcases the potential of specialized and focused implementation models in transforming the social sector landscape. The formation of GGRC as a Special Purpose Vehicle, involving the collaboration of leading companies in the sector, has proved instrumental in increasing the adoption of micro irrigation significantly.

The impact of micro irrigation on water conservation, increased productivity, and the socio-economic well being of farmers in Gujarat has been profound. The state's agricultural growth and prosperity have been bolstered by the widespread adoption of micro irrigation, which has led to increased income and water-use efficiency. The GGRC model presents valuable lessons for other states in India to emulate and scale up micro irrigation adoption as a sustainable agricultural practice. With adequate awareness campaigns, financial incentives, and consistent efforts, India can achieve water security, food security, and rural prosperity through the adoption of micro irrigation technologies.

3.18 Kalpsar Department

3.18.1 Bhadbhut Barrage Project

Government of Gujarat has decided to construct a barrage structure with bridge on its top along with Flood protection embankment of Total @42km length on both bank of Narmada River

near Bhadbhut village of Bharuch district with the aim to gain multiple benefits like preventing salinity ingress by restricting intrusion of brackish sea-water along with storing the potable fresh water, prevention of erosion of cultivable land, protection against flood, and reduction in travel distance. The Administrative Approval for Bhadbhut Barrage Project of Rs.5322.19 crore have been given and construction work of project is under progress. It is planned to complete the project by October-2026.

The plan showing location of barrage & FPE is as below:

Figure 26-Location of Bhadbhut Barrage Project

3.18.1.1 Quantum of water available

On completion of the project, a fresh-sweet water reservoir of having capacity of 599 MCM will be available which will be helpful to improve ground water quality upto Shukltirth on u/s of barrage and will become a source of water supply for drinking, agriculture and industrial purposes.

3.18.2 Kalpasar Project

Government of Gujarat has envisaged to create world's largest man-made fresh water reservoir in sea by constructing 60.13 KM long dam across the Gulf of Khambhat between Paniadara village of Bharuch district on the eastern side and Bhavnagar on the western side. This reservoir will store about 7800 MCM of surface water from various contributing rivers i.e, Sabarmati, Mahi, Dhadhar, various Saurashtra rivers (i.e., Limbadi Bhogavo, Vadhwan Bhogavo, Utavali, Keri, Sukhbhadar, Ghelo and Kalubhar) and Narmada River through Narmada Diversion Canal.

3.18.2.1 Quantum of Water Available

At 50% dependability about 7800 million Cubic Meter (MCM) of water is expected to be available at the proposed reservoir. From which about 4375 MCM of water is planned to be utilised for irrigation purpose, about 1000 MCM for domestic use purpose and about 450 MCM for industrial use purpose.

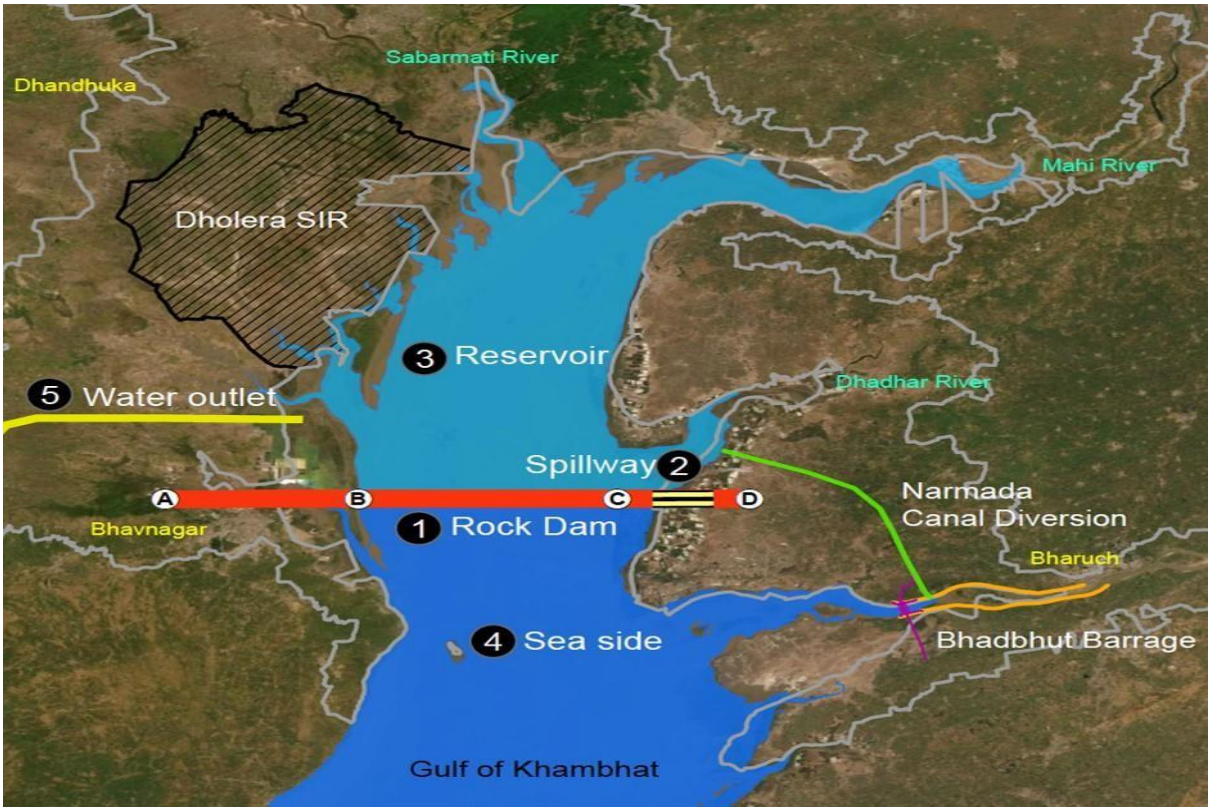


Figure 27- Location of Kalpasar Project

3.18.2.2 Irrigation System Envisaged

It is planned to irrigate Saurashtra region by constructing a network of lined canals and underground pipelines. Kalpasar canal system is expected to serve 42 talukas of 9 districts of Saurashtra, totalling to 9,99,611 hectare command area. It is also planned to firm up existing water resource schemes along the main canal alignment. To increase efficiency of the system, the whole irrigation system is planned as 100% Micro Irrigation System.

