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केन्द्रीय भूमिजल बोर्ड

GOVERNMENT OF INDIA

MINISTRY JAL SHAKTI

DEPARTMENT OF WATER RESOURCES, RIVER DEVELOPMENT

AND GANGA REJUVENATION

CENTRAL GROUND WATER BOARD

AQUIFER MAP AND MANAGEMENT PLAN, CHHOTA UDEPUR DISTRICT, GUJARAT STATE

CENTRAL GROUND WATER BOARD
WEST CENTRAL REGION
GUJARAT
OCTOBER 2022

AQUIFER MAP AND MANAGEMENT PLAN
CHHOTA UDEPUR DISTRICT
GUJARAT STATE

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Last but not least, I would like to acknowledge my family members for their unselfish sacrifices, constant blessing and moral support at every stage in my life.

Table of Contents

CHHOTA UDEPUR DISTRICT AT A GLANCE

SL No.	Items	Statistics
1	General Information	
	i) Geographical area /total reporting area (Sq. Km)	3436
	ii) Administrative Divisions Number of Talukas Number of Villages	 06 894
	iii) Populations (As per 2011 census)	10,71,830
	iv) Average Annual Rainfall (mm)	1083
2.	GEOMORPHOLOGY	
	Major Physiographic Units : Undulating plain and hills hilly terrain with several ridges, plateaus and isolated relict hills	
	Major Drainages: river – Orsang, Heran river	
3.	LAND USE (Ha) (2019-20)	
	a) Forest area b) Net area sown c) Area sown more than once d) Gross Cropped area	66667 190278 42322 232600
4.	MAJOR SOIL TYPES**:** medium black soils, hilly light soil and sandy loam soil	
5.	AREA UNDER PRINCIPAL CROPS (Ha) (2019-20) Rice 16271 , Wheat-1258, Corn-44235, Total pulses-19161, Total food crops- 100442, Cotton-87090	
6.	IRRIGATION BY DIFFERENT SOURCES (Area in Hectare)	
	Dugwells	38948
	Ponds	1923
	Canals	22035
	Other Sources	52634
	Net Irrigated area (sq. km.) (2014-15)	79026
	Gross Irrigated area (sq. km.) (2014-15)	115540
7.	NUMBERS OF GROUND WATER MONITORING WELLS OF CGWB (As on 31-03-2018) No of Dug Wells No of Piezometers	27 25 02
8.	PREDOMINANT GEOLOGICAL FORMATIONS: Meta-sediments such as Phyllites, quartzites; granite and gneiss; Infra-trappean of lameta beds; sandstones and limestone; Deccan trap basalts and alluvium.	
9.	HYDROGEOLOGY Major Water Bearing Formation**:** Groundwater occur in unconfined to semi-confined condition in phyllite, schist & quartzite, Granite and gneiss, deccan trap formation in weathered mantle and factures zones and under unconfined condition in alluvium formation.	

Depth to water Level during 2019-20				
Period	Phreatic Aquifer (DTW)		Semi-confined /Confined Aquifer (PZ head)	
	Min	Max	Min	Max

	Pre Monsoon	4.10 (Bodeli)	53.6 (Kavant)	**NA**	**NA**
	Post Monsoon	1.10 (Kalarani)	18.1 (Sankheda)	**NA**	**NA**
	Long Term (10 Years) Water Level Trend (2008 to 2017)				
	Trend	Pre-Monsoon		Post- Monsoon	
	Rise (m/Yr)	0.03 (Raisingpura) to 1.30(Panwad)		0.01 (Kalarani & Saidivasana) to 1.74(Kavant)	
	Fall (m/Yr)	0.01 (Gutanwad) to 1.35 (Vadtalav Pz)		0.01 (Kevdi & Chhota Udepur) to 0.50(Bodeli)	

