UNIVERSAL WATER REGISTRY

UWR Project Concept Note & Monitoring Report (PCNMR)

Project Name: Rainwater Harvesting and Reuse through Farm Ponds, Banaskantha, Gujarat, India

UWR RoU Scope: RoU Scope 2

Monitoring Period: 01/01/2021- 31/12/2022

RoU Crediting Period: 01/01/2021 - 31/12/2022 (For Year 2021-2022)

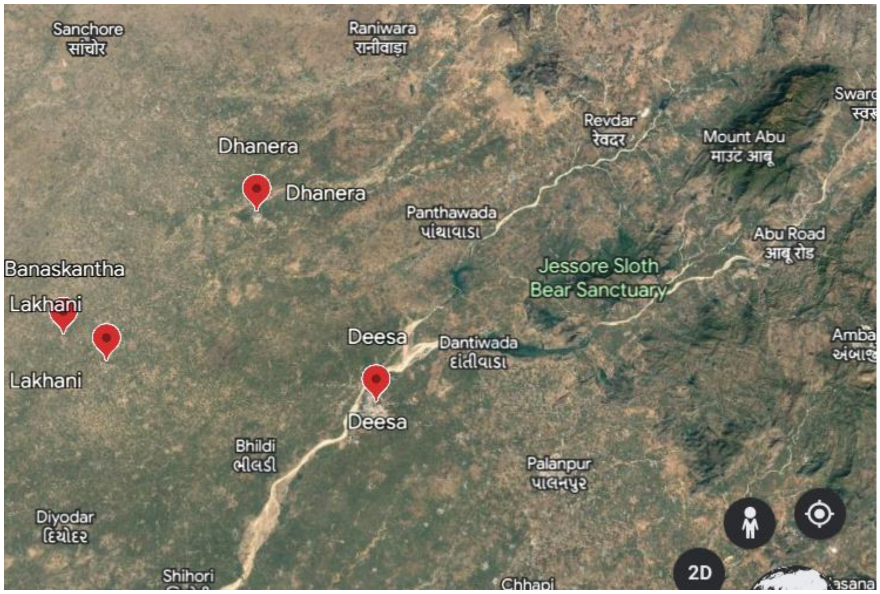
UNDP Human Development Indicator: 0.633 (India)

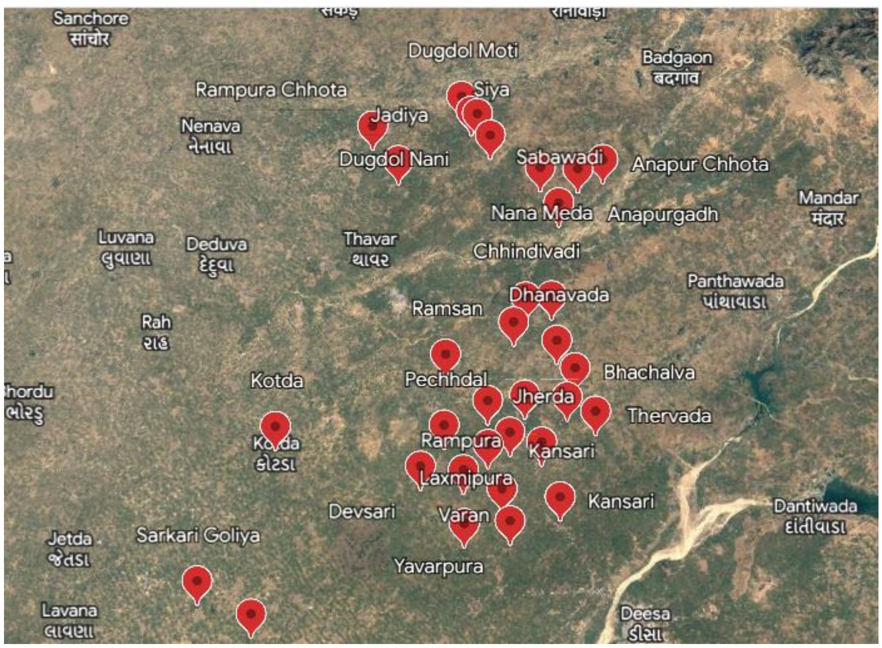
National Water Security Index: 2 (India)

Table of Contents

A.1 Location of Project Activity

Address of the project activity	: Deesa, Dhanera, and Lakhani Taluka
State	: Gujarat
District	: Banaskantha
Block Basin/Sub Basin/Watershed	: Kutch/Saraswati/ SRWT001, SRWT002, SRWT003, SRWT005, SRWT006, SRWT008
Lat. & Longitude	: Deesa- 24.2585^0 N , 72.1907^0 E Dhanera - 24.5064^0 N , 72.0258^0 E Lakhani - 24.3114^0 N , 71.8230^0 E
Area Extent	: Groundwater surface
No. of Villages/Towns	: 35 villages and 3 Talukas of Banaskantha district


Sanchore
सांचोर
Raniwara
रानीवाड़ा
Dhanera
Dhanera
Revdar
रेवदर
Mount Abu
माउंट आबू
Panthawada
પાંથાવાડા
Abu Road
आबू रोड
Jessore Sloth
Bear Sanctuary
Banaskantha
Lakhani
Lakhani
Deesa
Dantiwada
દાંતીવાડા
Deesa
Bhildi
ભીલડી
Palanpur
પાલનપુર
Diyodar
દિયોદર
Shihori
2D


Sanchore
सांचोर
Dugdol Moti
Badgaon
बदगांव
Rampura Chhota
Siya
Jadiya
Nenava
નેનાવા
Dugdol Nani
Sabawadi
Anapur Chhota
Nana Meda
Anapurgadh
Mandar
मंदार
Luvana
લુવાણા
Deduva
દેદુવા
Thavar
થાવર
Chhindivadi
Panthawada
પાંથાવાડા
Dhanavada
Ramsan
Rah
રાહ
Pechhdal
Bhachalva
Kotda
Jherda
Thervada
Rampura
Kansari
Laxmipura
Devsari
Kansari
Dantiwada
દાંતીવાડા
Varan
Jetda
જેતડા
Sarkari Goliya
Yavarpura
Lavana
લાવણા
Deesa
ડીસા

A.2. Project owner information, key roles and responsibilities

Project Proponent and Owner (PP)	**:**	Farm pond owner (farmers) of the villages from Deesa, Dhanera, and Lakhani Taluka, Banaskantha, Gujarat, India.
UWR Project Aggregator	**:**	Gram Vikas Trust
Project Aggregator Address	**:**	Office#37, 3rd Floor, Darshanam Trade Centre#1, Sayajiganj, Vadodara – 390 020 Gujarat. India.
Date PCNMR Prepared	**:**	22nd August 2023

The Project Proponent and owner (PP) maintain the project activity and ensure that the rainwater runoff is harvested and flows into the farm pond that provides potable water supply to the PP during post-monsoons for irrigation and other usage. PP is responsible for maintaining the catchment area and ensuring the smooth flow of rainwater during the monsoon period in the farm pond. PP maintains all the necessary permits and ownership documents for the water harvesting and conservation activity.

A.2.1 Project RoU Scope and Details

Project Name	:	Rainwater Harvesting and Reuse through Farm Ponds, Banaskantha, Gujarat India
UWR Scope: RoU Scope 2	:	Measures for conservation and storage of excess surface water for future requirement
Date PCNMR Prepared	:	22nd August 2023
Catchment Area	:	2000-3600 Sq.mt (approx.)
Type of structure	:	Square Shape Farm pond
Month and Year of Construction	:	June 2020
Month and Year of Commissioning Rwh's	:	01/01/2021
Average Rainfall	:	678 mm (for the year 2021-2022)
Run off Coefficient	:	0.3
Evaporation and absorption losses	:	35%
Catchment Capacity	:	Approx. 6-8 million liters of water in each pond
RoU Crediting Period	:	01/01/2021 – 31/12/2022 (For Year 2021-2022)
Total RoUs Generated For the Crediting Period	:	130678

The project activity **<u>Rainwater Harvesting and Reuse through Farm Ponds, Banaskantha, Gujarat India</u>** is a man-made constructed pond structure having a large catchment area that conserves and stores rainwater for future use in the different villages of Deesa, Dhanera, and Lakhani Taluka.

The project activity fulfills the UWR RoU requirements for "measures undertaken for conservation and storage of excess surface water for future requirements."

A farm Pond is a dug-out structure with a definite shape and size having proper inlet and outlet structures for collecting the surface runoff flowing from the farm area and others. It is one of the most important rainwater harvesting structures constructed at the lowest portion of the farm area and is cost-effective.

Benefits of Farm Pond

- It collects excess runoff during rainy periods.
- Stored water can be used for supplemental irrigation to crops, without waiting for rainfall.
- It is useful as drinking water for cattle during drought situations.
- It can be used for spraying pesticides.
- It conserves soil and moisture.
- It reduces soil erosion and recharges groundwater/Borewell
- It helps to recharge the open well when there is excess water in the pond.
- One can use the soil excavated during pond construction as topsoil for uncultivable land
- Increase the income of farmers as the increase in the crop irrigation

Banaskantha district is a district that has been struggling against water for years. As the water tables are getting deeper in the Banaskantha district, the water problem is becoming dire day by day. Every year the groundwater level is depleted to 3 - 4 mt down. Due to the continuous fall of groundwater level in Banaskantha district farmers are worried as there is no other irrigation system and most of the population depends economically on crop irrigation (as their major source of income).

To overcome this water scarcity, many villages and Talukas of Banaskantha adapted to make farm ponds in their farm to store the runoff rainwater from the ground surface with the help of government schemes and other NGOs. Up to 2016, the Geomembranes sheets were not installed in the farm ponds. But later on, the government announced to provide the Geomembranes for the construction of farm ponds in water scarcity areas under Gujarat's Narmada, Water Resources and Water Supply Department which has come up with a plan to store the water wasted in the monsoon. Plastic- Polythene will be provided free of cost by the government. By laying the Geomembranes, a structure like a water tank is formed. Irrigation can be done by rainwater harvesting during monsoon. The water is stored and farmers' crops can be irrigated. **(Source: https://allgujaratnews.in/en/gujarat-geomembrane-ponds-water-reality/)**

To overcome this water scarcity, the Gujarat government has started lifting irrigation schemes from the Narmada Main Canal to various reservoirs of the North Gujarat region under the Sujalam Sufalam Yojana.

As the scheme will not benefit all the parts of the Banaskantha district one has to go for the rainwater harvesting. The creation of such small farm ponds in a farm is one effective solution offered to resolve the problem of sharing benefits with those who do not derive any direct benefits from the watershed development structures. These ponds also increase the efficiency of water use in the area.

With the help of a farm pond (approx. 40*40*6 mt), farmers can cultivate approx. 2 to 15 bighas of land in winter and 8 to 10 bighas of land in summer with the water stored in the farm pond. Anada Jat, a farmer of Banaskantha district, for the first time, built a pond in his field at his own expense. Sufficient water is available for agricultural irrigation from the water of that farm pond throughout the year.

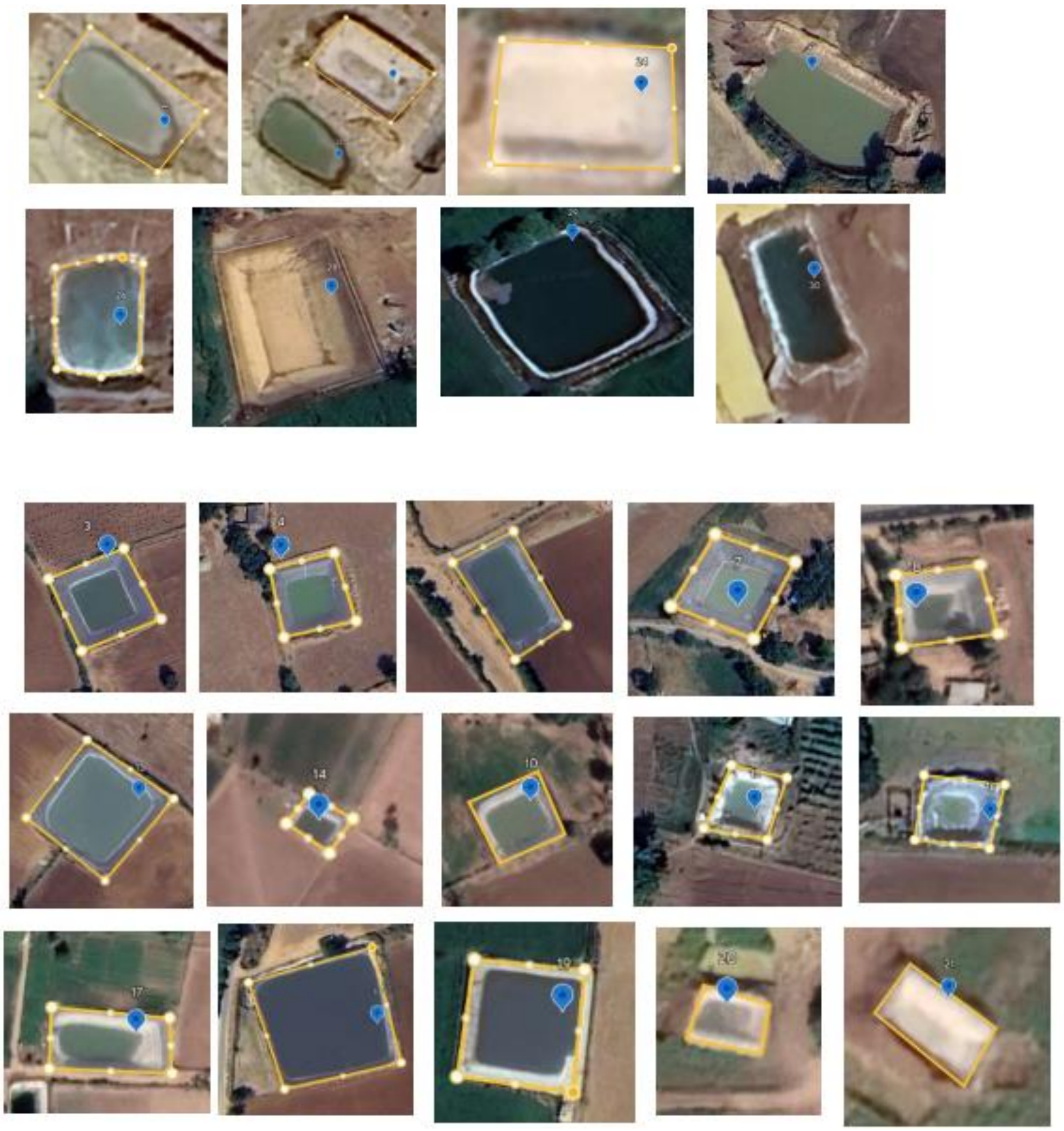
One cubic foot of farm pond can hold 7.48 gallons of water. One gallon means 3.785 liters of water i.e. approximately 28 liters of water can be stored for further use. This can reduced the consumption of Groundwater.

The overall goal of this project is to promote sustainable water development in the villages of Deesa, Dhanera, and Lakhani Taluka of Banaskantha district, Gujarat, India and prevent over-exploitation of groundwater resources.

Hence the project activity ensures the water security of India and attains the Sustainable Development Goals (**SDGs) 1, 6, 8, 10, 11, 12, and 13.**

A.2.2 Project boundary and Satellite Image

Below are the satellite images for some of farm ponds for reference:

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A.3. Land use and Drainage Pattern

A.3.1 Urban and Rural Residential

A.3.1.1 Introduction

The Banaskantha is situated in the northern part of Gujarat State and forms a part of the North Gujarat region with the city of Palanpur as its administrative headquarters. It lies between 23° 29’24” and 24°25’12” north and 71°01’48” and 73°01’12” east longitudes. It has a total area of 10743 sq. km (10544.75 Km2 Rural and 198.25 Km2 Urban, census 2011) and is bounded in the north by the state of Rajasthan, towards west and southwest by Kutch district (Threat Rann of Kutch and Little Rann of Kutch) and towards southeast and east by the districts of Mahesana and Sabarkantha respectively.

Banaskantha district consists of 12 talukas as per the census 2011 and later two more talukas Lakhani and Suigam has been created from the AQUIFER MAPS & MANAGEMENT PLANS, BANASKANTHA DISTRICT, GUJARAT. Lakhani formed by part of the area of Deesa, Deodar and Tharad talukas, and Suigam carved by most part of the area of Vav and small portion of area of Bhabhar taluka. Percentage of area of old talukas shared to constitute the new talukas is estimated based upon the GIS layers of administrative boundaries. As per census 2011, total population of the district is 3120506 and population density is 290 per Km. At present Banaskantha district has 14 talukas having total 1238 villages (habituated) and out of which 5 are inhabituated.