3.19 Water Sourcing & Availability

- Currently Gujarat relies on four types of sources: a) Narmada based, b) Local sources (rivers, dams etc), c) Reclaimed municipal wastewater and d) desalinated sea water.
- There is a need to identify new water sources to cater to the **source gap of 6,483 MLD** which will be created by 2047. This gap is estimated to be 3,700 MLD by 2035.
- The state will look to diversify its existing water sources and aim to become water secure.

3.20 Way forward & Vision

Description	2022	2030	2035	2040	2045	2047
Domestic Demand	8,892	10,075	10,716	11,314	11,869	12,079
Metro	2,760	3,415	3,782	4,149	4,516	4,663
Urban	2,338	2,699	2,924	3,150	3,375	3,465
Rural	3,794	3,961	4,009	4,015	3,977	3,950
Industrial Demand	1,128	1,715	2,074	2,543	3,157	3,452
Total Water Demand	10,020	11,790	12,790	13,857	15,026	15,531
Existing & Proposed Sources	9,048	9,048	9,048	9,048	9,048	9,048
Total Source Gap (MLD)	972	2,742	3,742	4,809	5,978	6,483

Note: All figures in MLD

3.20.1 Leveraging alternate water sources

- **Desalination of sea water:** The state shall aim to increase the capacity of desalination to cater at least 10% of its total water demand in 2047. This will mean **adding ~1500 MLD of desalination plants** across the coast of Gujarat. These desalination plants may be proposed at the high growth clusters identified such as Navlakhi, Kachchh, Maliya/ Morbi, Dholera, Dahej, Surat and Valsad.
- **Treated municipal wastewater:** The state's urban areas will generate wastewater in excess of 9,000 MLD by 2047. The state will thrive to reuse 50% of the municipal wastewater to cater to the non-potable uses. Large municipal corporations/ cities provide excellent opportunity of recycling used water due to the quantum of sewage generated by them and presence of sewage collection network.

- **Non-conventional water sources:** Sources such as water generated from air, stormwater water harvesting, development of aquifer storage reservoirs (ASR) etc. may be explored.

Source	Existing Capacity (MLD)	Additional Capacity (MLD)	Remarks
Narmada based	3,600	2,083	Additional allocation will be required to the tune of ~2100 MLD. Condition: 3000 MLD and 1400 MLD reuse and desalination capacity is created
Local Surface Water Sources	4,000		A detailed source reliability and sustainability assessment shall be carried out for existing sources
Treated Wastewater (Industrial use) *	1,078	3,000	Apart from existing and under implementation projects, 3000 MLD reuse capacity must be added to cater the industrial/non-potable water demand
Desalinated Sea Water*	370	1,400	Apart from existing and under implementation projects, 1400 MLD capacity must be added in the coastal region of the state
Total	**9,048**	**6,483**	**15,531**

3.20.2 Building sustainable water infrastructure

3.19.2.1 Demand management

- Metering of all connections to ensure judicious use of water.
- Strategizing steps for non-revenue water reduction.
- Tariff sustainability: Affordable water for marginalized communities, cross subsidizing domestic water tariff by commercial and industrial tariff adjustments.

3.19.2.2 Diversification of water sources to become a 'water secure' state

3.19.2.3 Sustainable operations & enhanced monitoring

- Formulating state-wide O&M policy for water supply systems.

- Enhancing monitoring by IoT based sensor to monitor quality, quantity and service levels at multiple levels and scale.
- Regular water audits and non-revenue water investigations and relevant interventions to reduce unauthorized water connections and leakages.
- Mandating interventions like Zero Liquid Discharge in medium and large-scale industries to reduce dependence on fresh water source.
- Improvements in building byelaws to promote recycling of used water and water conservation. For example, use of plumbing fixtures such as dual flushing cistern.

3.20.3 Promote & replace traditional methods of irrigation with micro Irrigation techniques

To achieve the same, it is to be targeted in available irrigated area as well as newly created individual water sources. Also, Micro Irrigation in SSP Command as well as other small and Medium Irrigation scheme Command area:

Need to implement Micro Irrigation using Surface Water in Project Mode

1. Lift Irrigation schemes
2. Minor Irrigation schemes
3. Sardar Sarovar Project
4. Other Medium and Major Dam command

The area covered under Micro Irrigation from 2005-06 to 2023-24 (Jan-24) is 22.92 lakh hectares. Considering the Vision – 2047, total area to be covered till 2047 (From 2005-06 to 2047) will be 50 lakhs hectares.

The Gujarat Green Revolution Company Ltd. (GGRC) model aligns well with the principles and characteristics of the New Public Management (NPM) approach. NPM is a management philosophy that emerged in the 1980s, emphasizing market-oriented and business-like practices in public administration to improve efficiency, effectiveness, and accountability. The GGRC model fits into the NPM framework quite well.

1. Corporate Governance and Special Purpose Vehicle (SPV): NPM encourages the use of corporate governance principles in the public sector, treating public organizations more like business enterprises. GGRC's formation as a Special Purpose Vehicle (SPV) exemplifies this approach. It operates with a corporate structure, involving government-owned companies as promoters and functioning independently with a clear focus on its objectives. This corporate setup allows GGRC to make decisions autonomously, streamline its processes, and implement schemes with efficiency and effectiveness, akin to a private business entity.

2. Efficiency and Single Window Approach: NPM emphasizes the need for efficiency in public service delivery. GGRC's single window approach to implement the Micro Irrigation Scheme exemplifies this principle. By centralizing the entire process through a web-based software module, GGRC eliminates bureaucratic red tape and simplifies the application and approval procedures. This approach speeds up the processing of farmer applications, leading to quicker implementation and timely disbursement of subsidies.

3. Transparency and Accountability: Transparency and accountability are crucial components of NPM. GGRC ensures transparency by making information accessible to all stakeholders, including farmers and the public. The web-based software module provides real-time updates on the progress of applications, installations, and subsidy disbursements. This transparency fosters trust and confidence among stakeholders and ensures that the scheme is implemented fairly and with integrity.