10.	GROUND WATER EXPLORATION BY CGWB (As on 31-03-2019)	
	No of wells drilled (EW, OW, Pz, SH, Total) EW: 10,OW: 08, Total: 18	10
	Depth Range(m)	25.70 m to 202.60
	Discharge (Litres per minute)	2.5 to 1100
11	GROUND WATER QUALITY	
	Presence of chemical constituents more than permissible limit)	Fluoride (17 location) and Nitrate (29 location)
	Type of water	Potable in general
12.	DYNAMIC GROUND WATER RESOURCES (As on March, 2017)	
	Annual Replenishable Ground Water Resources (MCM)	356.26
	Net Ground water Availability (MCM)	338.45
	Projected Demand for Domestic and industrial Uses upto 2025 (MCM)	19.91
	Stage of Ground Water Development (%)	48.05
13	GROUND WATER CONTROL AND REGULATION (2017)	
	Number of OE Blocks	Nil
	Number of Critical Blocks	Nil
	Number of Semi Critical Blocks	Nil
	Number of Safe Blocks	06
	Number of Saline Blocks	Nil
	No. Of Blocks Notified by CGWA	Nil
14	MAJOR GROUND WATER PROBLEMS AND ISSUES	
	i) Low Groundwater Development ii) Limited Yield Potential in Hard Rock iii) Pollution Geogenic and Anthropogenic (Fluoride & Nitrate in localised pockets) iv) Awareness amongst villagers on water conservation techniques v) Demand supply management	

AQUIFER MAP AND MANAGEMENT PLAN
CHOTTA UDEPUR DISTRICT

Introduction

Aquifer mapping is an attempt to combine a combination of geologic, geophysical, Hydrogeological and chemical data to characterize the quantity, quality and sustainability of ground water in aquifers. India is a country blessed with diverse hydrogeological settings and Groundwater accounts for by far the largest volume of unfrozen fresh water on Earth and thus it is a hugely important as a natural resource. Ground water is the water that seeps through rocks and soil and is stored below the ground. The rocks in which ground water is stored are called aquifers. The movement of groundwater in various aquifer systemare highly complex due to occurrence of diverse geological lithological tectonic framework and climatically parameter broadly.

In XIIth five year plan, National Aquifer Mapping & Management(NAQUIM) has been introduced to carry out detailed hydrogeological investigation on topo sheet wise on a scale of 1:50,000. The proposed activities include micro level hydrogeological data acquisition supported by geophysical and hydro-chemical investigations supplemented with ground water exploration, Hydrological and Hydro meteorological studies, Geophysical Surveys, Water Quality Analysis, Specific Yield determination, GIS data integration & analysis, Preparation of Aquifer map, Compilation of Data and Printing of reports etc. The activities under NAQUIM are aimed at identifying the aquifer geometry, aquifer characteristics their yield potential along with the quality of water occurring at various depths. This clear demarcation of aquifers and their potential will help the agencies involved in water supply in ascertaining, how much volume of water is under their control. This work will be systematically implemented in the country, by involving state organisations / institutions across India.

Objective:

The primary objective of the Aquifer Mapping Exercise can be summed up as “Know your Aquifer, Manage your Aquifer”. Demystification of Science and thereby involvement of stake holders is the essence of the entire project. The involvement and participation of the community will infuse a sense of ownership amongst the stakeholders. This is an activity where the Government and the Community work in tandem. Greater the harmony between the two, greater will be the chances of successful implementation and achievement of the goals of the Project. As per the Report of the Working Group on Sustainable Ground Water Management, “It is imperative to design an aquifer mapping programme with a clear-cut groundwater management purpose. This will ensure that aquifer mapping does not remain an academic exercise and that it will seamlessly flow into a participatory groundwater management programme. The aquifer mapping approach can help integrate ground water availability with ground water accessibility and quality aspects.

Methodology:

Methodology involves creation of database for each of the principal aquifer and delineation of aquifer extent (vertical and lateral). Standard output for effective presentation of scientific integration of Hydrogeological, geophysical, geological, hydro chemical data facts and on GIS

platform, identification of issues, manifestation of issues and formulation of strategies to address the issues by possible interventions at local and regional level.

The activities of the Aquifer Mapping can be grouped as follows.