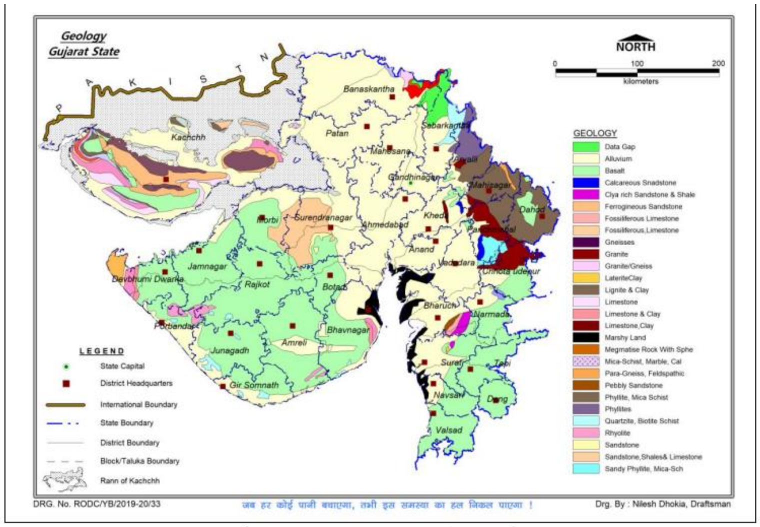
A.3.1.2 Geology

The district has a diverse landscape, it is characterized by hilly upland in the northeast with intermountain valleys, followed by a piedmont zone with alluvium and residual hills/inselbergs and a gently sloping vast alluvial – Aeolian plain.

The Rann in the west forms a totally different landscape in which a few isolated islands (Bets) are inhabited. The elevation in the district ranges from less than 10 m in the western part to more than 800 m amsl in the northeastern part.

The district has a semi-arid climate. Extreme temperatures, erratic rainfall, and high evaporation are the characteristic features of this type of climate. Since the district experiences a semi-arid type of climate, the rivers flowing through it are of ephemeral nature i.e. have water during monsoon only and dry up after monsoon.

(Source: http://cgwb.gov.in/AQM/NAQUIM_REPORT/Gujarat/Banaskantha/NAQUIM_BK_Dist_Report_Banaskanta.pdf)



Source: http://cgwb.gov.in/Dynamic-GW-Resources.html

A.3.1.3 Physiography

The district can be divided into three main parts – the hilly- mountainous region having high relief and rugged topography covering parts of Dhanera, Palanpur, Vadgaon and the entire Danta taluka in the east, the piedmont zone all along the periphery of hilly area, and west and southwest of River Banas the area is flat plain with occasional undulations given rise to by sand dunes and mounds in the west. The western extension of this plain merges into the marshy area of Rann of Kutch.

Geomorphologically the district can be divided into six sub micro regions on the basis of physiography, climate, geology, soils and natural vegetation.

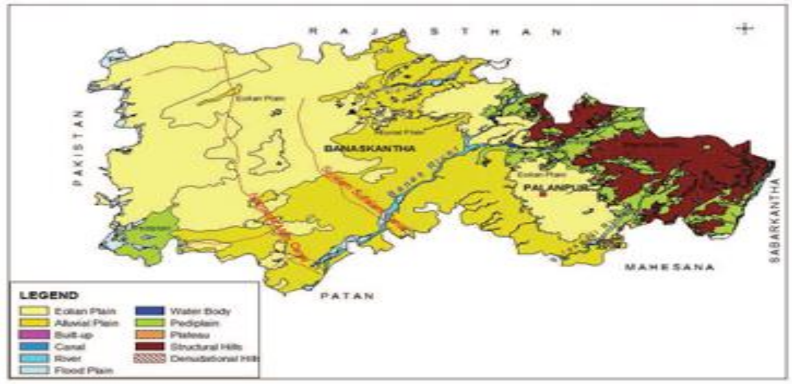


Fig.2.1 Physiographic division of Banaskantha district

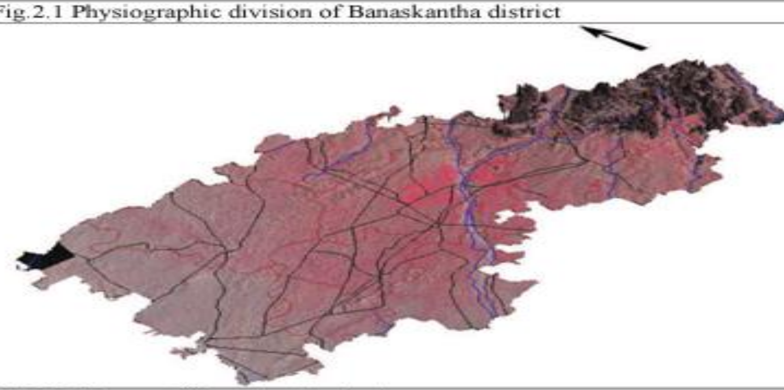


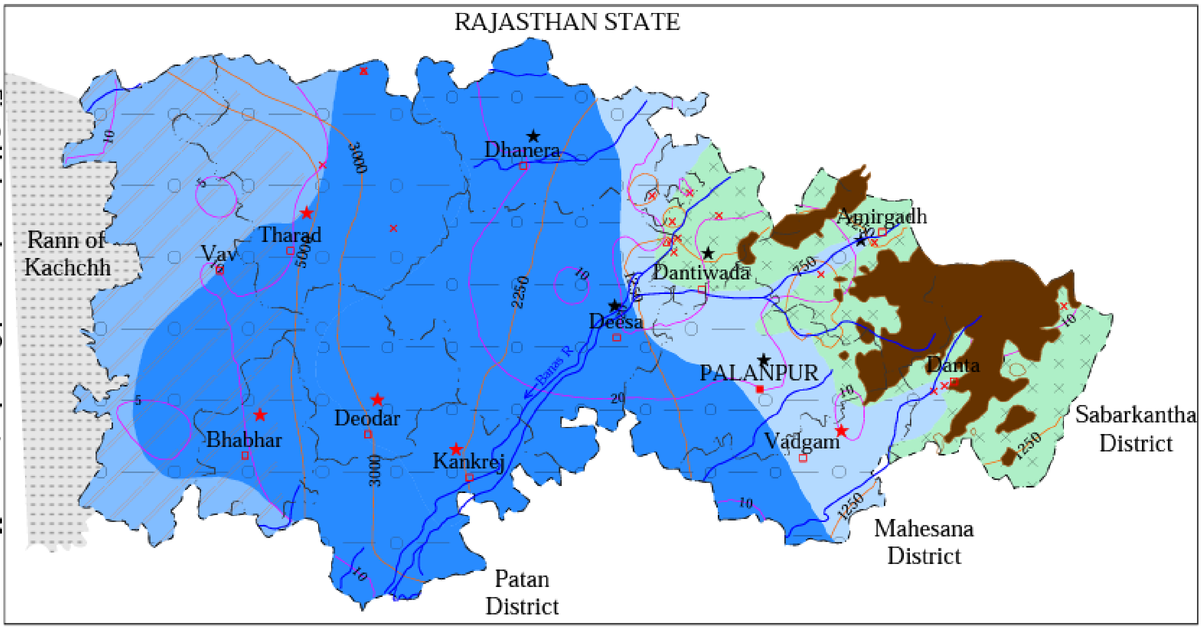
Fig.2.2 3D map of Banaskantha district.

Source: http://cgwb.gov.in/AQM/NAQUIM_REPORT/Gujarat/Banaskantha/NAQUIM_BK_Dist_Report_Banaskanta.pdf

A.3.1.4 Hydrogeology

Precambrian hard rocks, semi-consolidated Mesozoic and tertiary formations, and unconsolidated quaternary alluvial deposits form a multi-layer aquifer system in the district. Groundwater occurs both under phreatic and confined conditions, however, its development is restricted depending upon the aquifer geometry and yield characteristic of the individual aquifer and/or groundwater quality of the formation water. The Hydrogeological framework of the district is presented in the below image.

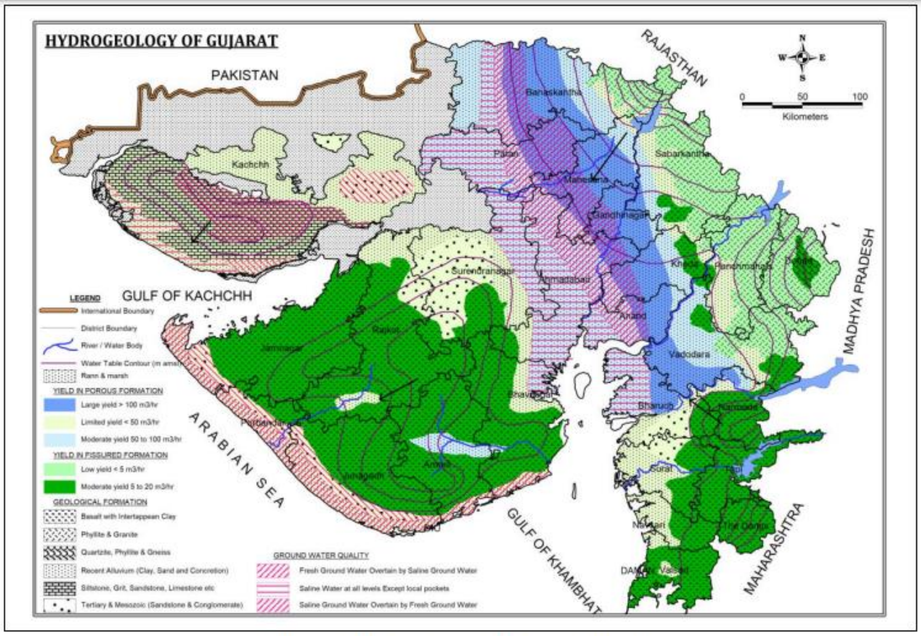
Fig:3-Hydrogeology and Groundwater user Map



Legend Hydrogeological Map

	Wells Feasible	Rigs Suitable	Depth of Well (m)	Discharge (lpm)	Artificial Recharge Structure Suitable
Soft Rock Aquifer	Dug Well Tubewell	Manual Direct Rotary, Reverse Rotary	10-25 50-100	200-300 600-1000	Percolation Tanks/ Ponds, Recharge Wells,
Soft Rock Aquifer	Dug Well Tubewell	Manual Direct Rotary Reverse Rotary	15-30 100-300	200-300 800-1000	Percolation Tanks/ Ponds, Recharge Wells, Recharge Shaft
Soft Rock Aquifer	Dug Well Tubewell	Manual Direct Rotary Reverse Rotary	15- 30 100-300	200-300 1000-1200	Percolation Tanks/ Ponds, Recharge Wells, Recharge Shaft
Hard Rock Aquifer	Dug Well Borewell	Manual Down the Hole Hammer (DTH)	10-25 100-200	60-150 100-300	Percolation Tanks/ Ponds, Recharge Wells, Check Dams, Nalla Bunds.
Hilly Areas	Not Suitable				Check Dam, Nalla Bund, Gully Plug
Saline Area	Not Suitable except localised fresh water pockets				
20	Pre-monsoon Decadal mean (1993-2000) Depth to Water Level (mbgl)	2000	Electrical Conductivity (µS/cm at 25° C)		
×	Fluoride > Maximum Permissible Limit (1.5 mg/l)	△	Nitrate > Maximum Permissible Limit (100 mg/l)		
★ (red)	Over Exploited Taluka	★ (black)	Dark Taluka		
	Drainage	■/□	District/Taluka HQS		
	Rann/Marsh				

Source: http://cgwb.gov.in/AQM/NAQUIM_REPORT/Gujarat/Banaskantha/NAQUIM_BK_Dist_Report_Banaskanta.pdf



(Figure 7: Hydrogeological Map of Gujarat)

Source: http://cgwb.gov.in/Dynamic-GW-Resources.html

Fig:4 - Schematic Section showing dual aquifer system Concept

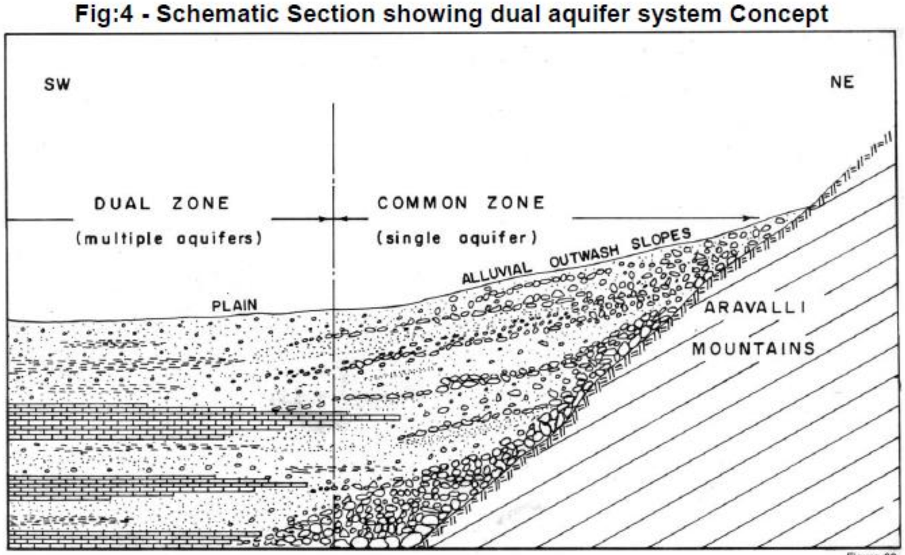
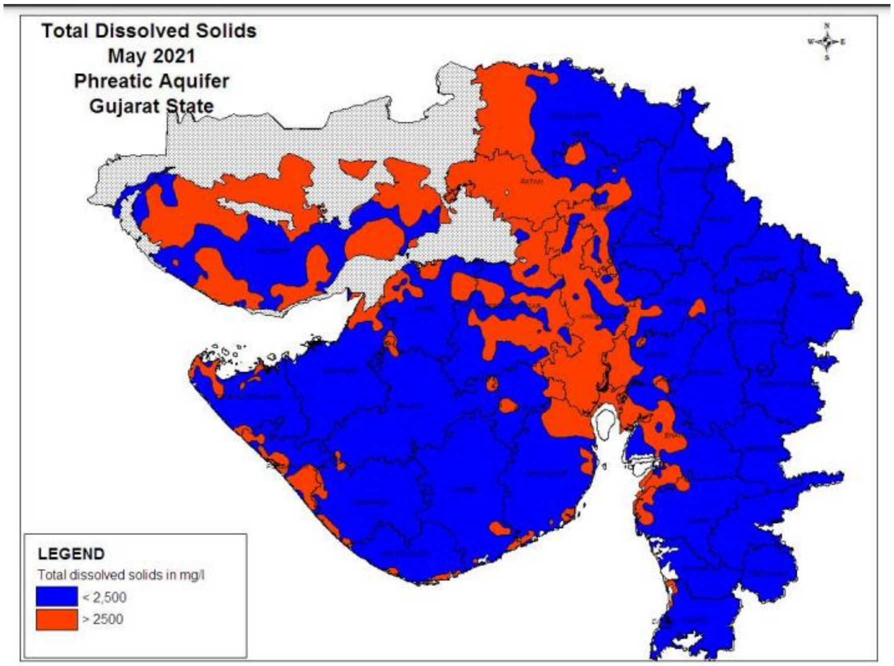


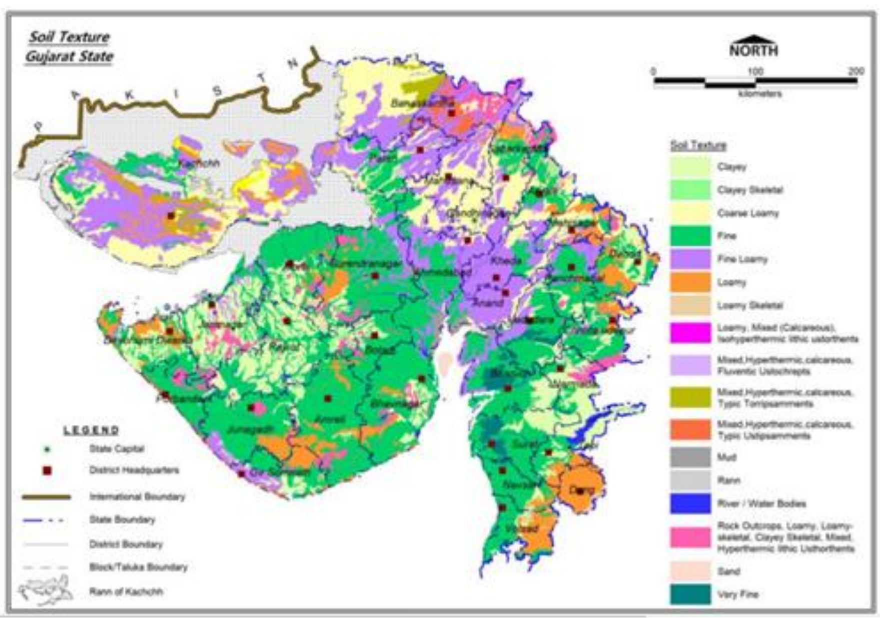
Figure 66

SCHEMATIC SECTION SHOWING DUAL-AQUIFER SYSTEM CONCEPT

Source: http://cgwb.gov.in/AQM/NAQUIM_REPORT/Gujarat/Banaskantha/NAQUIM_BK_Dist_Report_Banaskanta.pdf



Source: http://cgwb.gov.in/Dynamic-GW-Resources.html



Distribution of hydrogeological formations in Gujarat and their Potential

Age	Rock Formation	Distribution	Hydrogeological Characteristics
Porous Formation			
Quaternary to upper Tertiary	Impure limestones, limestones, sandstones, conglomerates, pebble beds, siltstones, sands, pebbles, gravels, etc.	Ahmedabad, Amreli, Banaskantha, Bhavnagar, Bharuch, Kachchh, Kheda, Jamnagar, Junagadh, Rajkot, Mahesana, Surendranagar, and Valsad Districts	Unconfined shallow aquifer, leaky confined/ confined, and deeper aquifer. Large to moderate yield prospects:10 to 40 lps, Storativity: 1.6x10E-4 to 7.3x 10E-4, Hydraulic Conductivity: 5 to 20m/day, Transmissivity: 50 to 2000m2/day
Mesozoic	Sandstones, Shales,	Kachchh, Surendranagar, Sabarkantha and Vadodara	Discontinuous aquifers with limited thickness of 50 to 300
	Limestones and Grits	districts	Meters. Limited yield prospects <15 lps, Hydraulic Conductivity: 2 to 10m/day, Transmissivity: 50 to 1000m2/day
Fissured formation			
Mesozoic to Paleozoic	Basalt with inter trappean clays	Uplands of Saurashtra, Kachchh Region, scattered patches in Panchmahals, Sabarkantha, and Vadodara districts, Continuous belt in the eastern part of Bharuch, Surat and Valsad districts	Groundwater occurrence is restricted to weathered and fractured zones, limited to 200m, with moderate yield prospects: 5 to 15lbs
Archaean and Pre-Cambrian	Granites, Gneiss, Marbles, Schists, Phyllites and Slates	Banaskantha, Sabarkantha, Panchmahals, Vadodara, andKheda districts.	Groundwater occurrence is restricted to weathered and fractured zones having secondary porosity, and limited yield prospects of 2 to 5 lbs.