4. Customer-Centric Approach and Flexibility: NPM emphasizes a customer-centric approach in public administration, treating citizens as customers and delivering services tailored to their needs. The GGRC model exemplifies this by offering farmers the flexibility to choose the extent of area they wish to cover under micro irrigation, the type of system, and the supplier. This farmer-centric approach enhances ownership and encourages sustainable adoption of micro irrigation technologies.

5. IT Integration and Quality Assurance: NPM encourages the use of Information Technology (IT) to enhance service delivery and streamline processes. GGRC's in-house developed IT Module (C-MIMS) and web-based software facilitate efficient scheme implementation and management. Additionally, GGRC ensures the quality of micro irrigation components by mandating the use of Bureau of Indian Standards (BIS) compliant materials and conducting

third-party inspections. This emphasis on quality assurance aligns with the NPM focus on delivering high-quality services.

6. Performance Measurement and Evaluation: NPM emphasizes performance measurement and evaluation to assess the effectiveness of public programs. GGRC conducts regular socio-economic evaluations of the Micro Irrigation Scheme through prestigious organizations, providing evidence-based insights into its impact. This evaluation helps identify strengths, weaknesses, and areas for improvement, enabling GGRC to fine-tune its approach and achieve better results.

7. Collaboration with Stakeholders: NPM encourages collaboration with various stakeholders, including private sector organizations, to leverage their expertise and resources. GGRC's collaboration with leading agricultural companies, government agencies, agricultural universities, and NGOs reflects this principle. This multi-stakeholder engagement ensures a holistic approach to scheme implementation and enhances the scheme's success.

The Gujarat Green Revolution Company Ltd. (GGRC) has undertaken proactive and progressive measures to enhance its public service delivery system. In 2022, GGRC introduced a novel model for delivering services to farmers, which can be seen as a transformative and defining change in the realm of public service delivery in the field of public administration. This model, represented by the "Khedut Shakti" (Farmer Empowerment) portal, revolutionizes the entire service delivery process by leveraging online platforms and empowering farmers as the principal beneficiaries.

The Khedut Shakti portal is designed to bring the services to the doorstep of farmers, ensuring greater accessibility and convenience. Through this online platform, farmers assume a central role in the service delivery process. They become the principal decision-makers, while GGRC and the entire administrative machinery operate as facilitators or agents, assisting farmers in availing expertise, funding, and technical know-how to set up micro-irrigation systems in their fields. This shift in the traditional service delivery paradigm empowers farmers, making them active participants in the process and enabling them to tailor the services to their specific needs and circumstances.

The innovative approach of the Khedut Shakti portal represents a paradigm shift in public service delivery, aligning with modern theoretical frameworks in public administration. It embraces

principles of citizen-centric service delivery, putting farmers at the forefront and considering them as customers rather than passive recipients of benefits. This approach aligns with the New Public Management (NPM) philosophy, which emphasizes customer-centricity, efficiency, and accountability in public administration.

The portal's online nature reflects the incorporation of e-governance principles, another important aspect of modern public service delivery. By leveraging technology, the Khedut Shakti portal streamlines processes, reduces bureaucratic hurdles, and enhances transparency. It enables real-time tracking and monitoring of applications, installations, and subsidy disbursements, ensuring accountability and trust in the service delivery process.

The success and recognition of GGRC's new service delivery model have been significant. The Government of India (GOI) has acknowledged the model as an exemplary approach in public service delivery and has encouraged other states to adopt it through a circular issued to all states implementing the GOI-funded Pradhan Mantri Krishi Sinchai Yojana (PMKSY). Furthermore, GOI and GGRC have signed a Memorandum of Understanding (MoU) to develop a national portal to standardize and replicate this innovative model across the country.

In the field of public administration, this innovative approach has the potential to revolutionize service delivery not only in the agriculture sector but also in other areas where satisfactory results have been elusive despite substantial funding. By adopting a flexible and dynamic approach, GGRC has demonstrated how a Special Purpose Vehicle (SPV) can bring efficiency, effectiveness, and transformative change to the delivery of public services. This experience can serve as a blueprint for delivering other social services in a vast and diverse country like India, where tailoring services to the specific needs of beneficiaries is essential for achieving meaningful impact.

Chapter - IV

Recommendations of Water Task Force

4.1. Task Force Formation

Water is the most essential constituent for sustenance of life. It has also become an essential input good for the social and economic development in the state. Given the past history of water scarcity in Gujarat and uneven distribution of water resources across the state, 'Sustained Availability of Water' is one critical issue for which the state is very conscious . In this context, the state Government is aware of the need for a multi-dimensional assessment of water availability and sustainable harvesting.

Accordingly, it was under consideration of the state Government to constitute a task force to formulate strategies and recommendation on sustainability issue in water. With a view to come out with and recommend to the state Government a comprehensive plan of action, the Government is pleased to constitute a · Task Force on Water consisting of the following members: -

No.	Designation	Position in the Task Force
1	Additional Chief Secretary Agriculture, Farmers Welfare & Co-operation Department	Chairman
2	Managing Director, Sardar Sarovar Narmada Nigam Ltd.	Member
3	Principal Secretary, Finance Department	Member
4	Principal Secretary, Urban Development & Urban Housing Department	Member
5	Principal Secretary (Rural Development), Panchayat, Rural Housing & Rural Development Department	Member
6	Principal Secretary (Narmada), Narmada, Water Resources, Water Supply &Kalpsar Department	Member
7	Secretary (Water Supply), Narmada, Water Resources, Water Supply & Kalpsar Department	Member
8	Secretary (Water Resources), Narmada, Water Resources, Water Supply &Kalpsar Department	Member & Convener
9	Secretary (Kalpsar), Narmada, Water Resources, Water Supply & Kalpsar Department	Member
10	Managing Director, Gujarat Water Resources Development Corporation	Member
11	Chairman, Gujarat Pollution Control Board	Member
12	Director, Central Ground Water Board(Gujarat)	Member
13	Director, Central Water Commission(Gujarat)	Member

Based on the discussion held and facts provided by various departments on present scenario and future planning for water conservation and water use, measures required are broadly divided into following four categories. The measures suggested and action points are elaborated in the following section

4.2. Recommendation of Task Force

4.2.1 Policy Measures

4.2.1.1 Incentive Policy for Crop Diversification

- Develop an incentive policy that provides financial support and benefits to farmers adopting crop diversification practices.
- Collaborate with agricultural research institutes to identify suitable alternative crops that are water-efficient and sustainable.
- Conduct awareness campaigns and training programs to educate farmers about the benefits of crop diversification.
- Guideline for area wise crops to grown.
- Promotion of natural farming with less water use.
- Adoption of corporate, contract farming.
- Value addition, Agro industries for crops.
- Restriction on water intensive crops.