Data Compilation & Data Gap Analysis:

One of the important aspect of the aquifer mapping programme was the synthesis of the large volume of data already collected during specific studies carried out by Central Ground Water Board and various Government organizations with a new data set generated that broadly describe an aquifer system. The data were assembled from the available sources, analyzed, examined, synthesized and interpreted. These sources were predominantly non-computerized data, which was converted into computer based GIS data sets and on the basis of available data, data gaps were identified.

Data Generation:

There a strong need for generating additional data to fill the data gaps to achieve the task of aquifer mapping. This was achieved by multiple activities such as exploratory drilling, geophysical techniques, hydro-geochemical analysis, remote sensing, and hydrogeological surveys to delineate multi aquifer system to bring out the efficacy of various geophysical techniques and a protocol for use of geophysical techniques for aquifer mapping in different hydrogeological environs.

Aquifer Map Preparation:

On the basis of integration of data generated from various studies of hydrogeology & geophysics, aquifers have been delineated and characterized in terms of quality and potential. Various maps have been prepared bringing out details of Aquifers; these are termed as Aquifer maps providing spatial variation (lateral & vertical) in reference to aquifer extremities (i.e. quality & quantity).

Aquifer Management Plan Formulation:

Aquifer response Model has been utilized to identify a suitable strategy for sustainable development of the aquifer in the area.

All the above activities under the ground National Aquifer Mapping programme is depicted/elaborated in Annexure –I and presented in figure 1.

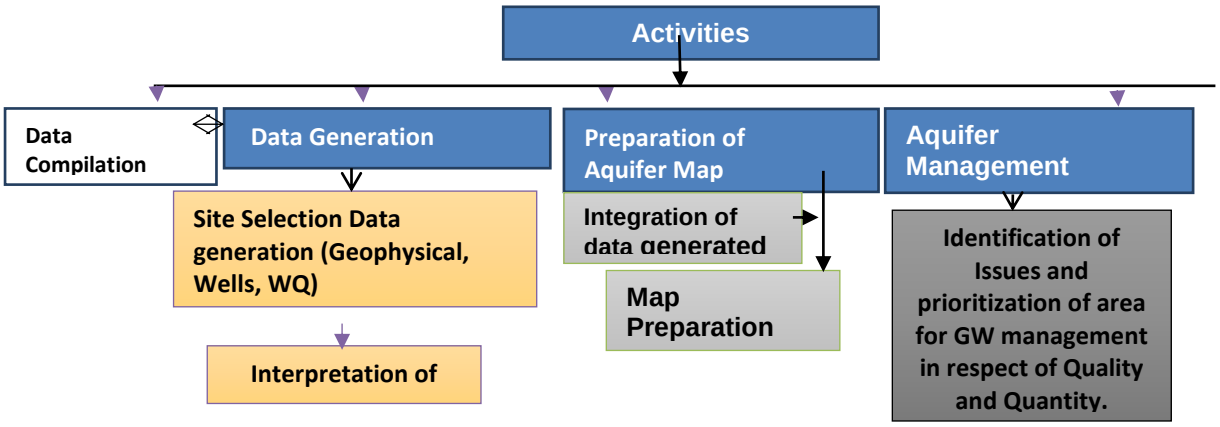


FIGURE 1 ACTIVITY UNDER NATIONAL AQUIFER MAPPING PROGRAMME

Chhotaudepur district is carved out of the Vadodara district on August 15, 2013 with its headquarters at Chhotaudepur town. Chhotaudepur is a tribal dominated district and the district headquarters is located 110 km away from Vadodara. It shares its land borders with the state of Madhya Pradesh & water border with the state of Maharashtra. The district was created to facilitate decentralization and ease of access to government services and lies between north latitudes 22.3085 and east longitudes 74.0120. The total area of the district is 3436 $KM^{2.}$

Chhotaudepur is the third tribal dominated district in eastern Gujarat after the Narmada and Tapi districts. The district is to consist of the six talukas of Chhotaudepur, Pavi Jetpur, Kawant, Naswadi, Sankheda and the newly created Bodeli taluka. Chhotaudepur district has a large forest area and has deposits of dolomite, fluorite, granite and sand all of which are mined. The Rathwa tribals who live here produce the Pithora mural paintings by mixing colours with liquour and milk and then using it to depict intricate motifs and scenes on the walls of their village dwelling.