Source: http://cgwb.gov.in/Regions/WCR/Reports/Gujarat_State_Year_Book_2018-19.pdf

A.3.2 Land use

The total area reported for land use purposes was 10448.41 km2 in the year 2014-15 while the total geographical area is 10743 Km2 (Census 2011). The net sown area was 7440.87 Km2 which is 71% of the total area reported. Silent details of the land use pattern is as below

Sr. No.	Classification of the area	Area (Km2)
1	Forest Area	1106.55
2	Land put to non-agriculture use	529.39
3	Barren and uncultivable land	309.88
4	Permanent pasture and other Grazing land	651.39
5	Cultivable waste	175.77
6	Land under misc. tree crops and groves not included in Area sown	-
7	Current fallow	234.56
8	Fallow land other than current fallow	-
9	Net area sown	7440.87
10	Area sown more than once	2894.28
11	Cropping intensity	138.67

Taluka wise details of land utilization in the district for the year 2014-15

Sr. No.	Taluka	Area according to village papers	Area under Forest	Land not available for cultivation			Other uncultivable land excluding fallow				Fallow land			Net area sown	Area sown more than once	Total cropped area (15+16)	Cropping intensity
				Land put to non agricultural uses	Barren & uncultivable land	Total (6+7)	Permanent pastures & other grazing lands	Land under miscellaneous tree crops & groves not included in net area sown	Culturable waste	Total (8+9+10)	Fallow land other than current fallow	Current fallow	Total				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	Amirgadh	608.99	372.38	20.3	5.39	25.69	27.03	0	1.85	28.88	0	6.44	6.44	175.6	51.64	227.24	129.41
2	Danta	859.01	507.02	26.66	35.45	62.11	15.35	0	18.2	33.55	0	29.35	29.35	226.98	37.04	264.02	116.32
3	Deesa	1456.68	3.93	108.99	26.69	135.68	132.12	0	14.7	146.82	0	32.96	32.96	1137.29	886.67	2023.96	177.96
4	Dhanera	842.98	3.82	48.4	18.19	66.59	55.03	0	9.24	64.27	0	34.8	34.8	673.5	319.48	992.98	147.44
5	Diyodar	593.05	0	16.88	8.16	25.04	51.1	0	0.66	51.76	0	10.57	10.57	505.68	314.14	819.82	162.12
6	Dantiwada	417.95	70.32	47.67	4.73	52.4	25.43	0	5.63	31.06	0	4.67	4.67	259.5	137.46	396.96	152.97
7	Kankrej	825.17	0	32.39	39.85	72.24	45.6	0	23.46	69.06	0	24.8	24.8	659.07	164.68	823.75	124.99
8	Palanpur	792.31	54.91	45.55	24.23	69.78	47.68	0	12.3	59.98	0	16.85	16.85	590.79	293.16	883.95	149.62
9	Tharad	1351	0.2	38.95	5.43	44.38	102.14	0	13.8	115.94	0	20.58	20.58	1169.9	338.98	1508.88	128.98
10	Vadgam	562.42	13.2	35.79	31.97	67.76	42.5	0	12.22	54.72	0	6.33	6.33	420.41	217.08	637.49	151.64
11	Vav	1709.6	80.77	84.99	93.6	178.59	79.15	0	62.11	141.26	0	41.93	41.93	1267.05	74.9	1341.95	105.91
12	Bhabhar	429.25	0	22.82	16.19	39.01	28.26	0	1.6	29.86	0	5.28	5.28	355.1	59.35	414.45	116.71
	Total	10448.41	1106.55	529.39	309.88	839.27	651.39	0	175.77	827.16	0	234.56	234.56	7440.87	2894.58	10335.45	138.67

Source: http://cgwb.gov.in/AQM/NAQUIM_REPORT/Gujarat/Banaskantha/NAQUIM_BK_Dist_Report_Banaskanta.pdf

Source: http://cgwb.gov.in/Regions/WCR/Reports/Gujarat_State_Year_Book_2018-19.pdf

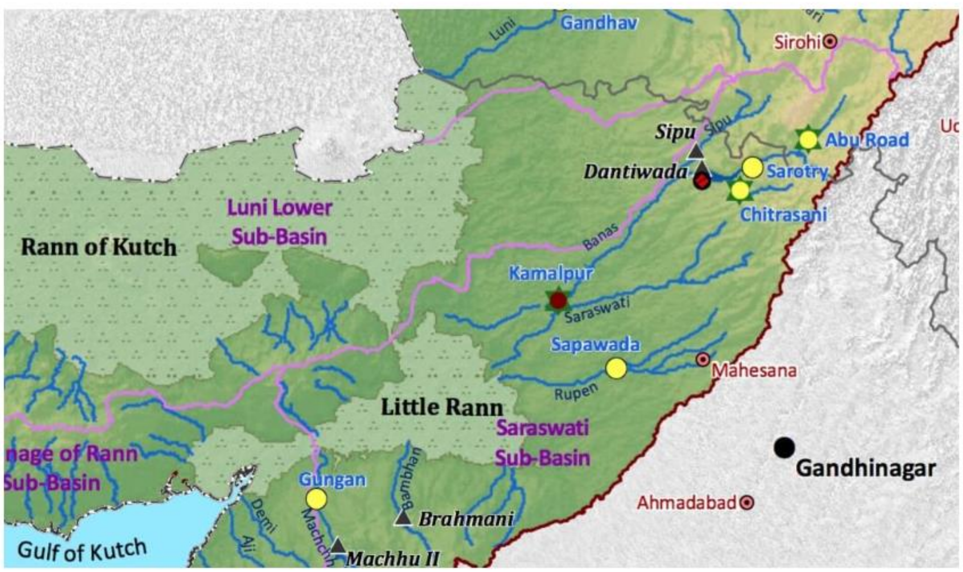
A.3.3 Drainage

The drainage network in the district is constituted mainly by the Banas and Sarashwati rivers and their tributaries. In the extreme east, Sabarmati river forms district boundary with Sabarkantha district and in part controls the drainage network of the hilly area east of Danta. Other important rivers passing through or originating from the district are Arjuni, Sipu, Balaram, Khari, Khapra, Kalari, Gujudi, Dholka, Umardashi, Chekaria, Selvam, Rel, Ravi, and Sirinala. Since the district experiences a semi-arid type of climate, the rivers flowing through it are of ephemeral nature i.e. have water during monsoon only and dry up after monsoon. Some of the rivers like Banas and Saraswati, however, carry a fairly good amount of water during the rainy season. Most of the rivers have south and south-westerly flow directions.

There are a few important lakes in the district i.e. Ganga Saragar near Jethi Village in Palanpur taluka, Man Sarover near Chitrasani village, and Dantiwala Lake constructed near Dantiwada Dam. Various canals drawn from the lakes irrigate the land of the district.

A.3.4. River Basin

Banas river originates from Aravalli hills and descends in a South-western direction through Rajasthan state and travels through Banaskantha and Mehsana district of Gujarat before it drains into little Rann of Kutchh. The Banas basin is the Northern basin and is situated between 230 30’ & 240 55’ North latitudes and 710 15’ to 730 15’ East longitudes approximately. Saraswati and Luni basins form the Southern and Northern boundaries of this basin. The Aravalli hills form its Eastern extremity.The Banas drains an area of 8674 sq km, out of which nearly 37.69% lies in Rajasthan state and remaining 62.31% falls in Gujarat state.



The state and district wise distribution of its drainage area is shown the following table

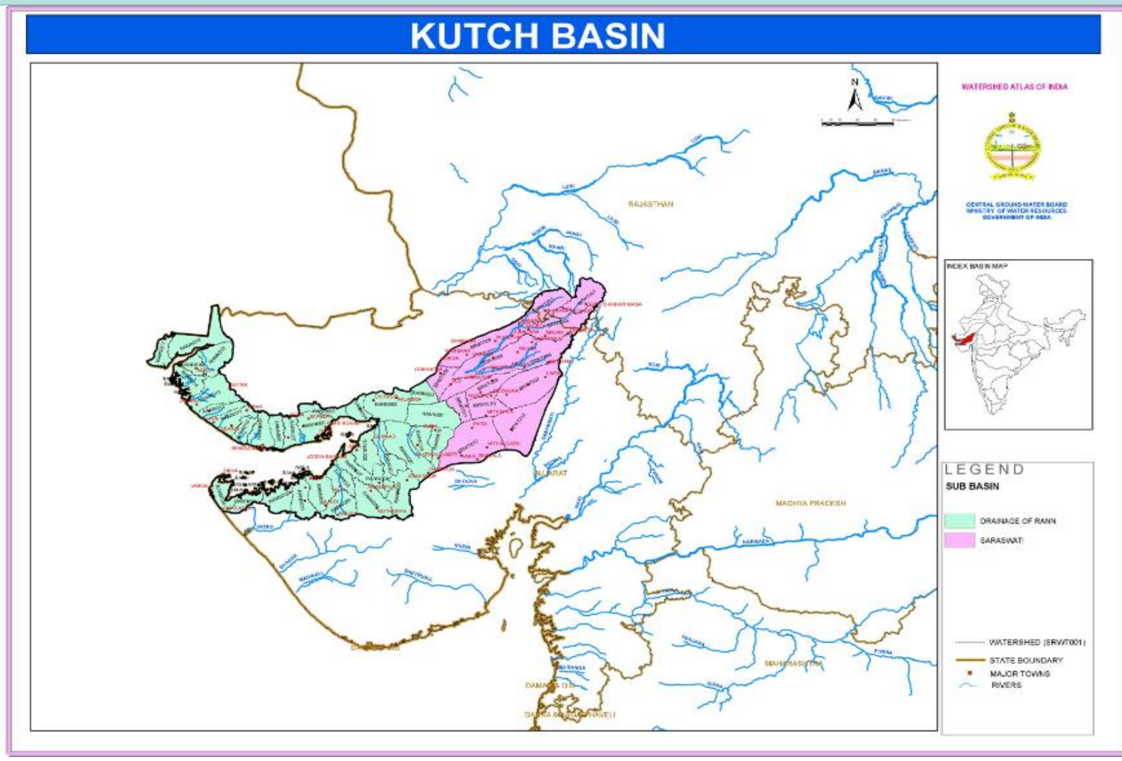
Sl.No.	Name of State	Name of District	Length of river km	Drainage area sqkm	% of Total CA
1	Rajasthan	Sirohi	78	3269	37.69
2	Gujarat	Banaskantha	119	4638	53.47
3	Gujarat	Mehasana	69	767	8.84
		Total	266	8674	100.00

A.3.5. DESCRIPTION OF RIVER SYSTEM

The Banas rises near Pindwara of Sirohi district of Rajasthan at an elevation of 372.51m above m.s.l. Little Rann of Kachchh is the outfall of Banas river. Sipu is the only right Bank tributary of Banas, which drains into the main channel. There are 6 tributaries on the left bank of the Banas River namely the Batria, the Sukli, the Sewaran, the Suket, the Balaram, and the Khari which drain into the main channel. Hence the draining system on the left bank of the Banas River is more extensive as compared to the right bank area. The Sipu and the Khari are the two important right and left bank tributaries, which together drain nearly 37% of the total catchment area of Banas.

The catchment area, length, and elevation of the above said tributaries is given below.

Sl.No.	Name of River	Bank	Elevation of source above m.s.l. (m)	Length (km)	Catchment area (sq km)
1	Banas	Main	372.51	266	8674
2	Sipu	Right	1150	75	1420
3	Sewaram	Left	850	28	202
4	Suket	Left	606	15	79
5	Balaram	Left	807	40	345
6	Khari	Left	215.285	88	1391



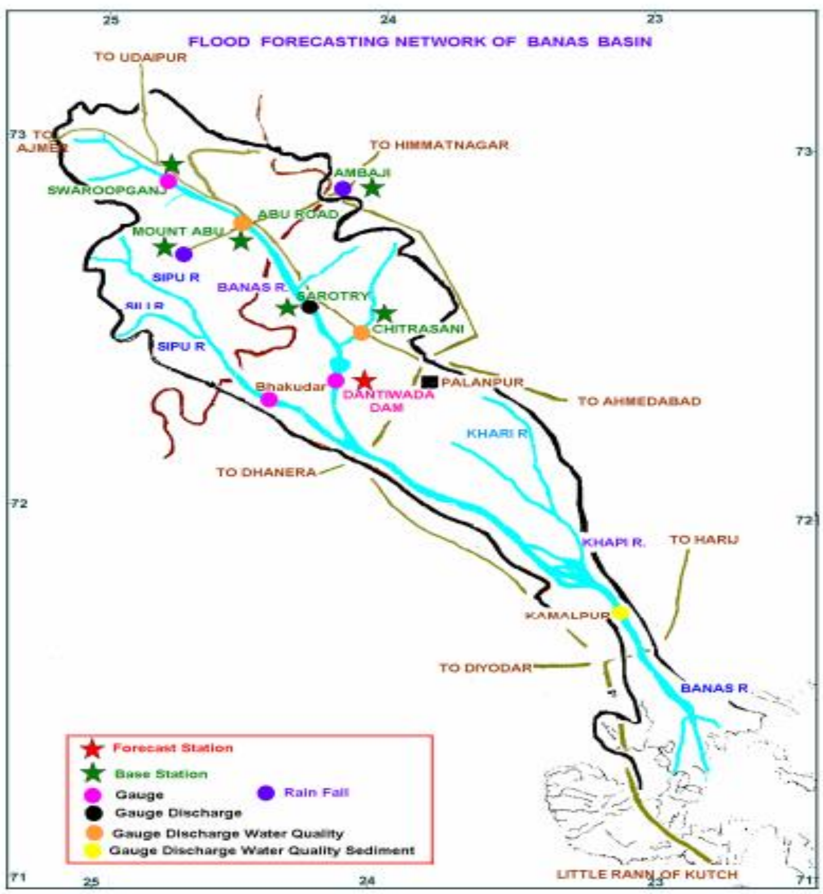
BASIN	SUB-BASIN	WATERSHED CODE	NAME OF STREAM	TOP SHEET NO.	SHARING STATE	AREA (SQ. KM.)
		SRWT001	WEST BANAS RIVER	45D,H	RAJASTHAN	1109
		SRWT002	BANAS RIVER	45D,H	GUJRAT, RAJASTHAN	1819
KUTCH	SARASWATI	SRWT003	RUPAN SARASWATI	45D	GUJRAT, RAJASTHAN	1258
		SRWT005	BANAS RIVER	40P, 45D, 40M, 46A	GUJRAT	1948
		SRWT006	BANAS RIVER	41M, 40P, 45D	GUJRAT	1889
		SRWT008	BANAS RIVER	41M	GUJRAT	746

Sources: http://cgwb.gov.in/watershed/cdkutch.html

Drainage of Banaskantha Rivers

Banaskantha	Draining into Gulf of Kutch	Rupen	32
	Draining into Gulf of Kutch Total		32
	Luni and other drainage into Great Rann of Kutch	Mainly Luni Mostly Great Rann Of Kutch	8 32
	Luni and other drainage into Great Rann of Kutch Total		40
	Sabarmati	Lb Of Sabarmati Upto Hathmati Rb Of Sabarmati And Upper Part Beyond Hathmati	1 1
	Sabarmati Total		2
Banaskantha Total			74

Sources: http://cgwb.gov.in/watershed/cdkutch.html



A.4. Climate

A.4.1. Type of Climate: Semi - arid

The Banaskantha has semi-arid climate. Climate in the district is characterized by the hot summer and dryness in the non-rainy seasons. The year is marked by four distinct seasons i.e. cold from December to February followed by the hot season from March to May/ (mid-June). The south-west monsoon season is from mid-June to mid-September and Post monsoon season is from mid-September to end of October. May is the hottest month with mean daily maximum temperature of 410 C. January is the coldest month in which the mean daily minimum temperature of 9.80 C recorded in 1998. Annual rainfall of the district is 578.8 mm and is mostly received during the south-west monsoon season from June to September.