Action Points and Recommendations

Improving Water Use Efficiency

- Enhancing water use efficiency at farm level through Micro Irrigation viz. Drip and Sprinkler Irrigation System. Also support micro level water storage or water conservation/management activities as other Interventions to supplement Micro Irrigation.
- To expanded ground-water and surface water irrigation through assured power supplies to rural areas through power feeder separation to help in increasing area under irrigation and ultimately area under diversified crops and production enhancement in many crops.

Financial Interventions

- Providing Financial assistance for
  - Setting up of mechanized fruit/ vegetable market waste/ agro-waste compost production units.
  - Setting up of state-of-the-art liquid/ carrier.

— Setting up of bio-fertilizer and organic fertilizer testing laboratory or strengthening of existing laboratory under Fertilizer Control Order.

Technological Interventions

- Promotion of organic inputs on the farmer's field.
  - — Support to research for development of organic package of practices specific to the State and cropping system.
  - — Setting up of separate Organic Agriculture Research and Teaching Institute
- Natural farming to be promoted in the state through dedicated scheme of Bhartiya Prakritik Krishi Paddhati program (BPKP). Under this scheme incentives to be provided to farmers on cluster formation, capacity building and continues handholding.

Capacity Building

- Capacity building of farmers and technicians to be supported for adopting improved technologies through existing institutions of ICAR, SAUs, State Horticultural Universities (SHUs), KVKs and Institutes with Department of Horticultures. Several technological innovations are available for use by farmers such as improved technology for orchard establishment, availability of true-to-type planting material, plant architecture engineering and management, mulching, fruit thinning, integrated nutrient management (INM), water management, integrated pest management (IPM) and disease management, post-harvest technology, and value addition, processing and marketing, etc.

4.2.1.2 Policy for Compulsory Micro-Irrigation in Canal Network

- Formulate a policy mandating the use of micro-irrigation systems in the canal network area.
- Provide incentives and subsidies to farmers to facilitate the transition to micro-irrigation.
- Establish a monitoring mechanism to ensure compliance with the policy.

Action Points and Recommendations

Technological Interventions

- In all the new irrigation commands where hydraulic heads are available, drip irrigation systems need to be encouraged as it can be operated without additional energy support.
- Facilities of micro irrigation is underutilized if it is not used for fertigation. Formulation of Plan to encourage the use of liquid fertilizers using micro irrigation systems. Availability of liquid fertilizers, awareness among farmers on the benefits of fertigation need to give desired attention for promoting fertigation.

- Efforts may be made for integration of micro irrigation with solar pumping units. A solar water pump has a mini power house at its heart and consists of a calibrated and matching solar array of modules – tuned with the equivalent power of pump for that particular application. The solar water pumping system is capable of running all types of electrical water pumps with applications varying from irrigation to household demands. Irrigation pumps such as submersible, surface or deep well can also be coupled with drip irrigation systems to enhance the returns from this configuration.

4.2.1.3 Water bill on a Volumetric Basis for Irrigation Use

- Currently, Water bill is issued on basis of area of farm irrigated.
- Introduce a billing system based on the volume of water used for irrigation.
- Install water metering systems and monitor water usage accurately.
- Establish a transparent pricing structure for water billing.

Action Points and Recommendations

Financial Interventions

- A Water Regulatory Authority (WRA) should be established in State. The authority will be responsible for fixing and regulating the water tariff system for not only irrigation, but for all users. Where the statutory responsibility for tariffs is with another agency, the WRA must be consulted and its recommendations must be given high weightage so as to ensure reasonable uniformity in policy and management of tariffs within the State.
- Tariffs may be levied on a volumetric basis or a combination of minimum and volumetric basis. The authorities should take into account development, management, and O&M charges while fixing tariffs.

Technological Interventions

- Metering required both at source level and user level. Metering at source level involves measuring the water flows impounded, conveyed and distributed. Metering at user level is to measure each user's consumption periodically in order 10 to charge for the service.

Capacity Building

- Water Users Associations (WUAs) or PRIs should be given statutory powers to collect (and enforce collection) water charges and retain a portion, manage the volumetric quantum of water allotted to them and maintain the distribution system in their jurisdiction.

4.2.1.4 New Electric Connection to Well with Compulsory Micro Irrigation System

- Out of 252 assessment units (talukas), 23 Talukas are 'Over- exploited', 7 Talukas are 'Critical', 20 Talukas are 'Semi-Critical', 189 Talukas are 'Safe' and 13 Talukas are saline. A large number of the OE/critical and semi- critical units are located in North Gujarat and Kachchh Regions of the state.
- Promotion of micro-irrigation techniques such as sprinkler and drip systems for improving water use efficiency and reduce ground water withdrawal.
- The micro-irrigation techniques are made mandatory from 27/03/2012 for new electric connection for withdrawal of Ground water for Agriculture purpose.
- Government of Gujarat is providing 100% subsidy for introduction of micro-irrigation in the command of all the 1293 GWRDC tube wells run by various beneficiary societies.
- Gujarat Green revolution Company (GGRC) is providing subsidy to the farmers
  - Up to 75% - for General Farmer: Small and Marginal farmer (Land holders of less than 2 Hectares),
  - Up to 60% - for General Farmer (Land holders of more than 2 Hectares) and
  - Up to 85% for SC/ST farmer for implementation of micro- irrigation.
  - About 22, 04,000 Ha area is covered under Drip / Sprinkler benefitting about 13 lakh farmers. (by GGRC and GWRDC)
- Under Atal Bhujal area for promoting demand side management following new initiatives have been implemented:
  - Enhanced subsidy to GGRC limited @ 15 % of Unit cost of the micro–Irrigation System and the total GST component.
  - To encourage Crop Diversification an incentive of Rs.10, 000 per hectare has been approved for shifting high water intensive to low water intensive crop.
- The department of Agriculture provides incentive for introduction of Underground Pipeline in place of existing open channel for conveyance of water in farmer's fields.