A.5. Rainfall

Rainfall data in respect of 6 rain gauge station representing Banaskantha district have been collected from Water Resources Investigation (WRI), State Data Centre, Govt. of Gujarat, Gandhinagar. Data has been analysed for the year of 1981 to 2016 (36 years). The average annual rainfall of the area is 552.62 mm (year 1981-2016), although there is a considerable variation from year to year. It occurs generally during the months of June to September. The isohyetal map (Fig. 4.2) for the year 2016 shows the progressive decrease in annual rainfall towards the west. It is more than 690 mm in the east side and less than 290 mm

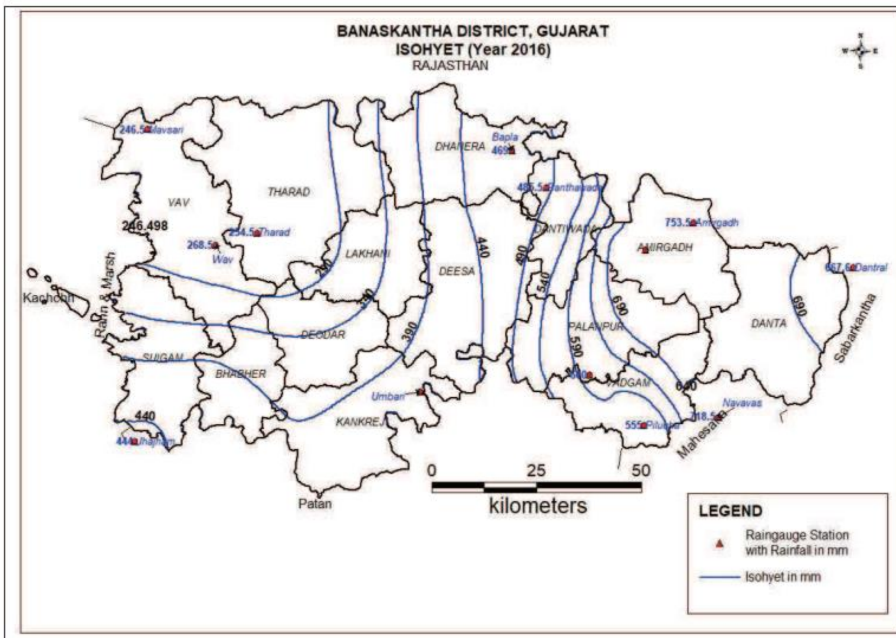


Fig.4.2 Isohyetal map year 2016, District Banaskantha.

YEAR	JAN		FEB		MAR		APR		MAY		JUN		JUL		AUG		SEPT		OCT		NOV		DEC	
	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP
2016	0.0	-100	0.0	-100	0.0	-100	0.0	-100	0.0	-100	19.9	-69	114.8	-48	233.4	29	20.2	-79	78.3	369	0.0	-100	0.0	-100
2017	0.0	-100	0.0	-100	0.0	-100	0.1	-84	0.3	-91	76.8	21	939.7	327	95.0	-48	25.3	-74	0.0	-100	0.0	-100	0.6	-43
2018	0.0	-100	0.0	-100	0.0	-100	0.0	-100	0.0	-100	32.1	-49	123.0	-44	54.3	-70	5.1	-95	0.0	-100	0.0	-100	0.0	-100
2019	0.0	-100	0.5	-59	0.0	-100	3.5	219	0.1	-98	73.5	16	116.2	-46	229.7	20	180.4	102	83.2	507	21.1	146	4.6	253
2020	0.0	-100	0.0	-100	6.6	185	0.0	-100	6.4	63	53.6	-16	86.7	-60	484.7	153	105.0	18	8.3	-40	0.0	-100	0.0	-100

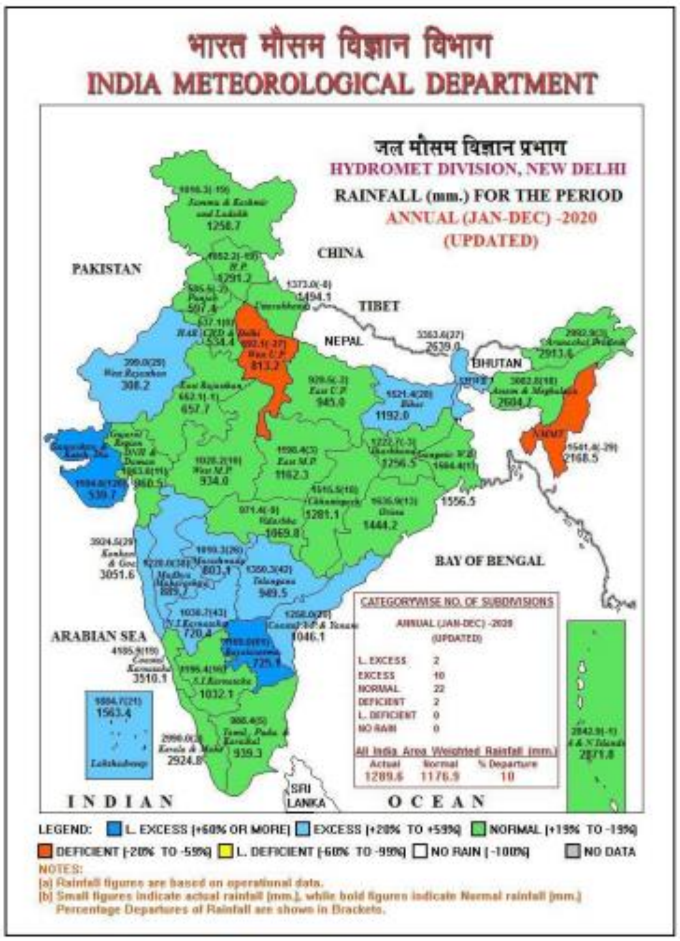
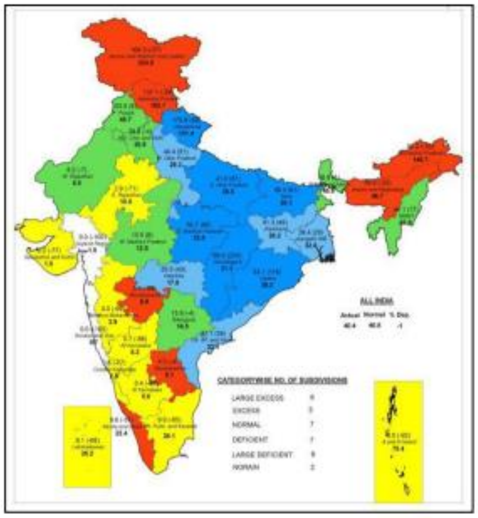


Figure-3.1 : Annual Rainfall Map-2020



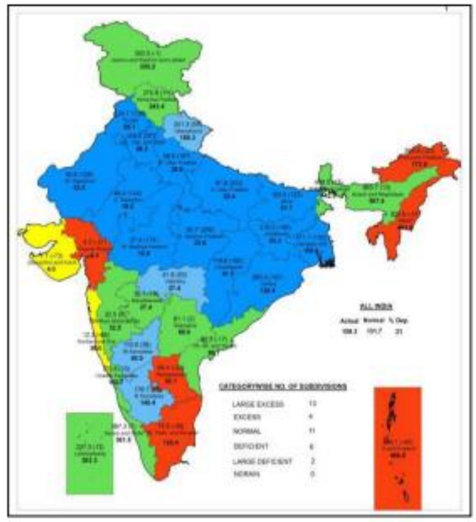


Figure-3.2 : Winter Rainfall Map **Figure-3.3 : Pre-Monsoon Rainfall Map**

Sources: http://cgwb.gov.in/documents/2022-11-11-GWRA%202022.pdf

Large Excess [60% or more] | Excess [20% to 59%] | Normal [-19% to 19%] | Deficient [-59% to -20%] | Large Deficient [-99% to -60%] | No Rain [-100%] | No Data

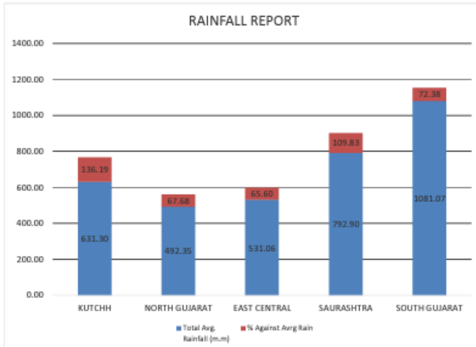
NOTES :
a) RainFall figures are based on operation data.
b) Small figures indicate actual rainfal (mm), while bold figures indicate Normal rainfall (mm).
c) Percentage Departures of rainfall are shown in brackets.

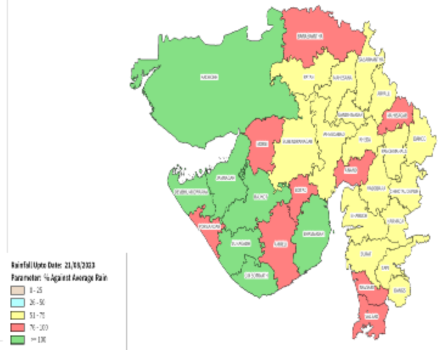
Table-3: The list of categories, their corresponding ranges and color codes

Category	Departure from Normals	Colour Code
Large Excess (LE)	60% or more	
Excess (E)	20% to 59%	
Normal (N)	-19% to +19%	
Deficient (D)	-20% to -59%	
Large Deficient (LD)	-60% to -99%	
No Rain	-100%	
No Data	Data Not Available	

8 - RAINFALL REPORT-ZONEWISE

Region	Avrg Rain (1993-2022)	Avg. Rain During last 24 Hrs.	Total Avg. Rainfall (m.m)	% Against Avrg Rain
KUTCHH	464	0.60	631.30	136.19
NORTH GUJARAT	727	2.84	492.35	67.68
EAST CENTRAL	810	3.95	531.06	65.60
SAURASHTRA	722	0.61	792.90	109.83
SOUTH GUJARAT	1494	5.48	1081.07	72.38
STATE	**877**	**2.81**	**711.44**	**81.16**





Source: http://www.gsdma.org/index.aspx

TOTAL RAINFALL FOR THE YEAR 2015-2022

Taluka/Year	Deesa (in mm)	Dhanera (in mm)	Lakhani (in mm)
2015	1068	1222	963
2016	452	392	392
2017	1266	1093	1105
2018	241	136	130
2019	777	660	684
2020	679	751	499
2021	708	465	272
2022	1125	757	741

A.6. Ground Water

A.6.1 Depth to water level

Since 1969, Central Ground Water Board, as a part of its national programme, has established a network of observation wells in the state of Gujarat and UT of Daman and Diu for periodic monitoring of water levels and the variation in quality of groundwater. At present 1039 (dugwells-655 & 384 piezometers) National Network monitoring Stations including 19 open wells and 42 Piezometers in Banaskantha district which form the important part of North Gujarat mainland are being monitored. Distribution of Hydrograph network stations in different units is presented below in table 4. The ground water scenario of the district is presented here

Table-4. Distributions of Monitoring Stations in Banaskantha District (Nov, 2010)

	Rock Type	Dug Wells	Piezometers	Total
Area				
	Hard rock	6	1	7
	Soft rock	13	41	54
	Total	19	42	61
Basin	**Subbasin**	**Dug Wells**	**Piezometers**	**Total**
Draining into Gulf	Rupam			25
Luni & other draining into Great Rann of Kutch	Luni			6
	Draining into Great Rann of Kutch			26
Sabarmati	Laft bank upto Hatmati			1
	Right bank beyond Hatmati			1
Total				59

Talukas	Dug Wells	Piezometer	Total
Amirgadh	3		3
Bhabhar		1	1
Danta	3	2	5
Dantiwada	4	1	5
Deesa	2	12	14
Dhanera	1	6	7
Diyodar		2	2
Kankrej	1	1	2
Palanpur	1	2	3
Tharad	4	3	7
Vadgaon		7	7
Vav		5	5
Total	**19**	**42**	**61**

A.6.2. Unconfined Aquifer

An unconfined aquifer is the most extensive aquifer occurring in the different hydrogeological units in the district with thickness ranging from 20 m in the northeast, west, and southern parts to about 70 meters in the central part of the district.

Depth to Water Level during the pre-monsoon period (Fig.-7.3) in 38% area falls in the range of 20 to 40 m bgl, in most parts of the district, 24% area in the range of 10 to 20 mbgl in western and eastern part of the area. The central part of the district comprises parts of Dhanera, Tharad, Lakahni, Deesa, Kankrej, Planpur, and Vadgaon are observed in deep water levels of more than 40 m bgl. The shallow water level 2 to 10 m bgl is observed in isolated patches in the western part and hilly region of the eastern part.

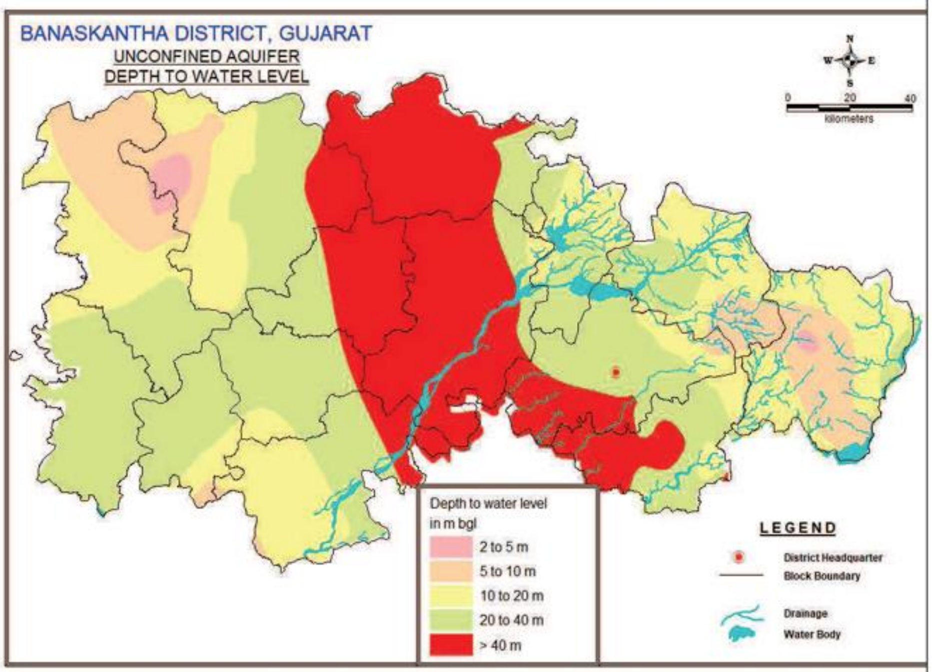


Fig. 7.3 Depth to water level in m bgl for the period of pre-monsoon 2016

During the post-monsoon period (Fig.- 7.4), 25% area falls in the water level range of 10 to 20 m bgl, 30% area in the range of 20 to 40 mbgl, and deeper water level of more than 40m bgl are observed in same parts of taluks as observed in the pre-monsoon period in the central part of the district. The shallow water level of 2 to10 m bgl is observed in isolated patches in the hilly region in the east and alluvial plain in the western part of the district. Pre-monsoon to post-monsoon fluctuation in the water level ranges from -0.5 m to more than 5 m in unconfined aquifers.

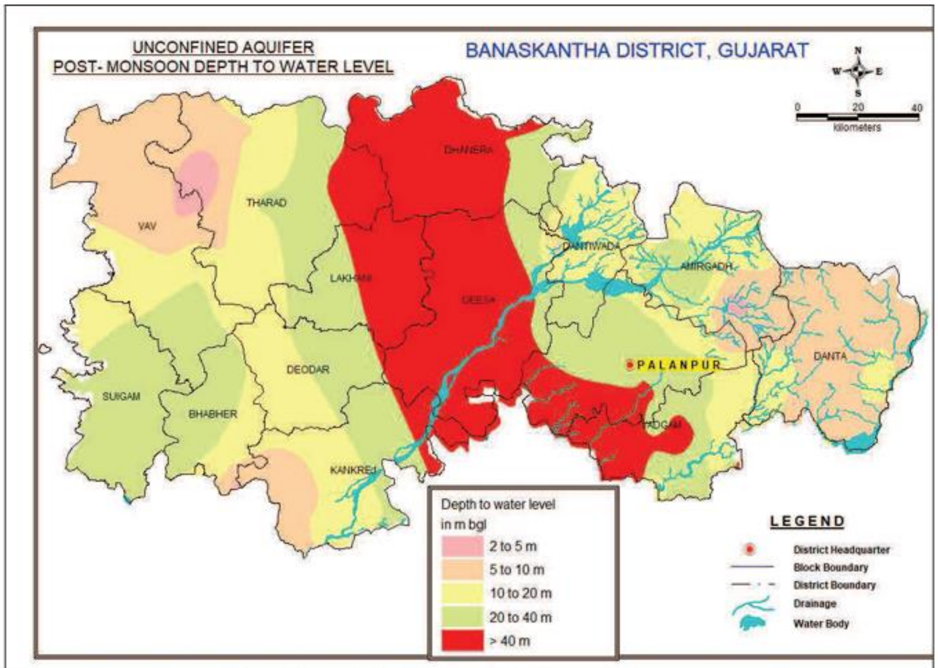


Fig. 7.4 Depth to water level in m bgl for the period of post-monsoon 2016

A.6.3. Confined Aquifer

Northern and central parts of the north Gujarat is underlain by the unconsolidated alluvial deposits of post Miocene age and semi consolidated Mesozoic and Tertiary sediments. These sedimentary formations form the most prolific multi-aquifer system comprising several confined aquifers. Confined aquifers in this area have been broadly grouped into, first confined (shallow) aquifer ranging in depth from 75 to 160 m bgl with an aerial extent up to Bharuch district and the second confined aquifer (deep) ranging in depth from 155 to 275 m bgl extended up to Anand district. These aquifers extend from the foothills of the Aravallis in the northeast to the little Rann of Kachchh in the west. During the premonsoon, 2010, depth to water level recorded in the range of 18.12 mbgl in Vadgam talukas to 108.57 mbgl in Deesa Taluka in confined aquifers. In the postmonsoon, 2010, depth to water level in the range of 17.38 mbgl in Vadgam talukas to 199.15 mbgl in BhabharTaluka in confined aquifer was observed. Pre-monsoon to post monsoon fluctuation in the water level ranges from 1 m (Rupal, Rah) to more than 10 m at Miyal in aquifers under semi confined and confined conditions with most frequent range being 5 to 8 m

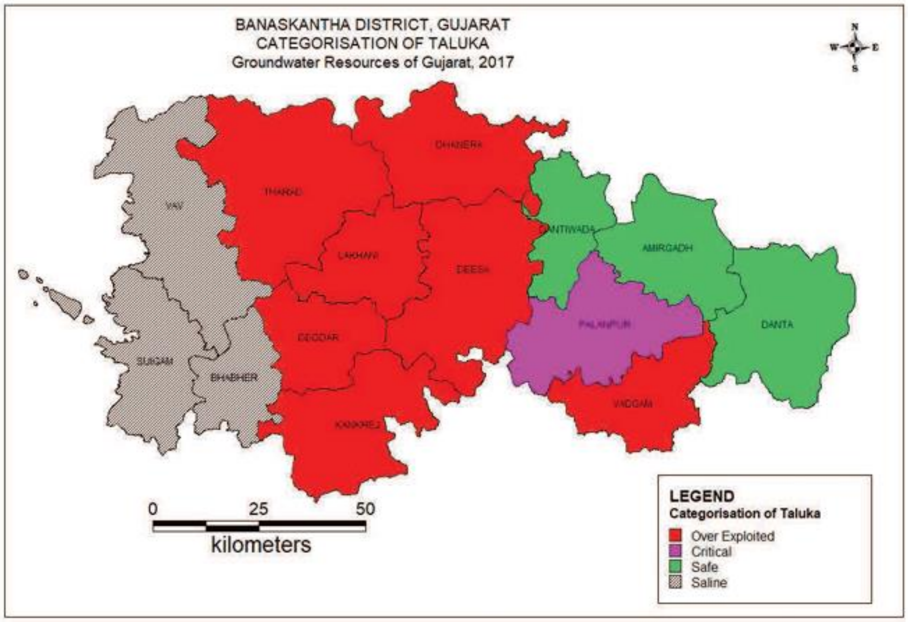


Figure 9.1 Categorization of Taluks for Ground Water Resource Development year 2017.

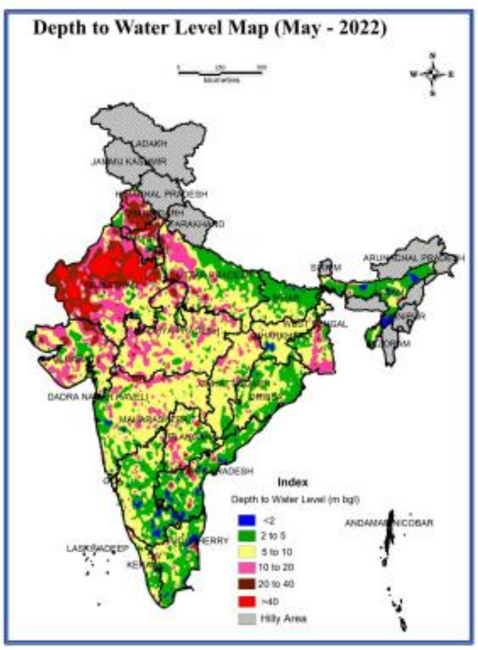
Taluka Wise Ground Water Resources, Availability, Utilization and Stage of Ground Water Development- 2022																
DISTRICT- BANASKANTHA																
Sr No	Taluka	ANNUAL REPLENISHABLE GROUND WATER RESOURCES (Ham)				Total Annual Ground water Recharge (3+4+5+6)	Environmental Flows (ham) (5% of 7 for WTF & 10% of 7 for RIF)	Annual Extractable Ground water Resource (ham)	ANNUAL GROUND WATER DRAFT (Ham)				Allocation of Ground Water Resource for Domestic Utilisation for projected year 2027 (ham)	Net Annual Ground Water Availability for Future Use (ham)	Stage of Ground Water Extraction (%)	Categorization of Assessment Unit
		Monsoon		Non Monsoon												
		Recharge from Rainfall	Recharge from Other Sources	Recharge from Rainfall	Recharge from Other Sources				Irrigation	Industrial	Domestic	Total Draft (10+11+12)				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	**AMIRGADH**	5319.11	1864.09	0.00	2146.49	9329.69	932.97	8396.72	4128.70	0.72	426.64	4556.05	473.54	3793.77	54.26	safe
2	**BHABHAR**	Saline														
3	**DANTA**	7734.91	2262.18	0.00	2648.54	12645.63	1264.56	11381.07	4786.60	0.65	304.48	5091.72	337.95	6255.88	44.74	safe
4	**DANTIWADA**	4040.61	1535.63	0.00	1795.89	7372.13	737.21	6634.92	7723.60	1.88	198.05	7923.53	219.83	0.00	119.42	over_exploited
5	**DEESA**	17545.75	1829.85	0.00	2194.02	21569.62	2156.96	19412.66	31164.95	7.30	1203.02	32375.27	1335.27	0.00	166.77	over_exploited
6	**DEODAR**	3283.80	474.15	0.00	482.49	4240.44	424.05	3816.39	5213.15	7.60	126.70	5347.44	281.25	0.00	140.12	over_exploited
7	**DHANERA**	10934.16	1229.19	0.00	1229.19	13392.54	1339.26	12053.28	21711.75	1.77	621.99	22335.50	690.36	0.00	185.31	over_exploited
8	**KANKREJ**	6969.70	1319.96	0.00	1343.16	9632.82	963.29	8669.53	13106.75	5.84	410.61	13523.21	558.53	0.00	155.99	over_exploited
9	**LAKHANI**	8222.96	564.75	0.00	564.75	9352.46	935.25	8417.21	12144.25	0.00	446.52	12590.77	495.61	0.00	149.58	over_exploited
10	**PALANPUR**	12901.79	1440.53	0.00	1554.87	15897.19	1589.72	14307.47	11293.80	112.68	84.54	11491.01	93.83	2807.17	80.31	semi_critical
11	**SUIGAM**	Saline														
12	**THARAD**	3381.39	442.84	0.00	498.31	4322.54	432.25	3890.29	7024.80	5.48	61.00	7091.28	687.26	0.00	182.28	over_exploited
13	**VADGAM**	9058.63	1903.08	0.00	1918.48	12880.19	1288.02	11592.17	12216.75	0.00	222.50	12439.25	246.96	0.00	107.31	over_exploited
14	**VAV**	Saline														
	District Total	**89392.81**	**14866.25**	**0.00**	**16376.19**	**120635.25**	**12063.54**	**108571.71**	**130515.10**	**143.90**	**4106.05**	**134765.03**	**5420.39**	**12856.82**	**124.13**	**over_exploited**

Source: http://cgwb.gov.in/AQM/NAQUIM_REPORT/Gujarat/Banaskantha/NAQUIM_BK_Dist_Report_Banaskanta.pdf

Table – 5 Long Term Premonsoon Water Level Trends (2001 -2010)

Location	Rise (m/year)	Fall (m/year)	Location	Rise (m/year)	Fall (m/year)
Ambaji_Pz	0.4772		Kuchwada		0.6445
Amirgadh	1.3990		Lakhani i		3.0627
Aserda_Pz		3.1540	Lakhani ii		2.8140
Asodar		0.1310	Lakhani iii		2.6239
Balodhar_Pz-I		6.2742	Mahi twi		3.7976
Balodhar_Pz-II		5.8461	Meda	1.2754	
Balodhar_Pz-III		3.5514	Miyal ii		0.3316
Bhabhar iii		0.7298	Miyal iii		0.2454
Bharol1	0.0090		Miyal pz-i		2.5320
Biyok_Pz-I	8.6435		Mohabbat gadh		0.0089
Biyok_Pz-II		1.3740	Moti mahudi	0.6203	
Danta	1.3616		Palanpur_Pz	1.8439	
Dantiwada		0.0840	Palanpur2	1.7450	
Dhanera Pz- II		2.2419	Panthawada	0.1181	
Dhanera Pz-I		1.9442	Rah Pz-III		1.5531
Dharnodhar_Pz-I		3.7908	Rah_Pz I		1.6575
Ganapipli	0.0230		Rah_Pz II		1.5239
Gangodra	0.5003		Rasna(Repl)_Pz_I		0.3604
Iqbalgarh	1.7040		Ratanpur2	1.2126	
Jalotra Pz-I		0.5188	Rupal_Pz_I		0.4959
Jalotra Pz-II		0.2515	Rupal_Pz_II		0.3567
Jerda Pz-I		5.1198	Sankad		1.8584
Jerda Pz-II		8.6965	Sihori i		1.4425
Jhat	0.5801		Sodapur	0.2742	
Jorapura	0.8975		Vav ii		1.1373
Khoda		0.8266	Vav i		0.1921
Kidotar	0.5962				

Source: cgwb.gov.in/district_profile/Gujarat/Banaskantha.pdf



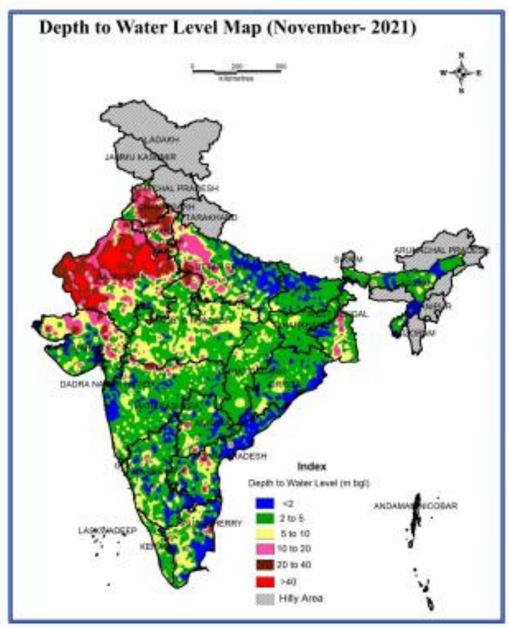


Fig-5.1: Pre-monsoon Depth to Water Level Map (2022)

Fig-5.2: Post-monsoon Depth to Water Level Map (2019)

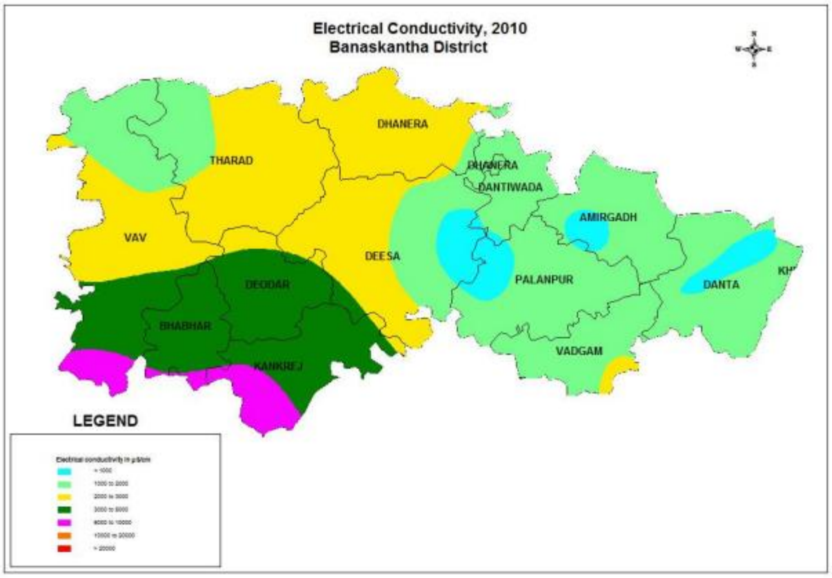
A.6.4. Ground Water Related Issues and Problems

Distribution of source of water supply to the 1238 villages of the district is mostly dependent on groundwater or wherever the ground water quality is saline, villages are dependent on the regional water supply schemes. Summary of the source of drinking water supply and potability of groundwater in the district as a whole indicated that about 16% of the sources are non potable due to salinity and about 21% due to excess fluoride in ground water and 63% source are potable.

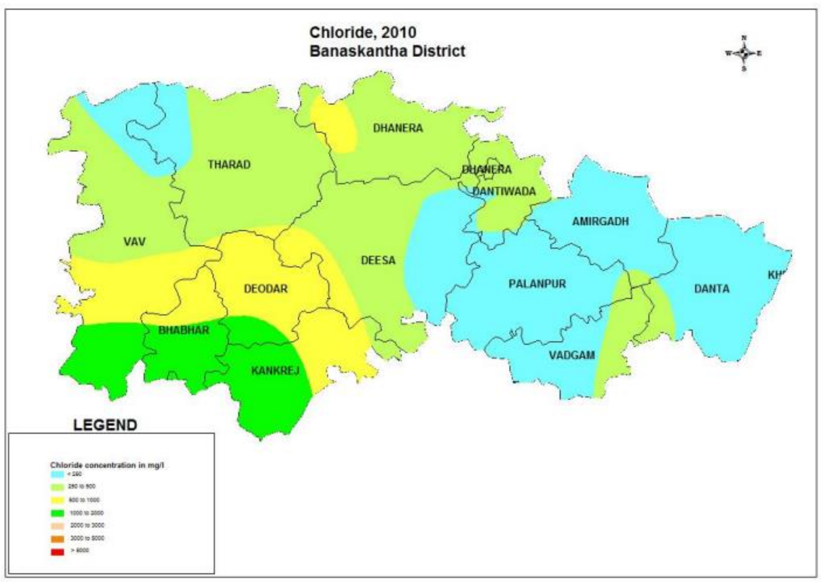
- Steady decline in water level due to - heavy withdrawal of groundwater owing to intensive irrigation which demands unhindered development of freshwater resources.
- Severe depletion in water level has led to a large number of failures of tube wells in many parts of the district. Farmers who invested heavily in newer technology and deeper wells were severely affected economically. In the quest for more water deeper wells are drilled which resulted in further monetary loss.
- Ever increasing population as well as industrialization has led to great demand and thus immense pressure on freshwater resources.
- Deterioration in quality of groundwater.
- Quality of ground water gradually deteriorates from east (recharge zone) to west and south west (discharge zone).
- Saline water in Vav, Bhabhar talukas and most part of Tharad taluka. Higher EC value (3000 to more than 5000 µs/cm) in most parts of Bhabar, Diyodar and kankrej taluka.
- High concentration of fluoride in Danta, Vadgam, Amirgarh, Dhanera talukas and excess nitrate (Vadgam, Palanpur, Deesa, Dhanera) in most of the talukas.
- Tharad taluka: Except for 34 villages rest of the villages are dependent on the regional water supply scheme as the quality is saline. Over withdrawal of ground water resources for irrigation leads to continuous decline in water level in the taluka.
- Bhabar, Diyodar Taluka -The quality of water is saline upto depth of 130-150 mbgl. Aquifer below this depth is under huge stress as groundwater development is more. Excessive withdrawal of groundwater resources for irrigation leads to continuous decline in water level in the taluka
- Vav Taluka: The quality of groundwater is saline because of marshy land, and salt/ mud flats devoid of vegetation (Rann). The villages are dependent on the regional water supply scheme as the quality is saline.

The farmers have no control over the power supply, therefore they irrigate the crops by groundwater when a power supply is available rather than waiting for the wilting to start.

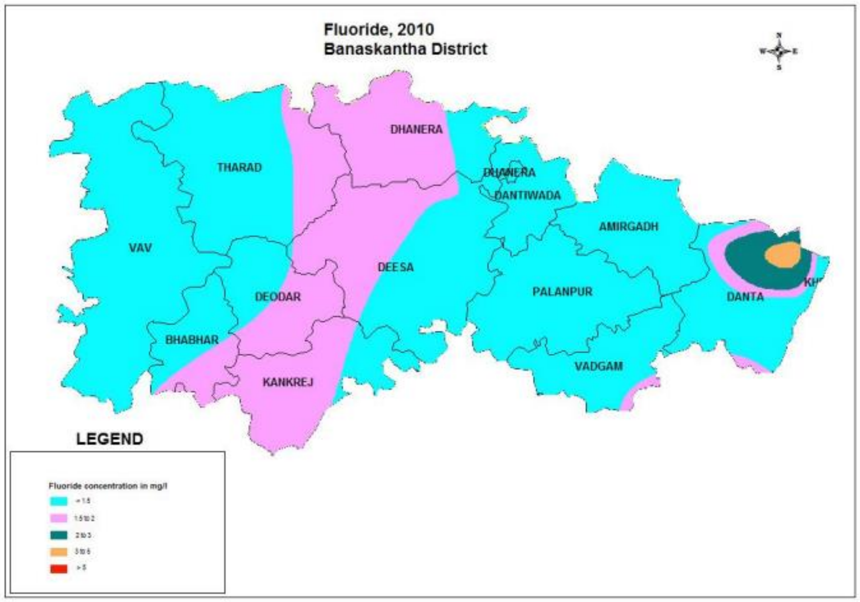
Flood irrigation technique which is practiced in the area is also the major cause of wastage of ground water as there is no control on the watering depth.