Action Points and Recommendations:

Regulatory Interventions

- Implement strict regulations and enforcement to control groundwater extraction in the 'Over-exploited' and 'Critical' talukas, and encourage sustainable water management practices in the 'Semi-critical' talukas to prevent further depletion.

- Expand the mandate of micro-irrigation techniques to cover existing electric connections for agricultural groundwater withdrawal, in addition to new connections, to promote efficient water usage and reduce reliance on groundwater resources.

Financial Interventions

- Review and increase the government's subsidy program for micro- irrigation, ensuring its accessibility to all farmers to encourage widespread adoption and maximize the benefits of drip and sprinkler irrigation, thereby conserving water and improving agricultural productivity.
- Pump motor bill as per power consumption instead of fix charges.

4.2.1.5 Telescopic Water Bill for Drinking Water

- Install with telescopic tariff water meters for accurate measurement of drinking water consumption.
- Implement tiered pricing structures to promote water conservation.
- Awareness campaigns to educate consumers about saving water and reduce wastage.
- 24X7 water supply with telescopic tariff charge.

Action Points and Recommendations:

Financial Interventions

- Total Cost Recovery for payment to Bulk Supplier for operation and maintenance of Large Surface Water Supply Scheme as well as for intra-village O&M of villages.
- Higher tariff for high consumption categories so as to promote water conservation.
- Retail tariff rates that are easy to comprehend by the end beneficiaries.
- Recovery for preventive maintenance cost.
- Reduction of cross consumer subsidization with telescopic tariff structure based upon consumption.
- Recovery of Management cost such as administrative over heads, cost of managing the customer care centres/ help lines, water conservation and consumer education activities etc. (not exceeding 10% of bulk supply recovery).
- Fixed Component for Revenue Stability and Variable Component for Water Consumption

Technological Interventions

- Affordability of drinking water supply to poor consumers.

- Measurement of water consumption through metered connections for all consumers based on actual consumption.
- Optimum utilization of surplus water generated, if any.

4.2.1.6 Strict Implementation of acts for Theft, Pollution, Wastage of Water

- Strengthen enforcement mechanisms to ensure the implementation of water-related laws and regulations.
- Increase penalties and fines for offenders engaged in illegal water activities.
- Collaborate with relevant agencies to expedite the resolution of water- related disputes.

Action Points and Recommendations:

Technological Interventions

- A survey should be conducted for inter-state Rivers and large water bodies to identify polluted or dying rivers/water bodies and a systematic-area based rejuvenation program to be launched to restore these river stretches/ water bodies to maintain its ecological flow and quality

Regulatory Interventions

- Encroachments and diversion of water bodies and drainage channels not to be allowed and the State Water Regulatory Authorities be given supervisory and directory powers.
- Wherever such diversions have taken place, they should be restored and maintained to the extent feasible. The law should be strengthened so that encroachment removal follows a summary process, with no scope for delay by the powerful or vested interests.
- Pollution of sources of water and water bodies should not be allowed. Water bodies should be periodically inspected by a third party under a mechanism devised by the WRA which should provide for levy of penalty and issue of directions to undertake rectification.

4.2.1.7 Groundwater Use Charges for Industrial Use

- Introduce charges for industrial groundwater use based on extraction quantity and area wise (Safe, Semi critical, Critical, Over Exploited).
- Monitor industrial groundwater usage and ensure compliance with usage charges.
- Utilize revenue generated for groundwater conservation initiatives.

Action Points and Recommendations:

Technological Interventions

- The industries who are planning reconnaissance, prospecting, general exploration, detailed exploration or mining in respect of any major or minor minerals, including sand mining,

must prepare and file a prospecting plan with the appropriate authority of the area concerned, indicating steps proposed to be taken for the protection of surface and groundwater, to minimize the adverse effect of prospecting operations on groundwater and the environment in general.

Regulatory Interventions

- Prohibiting new industry and mining projects in 'over-exploited' zones and making it mandatory for existing industries, commercial units and big housing societies to take 'no objection certificate' (NOC) under 'expanded compliance conditions'.

Financial Interventions

- The industrial or bulk groundwater use should be priced and a water rate, as prescribed by the appropriate authority, should be charged.
- Funds collected under this section should be used for groundwater conservation and augmentation activities. The groundwater rate proposed to be charged will be in addition to the water cess under the Water (Prevention and Control of Pollution) Cess Act, 1977.

4.2.1.8 Professionals & Adequate Staff Requirement

- New staff pattern for Gram Panchayat, Taluka Panchayat, Nagar Palika, Mahanagar Palika for water related execution, operation & maintenance work.
- Recruitment of minimum staff
- Capacity building & Training
- Powers to staff to take actions

Action Points and Recommendations:

Capacity Building

- Training of engineers and water supply and sewage staff at all levels is essential to ensure efficiency and reduce waste. Each State should set up a training institution to provide training and develop skills for Municipal, Panchayats, and outsourced service providers and Central Government should set up an R&D institution with Regional Centres for research on all aspects related to resource use efficiency in the sector.
- Develop National and State level Key Resource Centres to build the capacity of the staff and officials on efficient management of water resources.
- The training and capacity-building activities should be carried out in a sustained manner, with appropriate monitoring mechanism in place in order to effectively disseminate the learning and implement it on-ground.

- To meet the demand of skilled manpower in the water sector, regular training and academic courses in water management to be promoted.
- A state wide campaign for water literacy needs to be started for capacity building of stakeholders in the water sector.
- Water conservation equipment's should be installed & a water conservation team may be constituted to evaluate conservation ideas, methods and equipment. To realize maximum effectiveness, employees should be informed about the water conservation program and its goals. Employees should be educated on the importance of water conservation and suggestions may be solicited on ways to use water more efficiently. Employees should be effectively roped into the conservation efforts.