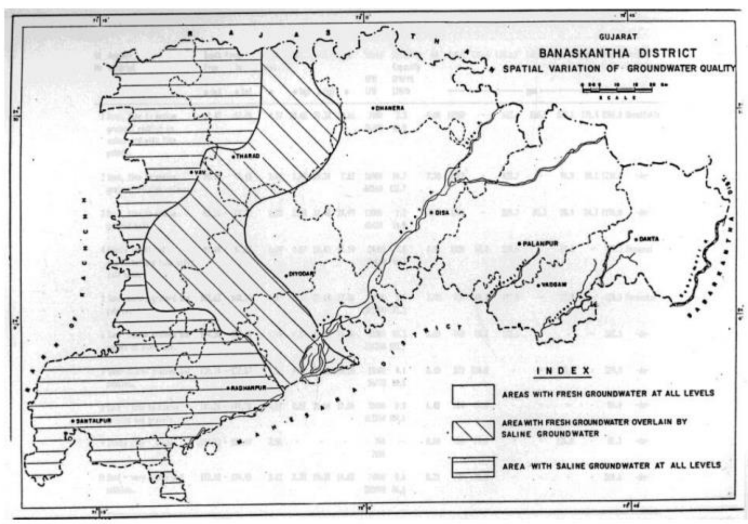


Electrical Conductivity, 2010
Banaskantha District
DHANERA
THARAD
DHANERA
DANTIWADA
AMIRGADH
VAV
DEESA
PALANPUR
DANTA
DEODAR
BHABHAR
VADGAM
KANKREJ
LEGEND



Chloride, 2010
Banaskantha District
DHANERA
THARAD
DHANERA
DANTIWADA
AMIRGADH
VAV
DEESA
PALANPUR
DANTA
DEODAR
BHABHAR
VADGAM
KANKREJ
LEGEND
Chloride concentration in mg/l
< 250
250 to 500
1000 to 2000
2000 to 3000





As per available information about drinking water sources about 16% of the wells are non potable due to salinity and 21% are due to fluoride beyond permissible limit.

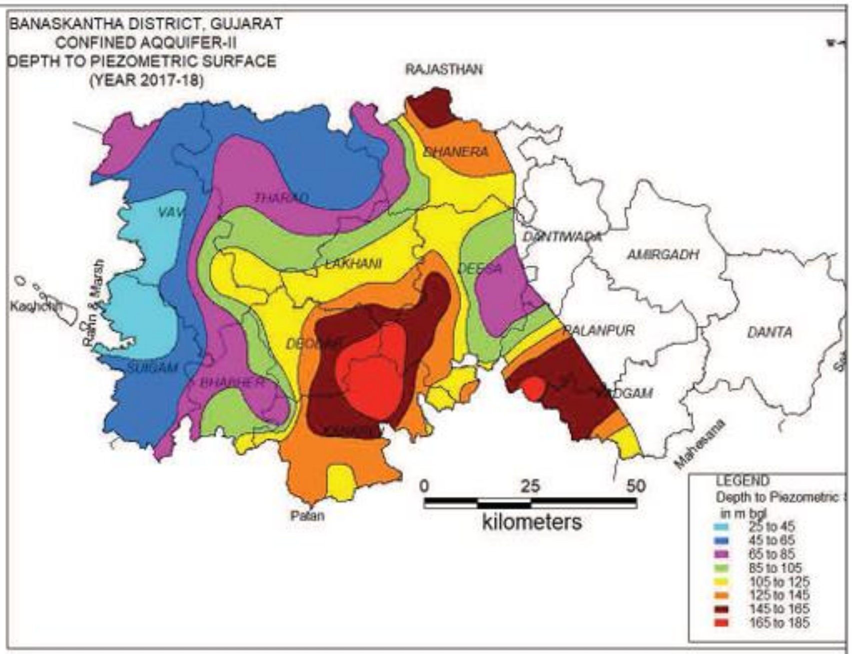


Fig.7.6 Depth to piezometric surface below ground level of confine Aquifer – II, year 2017-18

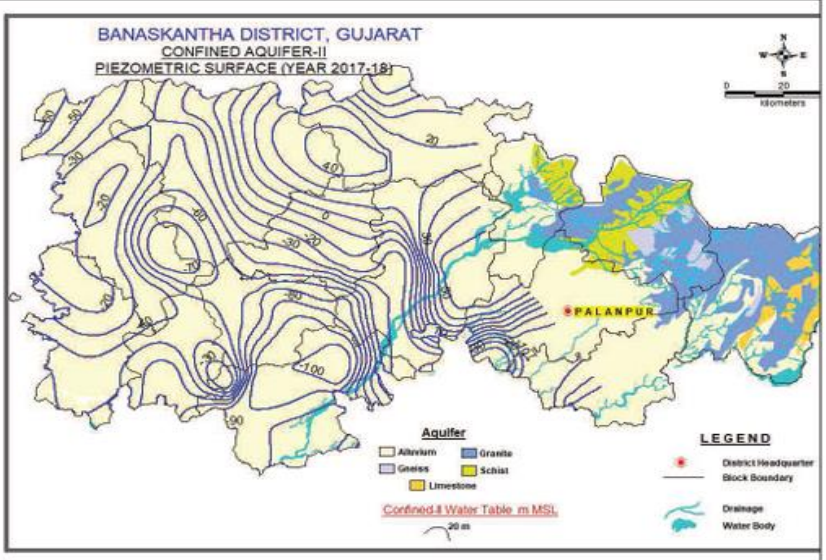


Fig. 7.7 Piezometric surface of water in m mean sea level (msl) of Confined aquifer-II

A.7. Alternate methods

The surface water resources of the district are very limited. Groundwater is the main source of irrigation. There are no perennial rivers flowing through the district. Important Irrigation schemes of the districts are Dantiwada, Mukteshvar Irrigation Project, Sipu Reservoir Project and Hadmatiya Irrigation Scheme.

All this irrigation scheme is not an option for recharging groundwater levels using rainfall and other sources near residential constructions, hence RWHs were the most cost-effective and logical option given the space constraints.

So the project proponent has chosen the option of recharging their existing Borewell for future use using rainfall.

Artificial recharge structures (ARSs) that have been identified and installed:

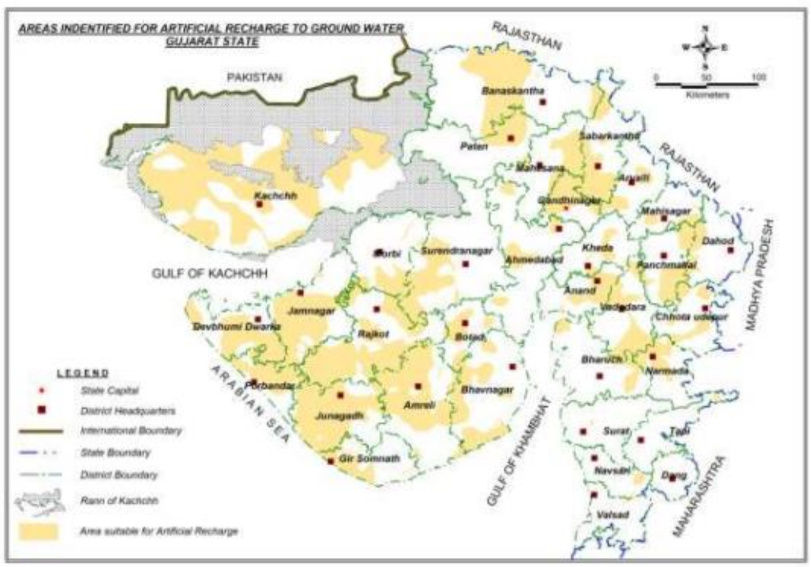


Fig 8.6.1 Area identified for Artificial Recharge in Gujarat

Table: 11.3 Status of recharge structures as on 2018 in Banaskantha district (source Groundwater Resource Estimation 2017 Gujarat State

Taluka	Fresh area – Recharge structures Fresh area				Saline area – Recharge structures saline area				Total Recharge structures – Total Recharge structures			
	Tanks	Percolation Tanks	Check Dams	Total Recharge in MCM	Tanks	Percolation Tanks	Check Dams	Total Recharge in MCM	Tanks	Percolation Tanks	Check Dams	Total Recharge in MCM
AMIRGADH	13	66	1387	12.81	0	0	0	0	13	66	1387	12.81
BHABHER	0	0	0	0	40	6	285	3.56	40	6	285	3.56
DANTA	100	49	1736	15.88	0	0	0	0	100	49	1736	15.88
DANTIWADA	50	13	1085	9.75	0	0	0	0	50	13	1085	9.75
DEESA	51	13	534	6.65	0	0	0	0	51	13	534	6.65
DEODAR	75	36	132	2.14	20	1	0	0.05	95	37	132	2.19
DHANERA	60	7	326	4.1					60	7	326	4.1
KANKREJ	44	12	750	9.22	30	14	1	0.23	74	26	751	9.45
LAKHANI	44	12	750	9.22	0	0	0	0	44	12	750	9.22
PALANPUR	88	62	793	10.41	0	0	0	0	88	62	793	10.41
SUIGAM	0	0	0	0	86	1	85	1.18	86	1	85	1.18
THARAD	130	6	79	1.24	45	6	0	0.15	175	12	79	1.39
VADGAM	54	66	1216	15.47	0	0	0	0	54	66	1216	15.47
VAV	0	0	0	0	142	3	190	2.55	142	3	190	2.55
Banaskantha District	709	342	8788	96.89	363	31	561	7.72	1072	373	9349	104.61

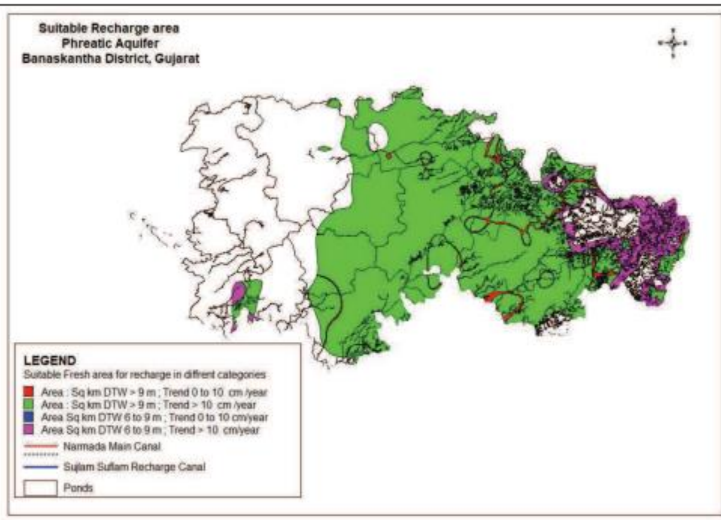


Fig.11.4 Suitable recharge area

Table 11.4 Computation of suitable recharge area in sq. Km.

Taluka	Area : Sq km DTW > 9 m ; Trend > 10 cm /year	Area : Sq km DTW > 9 m ; Trend 0 to 10 cm /year	Area Sq km DTW 6 to 9 m ; Trend > 10 cm/year	Area Sq km DTW 6 to 9 m ; Trend 0 to 10 cm/year	Grand Total
AMIRGADH	355.76	25.59	80.64	12.45	474.44
BHABHER	0.00		0.00		0.00
DANTA	201.18	23.35	478.18	51.78	754.49
DANTIWADA	414.70	0.00			414.70
DEESA	1044.89				1044.89
DEODAR		49.52			49.52
DHANERA	749.28	6.26			755.53
KANKREJ	284.00				284.00
LAKHANI	486.59				486.59
PALANPUR	779.38				779.38
SUIGAM	0.00		0.00		0.00
THARAD	160.00				160.00
VADGAM	512.35				512.35
VAV					0.00
Banaskantha	4988.13	104.71	558.82	64.23	5715.89

Source:http://cgwb.gov.in/AQM/NAQUIM_REPORT/Gujarat/Banaskantha/NAQUIM_BK_Dist_Report_Banaskanta.pdf

A.8. Design Specifications

A.8.1. Shape of the Farm Pond

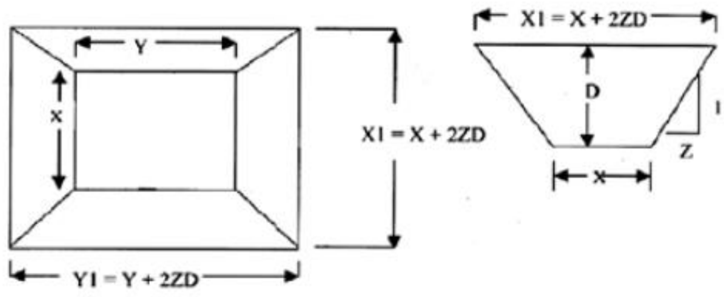
Excavated farm ponds are of two types viz. square and rectangular. However, the square pond is most commonly adopted having less evaporation and seepage area compared to a rectangular pond and this is easy to construct.

Here also the PP has constructed Square Pond on the project activity site. (i.e. Deesa, Dhanera, and Lakhani Taluka)

A.8.2. Dimensions of the farm Pond

Side slopes: The side slopes are decided by the angle repose for the sub-soil. Where the soils are very deep (more than 90 cm), the angle of repose for the deep black soils may also have to be considered. The constant action of standing water may require relatively flatter side slopes to avoid slippage due to saturation. Generally, the side slopes of 1.5:1 would be sufficient for the murrum obtained under the soils in this tract.

The design detail, construction procedures are as follows.

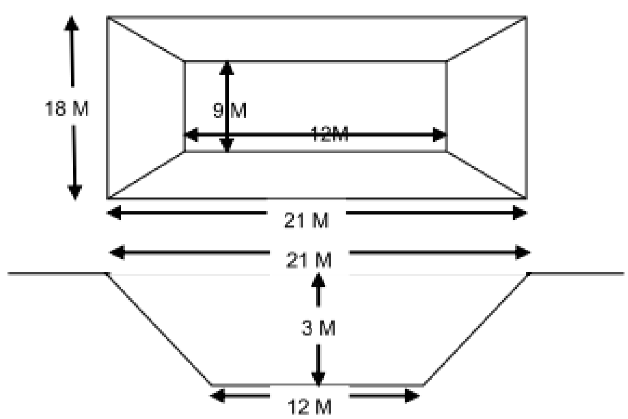


Dugout Farm Pond

NB: For square section X = Y

A.8.3. Structural Design of Farm Pond

This image shown here is for the reference purpose only the actual pond size may be vary



Source: https://www.cse.iitb.ac.in/~pocra/References/Rainwater%20Harvesting%20CRIDA.pdf

Below table shows the estimated size of farm pond based on the availability of the land of the farmer.(for reference purpose only)

Sr. No.	Land Area (in Hector)	Pond Size (L x W x H) in meter)
1	0.5 ha	15 x 15 x 3
2	1 ha	18 x 21 x 3 or 21 x 23 x 3

Source: https://www.cse.iitb.ac.in/~pocra/References/Rainwater%20Harvesting%20CRIDA.pdf

A.8.4. Seepage and Evaporation losses

As Banaskantha observes the high aridty during the summer season, the water stores in tanks, ponds and other small reservoirs can lead to heavy losses through evaporation.

The most efficient way of storing the water locally is to create reasonably sized ponds consistent with the catchment area.

The substantial water seepage loss in an unlined pond depends on the type of soil.

In USA, seepage rates of soil groups measured in Idaho using ponding tests are given in table below

Seepage Rate With Different Soil Types	
Soil Types	Seepage
Clayey	7 cm/day
Silty	23 cm/day
Loamy	29 cm/day
Sandy	48 cm/day

Source: https://www.cse.iitb.ac.in/~pocra/References/Rainwater%20Harvesting%20CRIDA.pdf

The water lost through seepage from ponds is priceless, so the approach for seepage control is lining the pond. The PP has used Geomembranes as lining material. Geomembranes are plastic sheet/film material, being highly extensible; these sheets readily adjust to the sub grade settlement. These sheets are highly impermeable to water and have lifespan of 30+ years.

Evaporization from the lining farm pond is depends on the storage time period so approx. 38% to 68 % can evaporate from the storage of 3.5 to 6.5 months. So it is more important to choose the correct irrigation method to minimize the rate of the evaporization. Also one can use the lift irrigation method to reduce the seepage and evaporation rate.

Table 3. Seepage losses in field size farm ponds	
Head (m)	Combined seepage and evaporation losses in lined farm Pond (mm/day)
0.0-1.0	28.5
1.0-2.0	63.6
2.0-3.0	96.0
Small catchment (Cultivated area)	
0.0-0.05	
0.5-1.0	26.23
1.0-1.5	36.56
1.5-2.0	47.87
2.0-2.5	91.33

Source: https://www.cse.iitb.ac.in/~pocra/References/Rainwater%20Harvesting%20CRIDA.pdf

For the different villages of Deesa, Dhanera and Lakhani Taluka of Banaskantha district 109 Farm ponds have been constructed. Among them 70% of the farm ponds are covered with Geomembranes sheet and 30% of the farm ponds are built by applying the layer of soil and cement mixtures.

Hence among all the 109 farm ponds, the farm ponds with Geomembranes sheets layered are being used or reused for different purposes like irrigation water for cattle's, drinking, etc. The farm ponds which are having the layer of soil and cement mixture will gets some small cracks into it within the passing year of time so by the mode of this cracks water gets into it ground level and will helps in improving the ground water table along with the other usage. Some of this farm ponds are also helping in the recharging their Borewell.

The approximated catchment area of the farm pond is 1600 to 2500 **sq.mt. of each pond. The total catchment area of all 109 farm ponds is approximately 1,64,737 Sq.mt.. Hence approx. 6-8 million liter of water can be stored in each farm pond during the heavy rainfall seasonal.**

So approx. 400 million liter of water can be stored in all the 109 farm ponds.

On-site Farm Pond Images:





A.9 Implementation Benefits to Water Security

The artificial recharge of groundwater by the project activity aims at the augmentation of groundwater reservoirs by modifying the natural movement of surface water utilizing suitable civil construction techniques, such as rooftop rainwater harvesting.

Such artificial recharge techniques normally address the following issues –

- Serve as alternatives to enhance the sustainable yield in areas where overdevelopment has depleted the aquifer.
- Serves to conserve and store excess surface water for future requirements, since these requirements often change within a season or a period.
- Serves as simple alternatives to improve the quality of existing ground water through dilution.
- Avoids the flooding of roads.
- Raises the underground water table
- Reduces groundwater pollution
- Reduces soils erosion
- To meet water demand for domestic, animal and recreational use.
- To provide lifesaving / supplemental / irrigation to crops and plantation
- To improve moisture status of the soil profile

- To spray insecticides /pesticides in crop management
- Supplements domestic water needs

The basic purpose of artificial recharge of ground water is to restore supplies from aquifers depleted due to excessive ground water development. The availability of source water, one of the prime requisites for ground water recharge, is basically assessed in terms of non-committed surplus monsoon run off, which as per present water resource development scenario is going unutilized. This component can be assessed by analyzing the monsoon rainfall pattern, its frequency, number of rainy days, and maximum rainfall in a day and its variation in space and time. The variations in rainfall pattern in space and time, and its relevance in relation to the scope for artificial recharge to sub-surface reservoirs can be considered for assessing the surplus surface water availability.

A 9.1 Objectives V/s Outcomes

Objectives:

The major objective was to make the area water sufficient and poverty-free while increasing the water-harvesting capacity of the village. Ensuring participatory planning and educating peoples on watershed management.

The impact assessment of this RWH scheme can generally be enumerated as follows:

- Conservation and harvesting of surplus monsoon runoff in ground water reservoir which otherwise was going un-utilised outside the watershed/ basin and to sea.
- Rise in ground water levels due to additional recharge to ground water. In case where continuous decline of ground water level was taking place, a check to this and/or the intensity of decline subsequently reduces. The energy consumption for lifting the water also reduces.
- The ground water structures (recharge wells) in the benefitted zone of artificial structures gains sustainability and the wells provides water in lean months when these were going dry.
- The domestic wells have become sustainable and many of the areas become tanker free.
- Green vegetation cover has increased in the zone of benefit and also along the structures due to additional availability of soil moisture.
- The quality of ground water has improved due to dilution.

- Besides the direct measurable impacts, the artificial recharge scheme generates indirect benefit in terms of decease in soil erosion, improvement in fauna and flora, influx of migratory birds, etc.
- Catchment area and pond management have a direct impact on groundwater levels and there are visible signs around the catchment area of the project activity site.

Outcome:

Farm ponds were made deeper than usual to conserve more rainwater and to ensure its availability for a longer duration. Changes in cropping pattern led to increased incomes. Higher yield and improved production of paddy. Better yield in the lowlands due to water storage and seepage. Increased confidence of community members on farm ponds for irrigation. Vegetable farming using trellis proved profitable and many farmers now plan to grow more vegetables using water stored in the farm ponds.

A.9.2 Interventions by Project Owner / Proponent / Seller

Increase in population density and improvement in quality of life has resulted in an increase in demand of natural resources like water. Groundwater being the major source of water supply catering to about 85% of rural water supply, the stress on groundwater is ever increasing. It has resulted in over-exploitation of the resources at places. The situation demands for a reorientation of the strategy for its development and management. Scientific understating of the hydro geological conditions and the aquifer systems are the important inputs for sustainable management of ground water resource so that the requirement of present generation is met without compromising the ability of future generations to meet their own needs. Large areas of Banaskantha district have been experiencing declining ground water levels due to over-exploitation.

The intervention of the PP and the local villagers has had a direct impact on the water security of the area. After construction of the farm pond villagers had to no longer depending upon the other water supply or not have to travel any miles for having water. The farm ponds will also make them efficient use of water conservations and also help them with the new technology of irrigations to make them extra income.

A farmer can also utilize the excavated soil during the dugging process of farm pond

Prior to the implementation of the project activity, the local villagers received very less amount of water for daily use and irrigation. They had to rely on water supplied by local water tankers (arranged by the village authorities) for their daily water needs or the women’s of the villages have to travel long for having water for their daily needs

Hence clearly indicating that such rainwater harvesting systems need to be scaled across the state which is cost effective and farmers can get direct benefits from it.

A.10. Feasibility Evaluation

As stated in section A.7, check dams is not a viable option for recharging of groundwater using rainfall in the area. Recharge wells and soak pits are the most feasible option to recharge the groundwater in the village. This is clearly evidenced by the improved groundwater table and improvement in drinking water availability for the villagers.

A.11. Ecological or Sustainable Development Goals (SDG's) Aspects

Unfortunately, in the modern era, the age-old methodology of rainwater harvesting is greatly neglected. Years of negligence, and short-sighted water management policies that mostly rely on overexploitation of ground and river water, has once again brought rainwater harvesting to the fore because of its life-saving qualities. Rainwater harvesting and management hold tremendous potential for alleviating storm water runoff and reducing groundwater consumption, particularly in urban areas. Though the costs of installing modern rainwater harvesting systems, storing, and treatment of rainwater was an area of concern earlier, but now with the advent of new technologies, the investment has a positive return. Today, rainwater harvesting systems are acting as incredible support systems in many Indian cities, providing a superb alternative to the main water supply, especially during dry seasons. Moreover, the advantages of storing rainwater are not only limited to a particular individual or a family, but it is coming off as a lifesaver for many urban communities as well. Widespread installation of these systems is also revitalizing the natural properties of land, helping to improve the quality of groundwater, raising its level, and preventing wells and tube wells from drying up. Additionally, efficient deployment of rainwater harvesting systems is limiting surface runoff of water, which is reducing soil erosion, and increasing its fertility.

Ecological issues addressed by the project activity in terms of	
Inundation of habitated land	The project is a RWHs and hence does not lead to inundation of residential land.
Creation of water logging and vector disease prevention mitigation	The catchment area and bore wells are inter-related and provide potable drinking water to the villagers and water is pumped daily to nearby fields for irrigation. There has been no reported outbreaks of vector borne water diseases in the area due to the project activity.
Deterioration of quality of groundwater	Recharging water into the aquifers helps in improving the quality of existing groundwater through dilution.

The project activity in Banaskantha district of Gujarat, complies the following sustainability goals

Sustainable Development Goals Targeted	Most relevant SDG Target / SDG Impact	Indicator (SDG Indicator)
Goal 1: End poverty in all its forms everywhere	1.4: By 2030, ensure that all men and women, in particular the poor and the vulnerable, have equal rights to economic resources, as well as access to basic services, ownership and control over land and other forms of property, inheritance, natural resources, appropriate new technology and financial services, including microfinance	1.4.1 Proportion of population living in households with access to basic services
Goal 3: Ensure healthy lives and promote well-being for all at all ages	3.9: By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination	3.9.2 Mortality rate attributed to unsafe water, unsafe sanitation and lack of hygiene (exposure to unsafe Water, Sanitation and Hygiene for All (WASH) services)
Goal 6: Ensure availability and sustainable management of water and sanitation for all	6.1: By 2030, achieve universal and equitable access to safe and affordable drinking water for all 6.4: By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity 6.b: Support and strengthen the participation of local communities in improving water and sanitation management	6.1.1: Proportion of population using safely managed drinking water services 6.4.2: Level of water stress: freshwater withdrawal as a proportion of available freshwater resources 6.b.1: Proportion of local administrative units with established and operational policies and procedures for participation of local communities in water and sanitation management

Goal 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	8.5: By 2030, achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value 8.6: By 2020, substantially reduce the proportion of youth not in employment, education or training	Number of jobs created and people trained during the installation and maintenance process of the project activity.
Goal 10: Reduce inequality within and among countries	10.2: By 2030, empower and promote the social, economic and political inclusion of all, irrespective of age, sex, disability, race, ethnicity, origin, religion or economic or other status	Improved water security and therefore a stronger sense of independence and trust amongst villagers
Goal 11: Make cities and human settlements inclusive, safe, resilient and sustainable	11.1: By 2030, ensure access for all to adequate, safe and affordable basic services.	The PP provides SDW as a basic human right.
Goal 12: Ensure sustainable consumption and production patterns	12.2 By 2030, achieve the sustainable management and efficient use of natural resources	The PP will store and use the runoff rain water for further use

Goal 13: Take urgent action to combat climate change and its impacts	13.2: Integrate climate change measures into national policies, strategies and planning	Amount of water conserved

A.12 Recharge Aspects

The RWHs by creating small farm pond directly helps in irrigation throughout the year during non-monsoon season, also indirectly recharges their existing bore wells during the monsoon season when the pond gets full and overflow within the project boundary.

The farm pond in the area are filled with water during the non-monsoon season, clearly indicating that the groundwater recharge is successful. The RoU verifier can interview the users of the farm pond water during the verification process to confirm the same.

A.12.1 Solving for Recharge

Water Budget Component	Typical Estimated Uncertainty (%)	Description
Surface Inflow	1.0%	Typical range of accuracy from meters to minimum delivery accuracy requirements of delivery and diversion measurement devices.
Precipitation	4.0%	Typical range of accuracy from field-level rain gauges to extrapolation of local weather station data
Surface Outflow	NA	Typical range of accuracy from meters to estimated outflow relationships

Evapotranspiration	10.00%	Clemmens and Burt, 1997; typical accuracy based on free water surface evaporation coefficient.
Change in Storage	NA	Estimated accuracy of change in storage calculation based on field scale water budget calibration to observed water levels.
Deep Percolation	20%	Typical range of calculated accuracy from field-scale water budget results (fields ranging from 56 to 125 acres)
Total	**35.0 %**	

A.13 Quantification Tools

A.13.1 Baseline scenario

The baseline scenario is the situation where, in the absence of the project activity, unutilized rainwater flows uncollected into drains or is not conserved and harvested within the project boundary and hence remains unutilized.

Baseline scenario, if not directly measurable, is calculated by using the UWR Standard.

The PP has selected the following method from UWR standard

Harvested water or Volume of water utilized (m3)

= Area of Catchment / Roof / Collection Zone (m2) X Amount of rainfall (mm) X Runoff coefficient *Uncertainty Factor (1-0.35 = 0.65)

As per UWR RoU Standard:

Runoff coefficient

Surface Area	Runoff Coefficient (K)
2.1 Untreated Ground surface catchment	0.3

Area of Catchment: 1,64,737 Sq. mt

Quantification of RoUs

Year	Crediting Period	RoU's(1000 liters)/year
2021	01/01/2021 – 31/12/2021	46418
2022	01/01/2022 – 31/12/2022	84260

All calculations of RoUs for **rainwater harvesting systems are rounded down*

A.14 UWR Rainwater Offset Do No Net Harm Principles

According to the UWR RoU Standard principles, the project activity accomplishes the following:

1. **Increase the sustainable water yield in areas where over development has depleted the aquifer**

According to the data released by the Central Groundwater Board in 2021, the total amount of groundwater that can be utilised in India in a year is 398 billion cubic meters (BCM), of which, approximately 245 BCM is currently being utilised, which is about 62 per cent of the total. But the level of exploitation of groundwater is very high in States like Punjab, Rajasthan, Haryana, Delhi and Tamil Nadu. This project activity was commissioned in April 2015, prior to the monsoon season. In 2015 the village groundwater table was very low and the village authorities were able to supply only 40 litres of water per household with the rainwater harvest project the villagers are now able to get 250 litres of water per household. In 2019, the PP has also set up a RO (Reverse Osmosis) water filtration system to provide clean drinking water to the residents at a nominal cost. Revenue from the sale of UWR RoUs will enable scaling up of such project activities.

2. **Collect unutilized water or rainwater from going into storm drains or sewers**

Water conservation initiatives are taken up by the Central Government on continuous basis and are covered under various schemes and programmes such as **Jal Shakti Abhiyan: Catch the Rain" (JSA:CTR), Atal Bhujal Yojana, Pradhan Mantri Sinchayee Yojana (PMKSY), Sujalam Suflam Abhiyan, etc.**

Gujarat's Narmada, Water Resources and Water Supply Department has also come up with a plan to store the water wasted in the monsoon, Plastic- Polythene (Geomembrane) will be provided free of cost by the government for construction of farm ponds in water scarcity areas of 10 districts. A big corruption scandal was found with this scheme
Source: https://allgujaratnews.in/en/big-scandal-of-employment-in-gujarat/

In India, at the district level, in 24 states/UTs, as many as 267 districts had stages of groundwater extraction more than 63 per cent, ranging from 64 per cent to 385 per cent

source: https://www.businessstandard.com/article/current-affairs/from-58-to-63-india-pumped-more-groundwaterbetween-2004-and-2017-121122101377_1.html

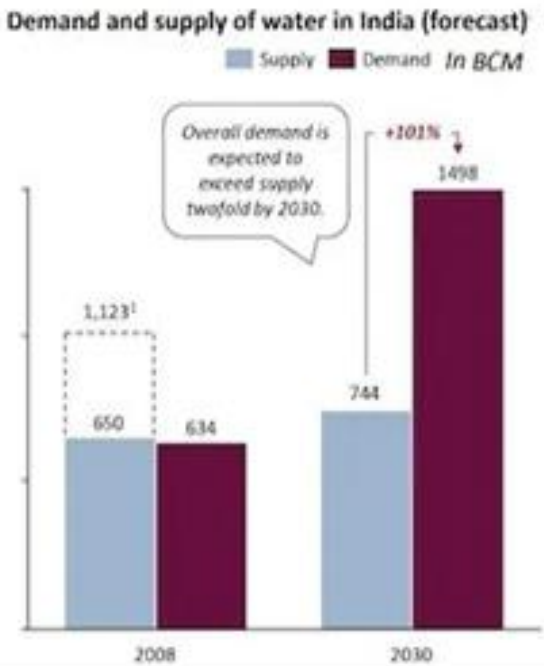
This project activity serves as an example to recharge unutilized water and and prevent water flowing into the drains uncollected. The project activity provides potable water for drinking purposes and agricultural purposes thereby preventing over exploitation of the groundwater aquifer. The project activity also helps in groundwater recharge efforts and water security of the country.

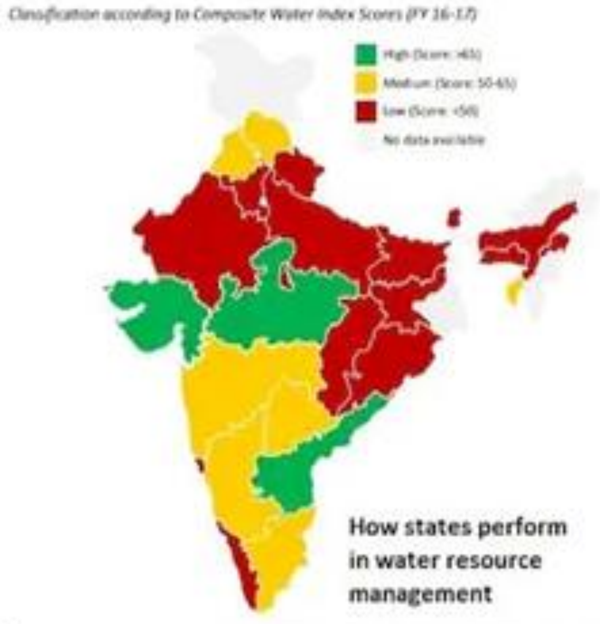
3. **Conserve and store excess water for future use**

RWH is responsible for lessening the load on primary water sources, adding fresh and potable water availability for the masses. In the urban areas, it is shown to be beneficial by increasing the efficiency of wastewater treatment plants since the need for clean water is compensated by the harvested rainwater, to a great extent. The project activity decreases the dependence on groundwater, thereby preventing excessive depletion.