4.2.2 Recycling and Reuse of Water

4.2.2.1 100% Sewage Water Treatment within Reuse of Treated Water

- Government of Gujarat has launched a policy for reuse of Treated waste water on 28th May 2018, with a vision of maximizing the collection and treatment of sewage and treatment of sewage generated and reusing the treated waste water on a sustainable basis, thereby reducing dependency on fresh water resources and to promote treated waste water as an economic resource.
- As per the policy, the prospective users of waste water are as follows:
  - Thermal Power plants (within a distance of 50 km from STP or city limits)
  - Industrial Units (GIDC, SIR at units which are using minimum 1 lac liter of water per day for non-potable purpose)
  - Construction activities
  - Parks and Gardens, rejuvenation of ponds, lakes and rivers, firefighting etc.
- GoG has passed a resolution for generic pricing of raw sewage and secondary treated waste water to be charged from the user which are as follows:
  - Raw sewage at a token price of Rs.1.00/ KL.
  - Secondary treated waste water at STP outlet at 25% of prevailing fresh water rate.
  - Secondary treated waste water at intermediate point or to a central point in a cluster or to GIDC at 45 % of prevailing fresh water rate.
  - Secondary treated waste water at doorstep of consumer at 60 % of prevailing fresh water rate.

- To promote reuse of Treated waste water in state, GoG has passed a resolution to provide financial aid in terms of grant of an amount up to 50 % of the cost of the reuse project shall be provided to Municipal Corporations and Urban Development Authorities.
- Projects for reuse of about 109 MLD TWW are in various stages of tender and execution. Further, projects for reuse of about 860 MLD TWW in various Municipal corporations and Municipalities are under feasibility stage.

Action Points and Recommendations:

Technological Interventions

- Implement a comprehensive plan to achieve 100% sewage water treatment across the state of Gujarat, ensuring that all sewage generated is treated to the secondary level or higher, enabling the maximum potential for the reuse of treated water.
- Expedite the feasibility studies for projects aimed at reusing approximately 860 MLD of treated wastewater in various Municipal Corporations and Municipalities, ensuring timely execution and maximizing the potential of treated wastewater for various applications, such as park and garden irrigation, rejuvenation of ponds and lakes, and firefighting.

Financial Interventions

- Provide financial support and grants to Municipal Corporations and Urban Development Authorities to encourage the development and implementation of projects for the reuse of treated wastewater, with the aim of promoting sustainable practices and reducing dependency on freshwater resources.

Capacity Building

- Collaborate with industries, thermal power plants, construction activities, and other potential users of treated wastewater to raise awareness about the benefits of reusing treated water and encourage their active participation in adopting sustainable practices, thereby contributing to water conservation and environmental sustainability.

Regulatory Interventions

- Enforcement for proper operation and maintenance of sewage treatment plant for required quality of reuse of water. Daily monitoring system to be developed.

4.2.2.2 Restriction and Control of Waste and Polluted Water Disposal in Water bodies, Rivers, and Groundwater

- Strengthen monitoring and enforcement mechanisms to prevent waste and polluted water disposal.
- Implement strict penalties for illegal disposal and educate the public about responsible waste management.
- Collaborate with stakeholders to develop effective waste disposal strategies and promote pollution prevention.
- Penalty on unauthorized water use.
- Penalty on wastage of water
- Heavy penalty on Ground water & River Pollution.

Action Points and Recommendations:

Regulatory Interventions

- Selection and zoning of industries associated with potential risks especially those releasing toxic waste need a thorough analysis and planning before they are set up in any water basin.
- The State Government and other local bodies will have a coordinated approach in selecting and locating industries of a specific nature with respect to their water requirement and facilities for wastewater disposal.
- A policy for zoning the water basins according to the types of industries, quantity of water consumed/discharged needs will be laid down. Clearance from the concerned Ministry dealing with State Water Resources to be made mandatory for discharging effluents in the drainage system.

Financial Interventions

- The existing system of subsidies and tax structure on investment in pollution control, water conservation and water recycling technologies to be reviewed.
- Particular attention needs to be paid to introduce a significant and punitive variable tax on the act of pollution.

4.2.2.3 Enforcing ZLD (Zero Liquid Discharge) Industries

- Enforce regulations and guidelines for industries to implement Zero Liquid Discharge technologies.
- Provide incentives and support to industries adopting ZLD technologies.
- Conduct regular inspections and audits to monitor compliance with ZLD practices.

Action Points and Recommendations:

Technological Interventions

- Water audit to be carried out annually. All industries should introduce Water audit as a regular activity. Central Water Commission and Central Ground Water Board "General Guidelines for Water Audit and Water Conservation" to be used for framing the state own specific guidelines.
- Benchmarking and identifying the companies in the same industry which are managing with less water and implementing ZLD, to establish bench marks, take up research to identify water efficient technologies that can be adopted by industries without appreciable additional investment, specially in water intensive industries and encourage them to adopt the same.

4.2.3 Measures to Increase Recharge and Water Use Efficiency

4.2.3.1 Promotion of horticulture crops

- Provide financial incentives and subsidies to farmers for cultivating horticulture crops, which require less water compared to traditional crops.
- Establish horticulture development centres to provide technical guidance and support to farmers interested in horticulture practices.
- Collaborate with marketing boards and cooperatives to create better market linkages for horticulture produce.

Action Points and Recommendations:

Technological Interventions

- Setting up Horticulture Innovation Lab (HIL) for testing and adapting various range of technologies aimed at significantly improving the profitability of fruit and vegetable production, such as those which can reduce constraints that limit the ability of smallholding farmers to achieve maximum profitability with high-value horticultural products.
    - For the application of need based fertilizers, infrastructure like soil and leaf testing laboratories with the world class equipments will be established.
    - More emphasis will be given to evolve high yielding and processable varieties. Work on root stocks of different fruits need to be strengthened for tolerance to various biotic and abiotic stresses.
    - Ancillary horticulture activities like beekeeping, mushroom cultivation and sericulture will be promoted.