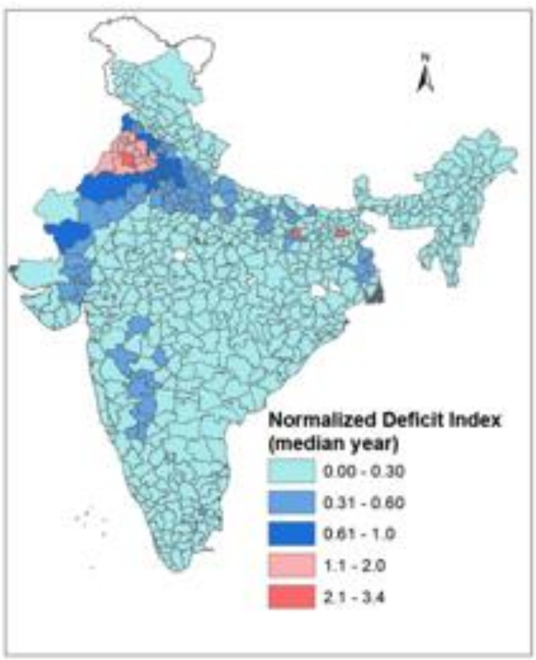
A.15 Scaling Projects

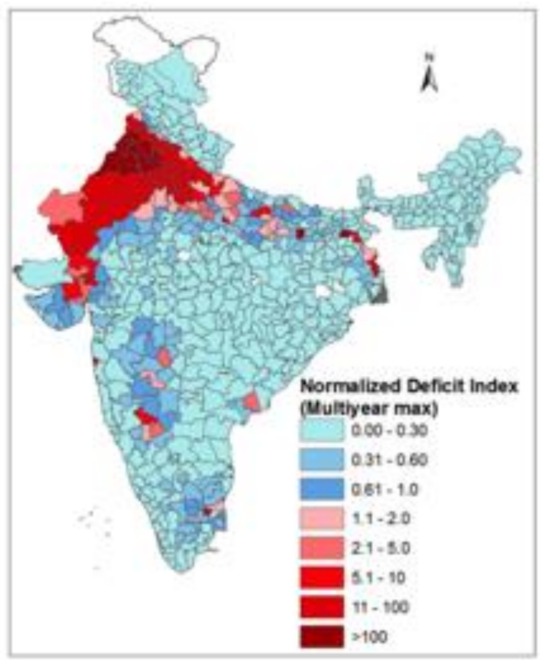
It is staggering to note that in a country of more than 1.3 billion people, 29 states and 4100 towns and cities, only two cities- Thiruvananthapuram and Kota, get continuous, 24×7 water supply, and all those cities with a population greater than 1 million, get water for around 3-4 hours a day.

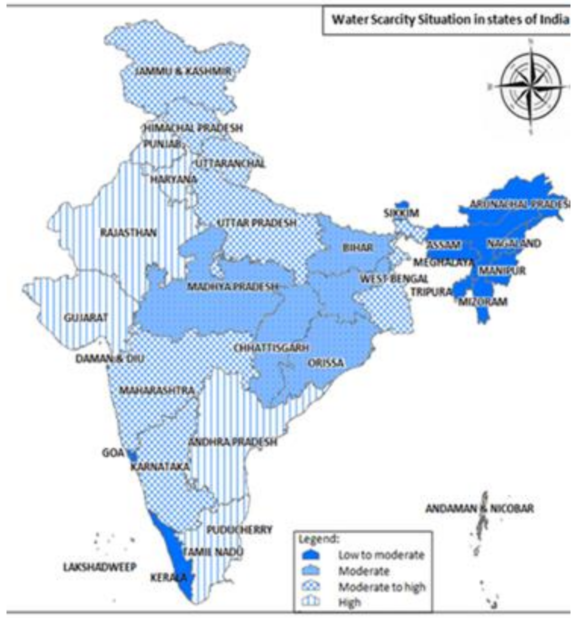




Source: NITI Aayog report

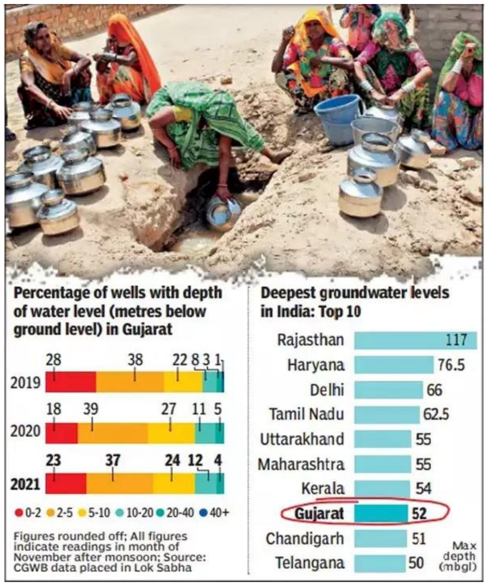


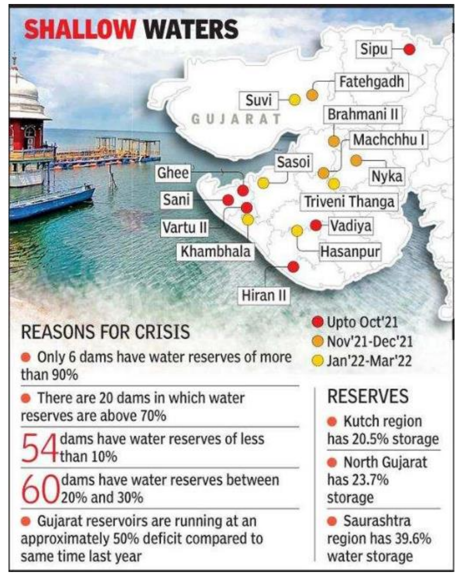




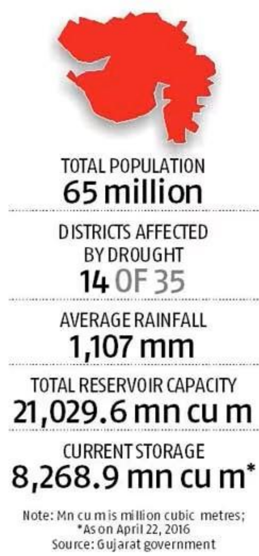
This is not due to lack of adequate infrastructure but due to mismanagement of the water distribution system in the districts. This results in a large section of the society, mostly the poor and downtrodden, consuming contaminated water for their basic sustenance, resulting in the spread of diseases.

The water scarcity of Gujarat


Percentage of wells with depth of water level (metres below ground level) in Gujarat
2019
28 38 22 8 3 1
2020
18 39 27 11 5
2021
23 37 24 12 4
0-2 2-5 5-10 10-20 20-40 40+
Figures rounded off; All figures indicate readings in month of November after monsoon; Source: CGWB data placed in Lok Sabha
Deepest groundwater levels in India: Top 10
Rajasthan 117
Haryana 76.5
Delhi 66
Tamil Nadu 62.5
Uttarakhand 55
Maharashtra 55
Kerala 54
Gujarat 52
Chandigarh 51
Telangana 50
Max depth (mbgl)


SHALLOW WATERS
GUJARAT
Sipu
Fatehgadh
Suvi
Brahmani II
Machchhu I
Sasoi
Nyka
Ghee
Triveni Thanga
Sani
Vadiya
Vartu II
Hasanpur
Khambhala
Hiran II
Upto Oct'21
Nov'21-Dec'21
Jan'22-Mar'22
REASONS FOR CRISIS
Only 6 dams have water reserves of more than 90%
There are 20 dams in which water reserves are above 70%
54 dams have water reserves of less than 10%
60 dams have water reserves between 20% and 30%
Gujarat reservoirs are running at an approximately 50% deficit compared to same time last year
RESERVES
Kutch region has 20.5% storage
North Gujarat has 23.7% storage
Saurashtra region has 39.6% water storage


READY RECKONER
Districts with maximum 'dark zone' talukas: Banaskantha, Gandhinagar, Mehsana, Kutch and Patan
More than 2mm
2 to 5mm
5 to 10mm
10 to 20mm
20 to 40mm
How to apply
All the applications will be online on the CGWB portal with identity documents and other proofs. The status of processing will also be updated online by officials. Officials said that with the new connections, installation of digital water flow meter (telemetry in case of commercial projects) and piezometers for monthly groundwater level monitoring will be mandatory. Installation of digital water level recorders (DWLR) is also mandatory for projects requiring groundwater in semi-critical areas
WHO'S EXEMPTED FROM THE NOC
(only for drinking and domestic purposes)
1 Individual domestic consumers in both rural and urban areas for drinking water and domestic uses
2 Rural drinking water supply schemes
3 Armed Forces Establishments and Central Armed Police Forces establishments in both rural and urban areas
4 Agricultural activities
5 Micro and small enterprises drawing ground water less than 10cum (cubic metres)/day
WHO HAS TO TAKE THE NOC
1 Individual household/ connection
2 Infrastructure projects/ industries/mining projects/ water supply agencies/others
IF YOU ARE A HOUSEHOLD
NOC required for delivery pipe of more than 1-inch diameter from single groundwater abstraction structure
Proof of ownership required for NOC
NOC will be granted only where a public supply system doesn't exist or supply is inadequate
Applicant will have to submit an affidavit on non-judicial stamp paper of Rs 10 confirming non/inadequate public water supply
NOC will be valid for up to 5 years or till the public water supply is available in the area
INFRA PROJECTS/INDUSTRIES/MINING PROJECTS/ PUBLIC WATER SUPPLY AGENCIES/OTHERS
Above pointers remain the same
Approval in form of terms of reference/ consent to establish/ consent to operate/ license by bodies such as the ministry of environment, forest & climate change, state pollution control boards, etc.
Water quality data of borewell/ tubewell/dug well in respect of existing projects from NABL-accredited laboratory
Use of recycled/treated wastewater for purposes such as flushing, green belt, etc. will be mandatory for new projects requiring more than 12.5 cubic metres per day of groundwater


TOTAL POPULATION
65 million
DISTRICTS AFFECTED BY DROUGHT
14 OF 35
AVERAGE RAINFALL
1,107 mm
TOTAL RESERVOIR CAPACITY
21,029.6 mn cu m
CURRENT STORAGE
8,268.9 mn cu m*
Note: Mn cu m is million cubic metres;
*As on April 22, 2016
Source: Gujarat government

The major issues in the villages of Banaskantha district is

- Day by day the level of groundwater goes down
- Less awareness amongst villagers on water conservation techniques
- Demand supply management
- Less awareness about the government projects related to water conservations

More systematic structures are needed. In some places, it exists but is not maintained. Cost is also a factor. It's a difficult area of work. It's simpler in open areas, parks, low lying areas, flood plains to create RWH structure. There are many areas where it is not being tapped. Only about 30% to 40% of the potential is utilised. There is no proper distribution in the city of RWH structures. In some parts, groundwater level is already low, while in some it's better. The pace of work has been slower in the last two years due to the pandemic. Another factor affecting the pace is budget.

Further, if not installed properly, it may attract mosquitoes and lead to waterborne diseases. Finally, storage limitations are an additional drawback. The State cannot harvest rain; people have to be involved. RWHs has to be done in every house; every colony; every village; and for every catchment.

Hence the UWR water credits program will serve as an initial spark to bring about change in rainwater management across India by providing an incentive to those who have already undertaken RWHs installation to monetize the past actions to build future climate resilience.

One hectare of land with just 100 of rain -- that's what even the most barren of Indian lands recieve on an average -- is capable of harvesting one million litres of water. A family of five would not need more than 10-15 litres a day for drinking and cooking. This comes to 4,000-5,000 litres in a year. This means one hectare can harvest enough water to meet the needs of 200-300 families.

With countless predictions that most major cities around the world are on the brink of running out or exhausting their groundwater supplies in the near future, it is extremely important to look beyond the conventional sources of sustenance and look towards adopting and adapting the non-conventional, renewable sources, essential for our survival.

Rainwater is a renewable source prevalent in areas with little to no rainfall, and the gathered water can be put to uses like irrigation and other domestic chores like toilet, flushing, washing, etc. It needs to be purified further in order to make it fit for drinking since rainwater collected from rooftops may contain animal and bird feces, dust particles and other particulate matter, and gases like Nitric and Sulphur oxide; which require elaborate purification setups, which are difficult to install, operate and maintain at the domestic level.

As for the legal enforcement of the rules and regulations for rainwater harvesting, all these rules and regulations aim towards one primary objective: to save water- which is the primary essence of life. Formulated by the respective local authorities in the districts, the major impediment in the effective implementation is the lack of information and mismanagement. The authorities should focus on encouraging community rainwater harvesting. (source).

Revenue from water credits (RoUs) will provide a much needed incentive to encourage creation of small ponds as it is one of the effective solution offered to resolve the problems of sharing benefits with those who do not derive any direct benefits from the watershed development structures. These ponds also increase the efficiency of water use in the area.

It also encourage recharge of other surrounding aquifers using rainwater harvesting, at scale and faster payback on investments undertaken for installation of filtration systems by similar PPs or other to build and operate recharge structures such as soak pits and recharge wells.

Glossary

i.	UWR	: Universal Water Registry
ii.	PCNMR	: Project Concept Note Monitoring Report
iii.	PP	: Project Proponent
iv.	RoU	: Rainwater offset unit
v.	Rwh	: Rainwater Harvesting
vi.	SDGs	: Sustainability Development Goals

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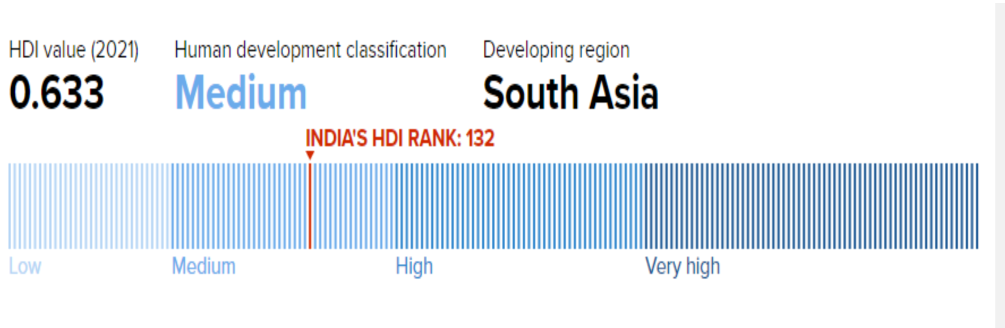
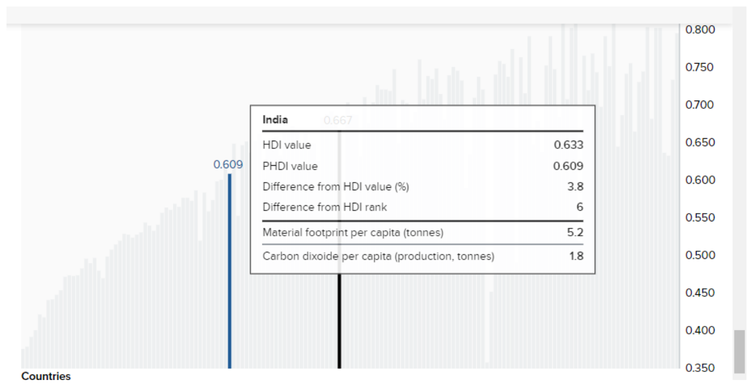
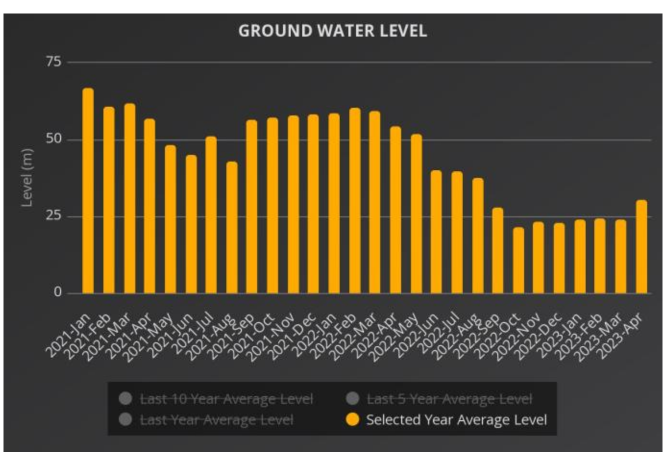
Attachments

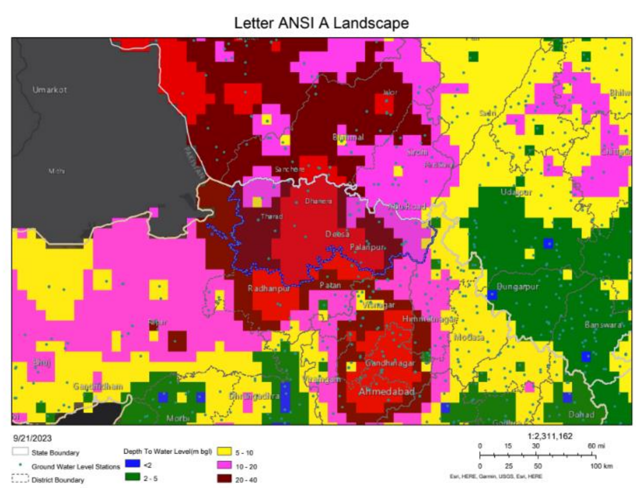
Human Development Index of India





Groundwater level of Banaskantha





Source: https://indiawris.gov.in/wris/#/groundWater