- Encouraging Green House/Protected Cultivation to produce an off-season crop to catch high marketable demand and rate. It provides the best controlled condition to the crop under the concept of protected cultivation and enhance the productivity per unit area. Low cost engineering of greenhouses and installations, mechanization with reasonable pay back times or choosing cultivars that require less labour and climate integration strategies to reduce energy costs are important.

Capacity Building

- Reducing post-harvest losses by developing cold storage facilities which are at present is virtually non-existent due to the high cost of equipment and limited electricity. Quick cooling of produce after harvest extends shelf-life by reducing metabolic activity, water loss and microbial growth. Farmers who can store their produce longer can access better prices, as market prices fluctuate.
- State Governments to ensure supply of quality planting materials for fruit crops by enactment of Fruit Plant Nursery (Regulation) Act and enforcement of its provisions through licensing of horticulture nurseries as per the standards set by National Horticulture Mission.
- State Government to set up a terminal wholesale market on the lines of SAFAL to introduce a transparent and efficient platform for sale and purchase of horticultural produce by connecting growers through Growers' Associations with farmers and wholesale buyers in various markets across the country to modernize the marketing of horticulture produce. This model involves establishment of an marketing structure that provides incentives for quality and productivity, thereby improving farmers' income.
- Promote Horticulture crops in their Natural Growing Areas by establishing estates where world class facilities along with technical knowhow will be provided under single roof. To reduce the over exploitation of water and for better fertilizer response, drip fertigation technology will be standardized and promoted for horticultural crops.

4.2.3.2 Every new lift irrigation project based on micro-irrigation only.

- Develop guidelines mandating the use of micro-irrigation techniques in all new lift irrigation projects.
- Provide financial and technical assistance to farmers and project implementers for adopting micro-irrigation systems.
- Monitor and evaluate the implementation of micro-irrigation systems in lift irrigation projects to ensure compliance and effectiveness.

Action Points and Recommendations:

Financial Interventions

- State Government to act as Guarantor for the Farmers Producers Organizations (FPOs)/Cooperatives/Water User Associations (WUAs)/State Level Agencies for availing the Micro Irrigation Fund available under PMKSY. These organizations may access this fund for innovative cluster based Community Irrigation projects for Micro irrigation coverage. The cluster size would be preferably 20 ha or more in North Eastern & Himalayan States and 50 ha or more in other States.
- States Government to access Micro Irrigation Fund exclusively for innovative integrated projects (like high water duty crops like sugarcane/solar linked systems/ Micro irrigation in commands etc.) including projects in the Public Private Partnership (PPP) mode depending on State specific requirements.
    - The methodology for implementation and evaluation for the Minor Irrigation Project includes
    - Field based survey to assess the impact of various scheme components.
    - Farmer beneficiary survey and farmer‟s group survey to assess the process and impact of scheme implementation.
    - Data collection from different project stake holders, Govt. Departmental staff and farmer beneficiaries.
    - Analysis of the available data and reports. Suitable sample size has to be worked out for each category of data collection and analysis and to decide the appropriate unit of analysis.

4.2.3.3 Adoption of Micro-Irrigation in Canal Network Areas

- WRD Dept. planned to establish micro irrigation network in 22 irrigation schemes at cost of 584 crores in collaboration with GGRC.
- Review and monitoring of lift irrigation project up to distribution network up to farmers farm, is to be done by Water Resources Department while Review and monitoring of Drip and Sprinkler irrigation system within farmers farm, is to be done in coordination with GGRC.

Action Points and Recommendations:

Technological Interventions

- Identify areas within the canal network suitable for micro-irrigation systems.

Financial Interventions

- Provide financial assistance and technical support to encourage farmers to adopt micro-irrigation practices.

- Expenses of Micro-irrigation system shall be borne by Government.

Capacity Building

- Conduct training programs to educate farmers about the benefits and management of micro-irrigation systems.

4.2.3.4 Irrigation Water Management through Water Users' Association

- Besides providing irrigation facilities, steps need to be taken to ensure that irrigation water be distributed efficiently and equitably in the command area and that it be used efficiently through Participatory Irrigation Management (PIM).
- Where irrigation Co-Operatives maintain the canal network and field channels, expand irrigated area and distribute and provide tail Enders their fair and just share of water.
- Total registered WUA are 3638 Nos. provided irrigation benefits in 8.52 lakh hectare area. (As per the details of PIM Walmi)

Action Points and Recommendations:

Technological Interventions

- Implement modern technologies such as remote sensing, telemetry, and real-time data monitoring to enable accurate measurement and recording of water distribution, ensuring transparency and accountability in water allocation within the command area.

Regulatory Interventions

- Strict implementation of volumetric rotational water supply.

Capacity Building

- Strengthen the capacity of Water Users' Associations (WUAs) by providing them with technical training, financial support, and resources to effectively manage the irrigation water distribution system. This will ensure equitable water distribution and enable the expansion of irrigated areas while ensuring fair access for tail-end users.
- Encourage the formation of new WUAs in areas where they are currently absent, promoting local participation and ownership in irrigation water management. This will enhance community involvement and decision- making, leading to improved efficiency and sustainability in water allocation.
- Foster collaboration and knowledge sharing among WUAs through regular meetings, workshops, and exchange programs. This will enable the sharing of best practices, experiences, and challenges faced in irrigation water management, leading to continuous improvement in water use efficiency.

4.2.3.5 Reduce Transmission loss in Canal and Pipeline

- To ensure the optimum utilization of available water resources, the department has adopted a perspective planning approach, which includes the renovation and improvement of existing canal systems, as well as the rehabilitation of old canal systems. These measures aim to minimize irrigation water losses and ensure the efficient supply of water to the tail end of the command area.
- Department conduct regular maintenance and repair of canal and pipeline infrastructure.
- In the financial year 2022-2023, the Extension, Renovation, and Maintenance Program allocated 23,414 Lakhs for the construction of approximately 1,680 kilometers of canal lining and 844 canal structures. Looking ahead to the financial year 2023-2024, the program plans to construct around 2,867 kilometers of canal lining and 5,101 canal structures at an estimated cost of 95,234 Lakhs.

Action Points and Recommendations:

Technological Interventions

- Implement a comprehensive maintenance program to regularly inspect, repair, and upgrade canal and pipeline infrastructure, reducing water losses and optimizing water distribution.
- Focus on renovating and improving existing canal systems, targeting areas with high transmission losses, and investing in modern technologies to enhance efficiency.

Financial Interventions

- Allocate adequate financial resources for the planned construction of canal lining and structures, ensuring adherence to quality standards and incorporating water-saving measures for sustainable water resource management.

4.2.3.6 Construction of More Recharge Structures, Water Conservation Works

- Sardar Patel Participatory Irrigation Scheme
- Massive Campaign for construction of Check dams in 185 river basins
- Involvement of NGO's, Farmer groups and industries in creating check dams, deepening of Ponds and desilting of reservoir.
- In this campaign, 1,86,587 check dam, 16,957 ponds, 3,23,268 Khet Talavadi, 1075 Van Talavadi, 1,25,377 Boribandh were built while 48,576 deepening of existing pond is done.

- Sujalam Sufalam Jal Abhiyan, aimed at water conservation and ground water recharge in Gujarat with direct involvement of the local people and public institutions, has been carried out annually since 2018.
- Till date, 8587 works have been completed and 15273 works are ongoing across the state, which has created the storage capacity of 541.24 lakh cubic meter.
- In addition to that, River Rejuvenation project has been taken up to revitalize 36 rivers/tributaries, under which, 7852 soil moisture conservation works / water recharge and harvesting structure have been planned with the cost of Rs. 80.06 Crore. As on date, 765 works have been completed and 515 works are ongoing, resulting in increased the storage capacity of 10.06 lakh cubic meter.

Action Points Recommendations:

Technological Interventions

- Prioritize Strategic Locations and Identifying areas with high water stress and prioritize the construction of recharge structures in those regions to maximize the impact on water conservation.
- Encourage Public-Private Partnerships to Foster collaboration between government agencies, NGOs, and private entities to leverage resources, expertise, and technology for the construction of recharge structures and water conservation works.
- Promote Rainwater Harvesting by Create awareness among communities about the importance of rainwater harvesting and incentivize the implementation of rainwater harvesting systems at the individual and community levels.

Capacity Building

- Enhance Maintenance and Sustainability by Developing a comprehensive maintenance plan for recharge structures and water conservation works to ensure their longevity and continued effectiveness in conserving water resources. Regular inspections, repairs, and community involvement can contribute to their sustainable operation.

4.2.3.7 Bulk Water Transfer Scheme

- The Water Resources Department (WRD) has undertaken several interlinking and inter-basin transfer schemes to address water scarcity and improve water availability across different regions. These schemes aim to enhance water management, increase irrigation potential, and meet the growing water demands.
  - Interstate Projects under planning of

- Par Tapi Narmada Link
- Damanganga -Pinjal Link
- Rajasthan –Sabarmati Link Project

— Intrastate Project under Planning

- Damanganga-Sabarmati-Chorwad link

— Work already Completed by the state

- Inter basin transfer of water from Narmada main canal to Enroute rivers
- Sabarmati-Saraswati link
- Deo-Sukhi Link
- Harnav - Guhai Link
- Mukteshwar - Harsoi Link
- 17 enroute rivers on alignment of Narmada Main Canal
- 21 enroute rivers on alignment of Sujalam sufalam spreading Canal
- Ukai –Purna High level Canal

— Link works under progress

- Interlinking of coastal rivers by spreading channel

Action Points and Recommendations:

- Assess the feasibility of bulk water transfer projects to address water scarcity.
- Conduct environmental and social impact assessments before implementation.
- Ensure equitable distribution of transferred water and prioritize the needs of communities in water-deficient regions.

4.2.4 Monitoring

4.2.4.1 Monitoring of Groundwater Table and Groundwater Use

- The GWRDC is monitoring the ground water regime through water level monitoring. GWRDC has existing 1625 piezometers and proposed new 1147 piezometers with DWLR with telemetry. CGWB has existing 264 piezometers.

Action Points and Recommendations:

Technological Interventions

- Increase the coverage of groundwater monitoring by deploying additional piezometers strategically across the state. The proposed 1147 new piezometers with DWLR (Digital

Water Level Recorder) and telemetry technology will enhance real-time monitoring capabilities, enabling more accurate and timely data collection.

- Collaborate and coordinate efforts between GWRDC and CGWB (Central Ground Water Board) to ensure a comprehensive and integrated groundwater monitoring network. By combining resources and expertise, the two agencies can maximize the coverage and effectiveness of groundwater monitoring, leading to a more comprehensive understanding of the groundwater regime.
- Develop an information system for data collection and dissemination.
- Utilize the collected groundwater data to develop proactive management strategies and policies.

4.2.4.2 Monitoring of Quality of Surface and Groundwater

- To monitor the surface water quality of water bodies, the Gujarat state Government is implementing World Bank assisted National hydrology project of Water Quality Monitoring (WQM) program.
- Around 808 water bodies are identified and it's intended to start the WQM of 400 sites, spread across entire state and gradually other water bodies will also be covered.
- The WQM plan covers assessing 23 water quality parameters, twice a year Pre -monsoon and post-monsoon.
- Under National Hydrology project an awareness campaign regarding the water Quality aspect educating young children need and importance of clean water and ways and means to attain the same has been initiated.
- The GWRDC is monitoring the ground water regime through water level monitoring and water quality sampling and providing this information to empower people in informed decision making. For monitoring the Ground water GWRDC has existing 1625 piezometers and proposed new 1147 piezometers with DWLR with telemetry. CGWB has existing 264 piezometers.
- To study the extend and degree of salinity in Ground Water in Coastal Area of Saurashtra and Kutch Monitoring of Ground Water condition and Ground Water Quality is carried out by GWRDC with 476 no. of monitoring stations along 715 km linear distance since 1985 as per recommendation of HLC-II high Level Committee.

Action Points and Recommendations:

Technological Interventions

- The monitoring program should cover a wide range of water bodies, including lakes, rivers, and reservoirs, to ensure representative coverage across the entire state. Strengthen monitoring and surveillance of surface and groundwater quality.

Capacity Building

- Collaborate with research institutions and laboratories for water quality monitoring.

Regulatory Interventions

- Enforce regulations and penalties for industries contributing to water contamination.