The Administrative and Index map of the study area is presented in Fig 2.

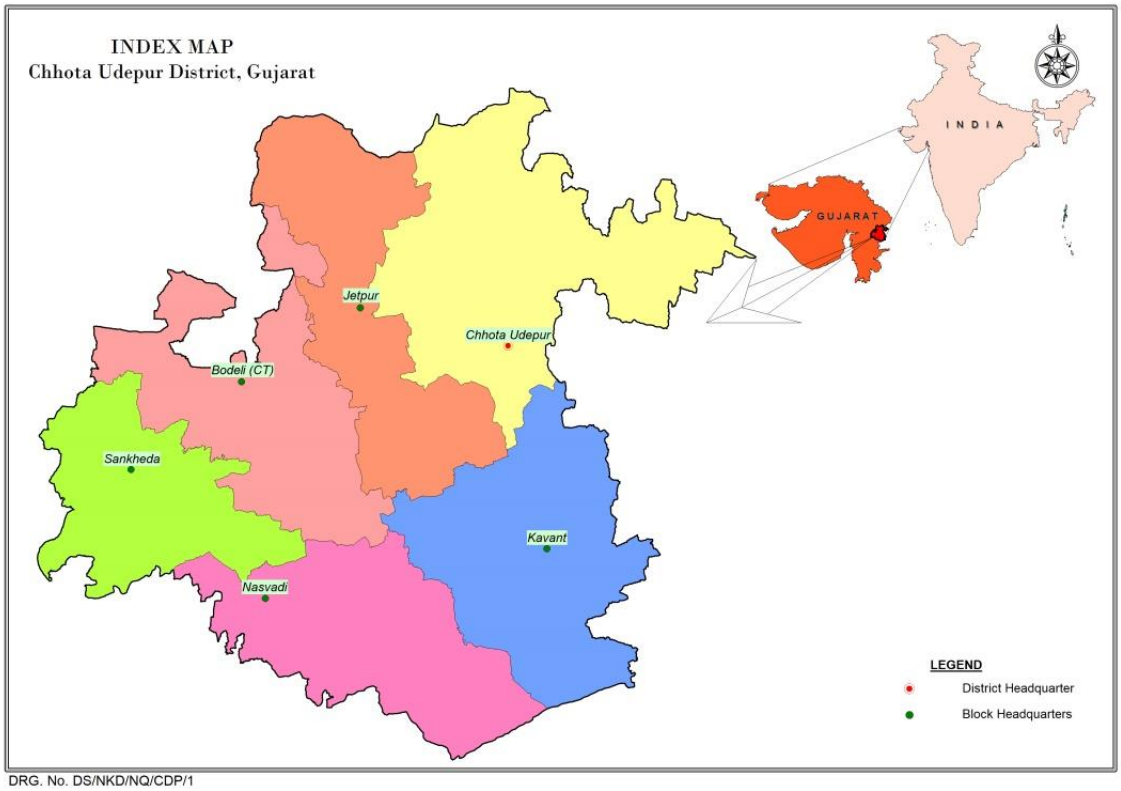


FIGURE 2 ADMINISTRATIVE MAP OF CHHOTA UDEPUR DISTRICT

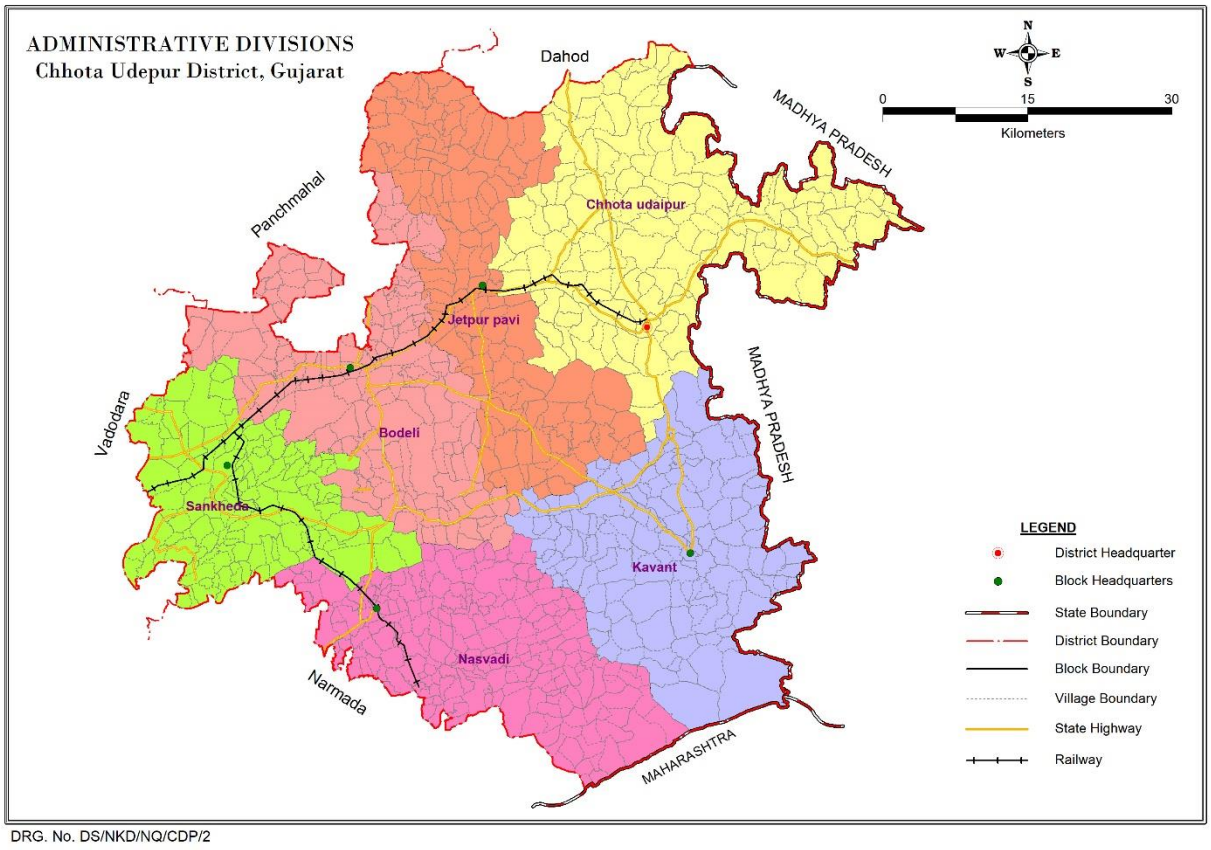


FIGURE 3 ADMINISTRATIVE DIVISION MAP OF CHHOTA UDEPUR DISTRICT

DEMOGRAPHY:

As per the 2011 census, the population of the district was 10,71,831 out of which number of males and females were 5,44,849and 5,26,982 respectively. The population density per square kilometer is 312 in the district. The demographic profile of the district (block wise) is indicated in below table no. 1.

Sr. No	Taluka	Male	Female	Total	Population Density (per Sq. km)
1	Bodeli	92905	87465	1,80,370	330
2	Chhota Udepur	121337	120040	2,41,377	315
3	Jetpur-Pavi	91234	87453	1,78,687	307
4	Kavant	105615	104387	2,10,002	346
5	Nasvadi	78838	76605	1,55,443	290
6	Sankheda	54920	51032	1,05,952	246
	Total	5,44,849	5,26,982	10,71,831	312

TABLE 1 DISTRICT POPULATION FIGURE (AS PER 2011)

PHYSIOGRAPHY:

The eastern portion of the district comprising the Chhota Udepur, the Kavant, the Jambughoda and the Naswadi taluka is hilly terrain with several ridges, plateaus and isolated relict hills have elevation in range of 150 to 481 m amsl. The south eastern plateau have the highest peaks of the district – Amba Dungar & Mandai Dongar 637 m amsl. The area between the Unch and the

Orsang river have aeolian low level stabilized dune with rolling topography. The hilly terrains of north - eastern part have residual hill features with more or less flat topped plateau. Except few volcanic peaks – Phenai Mata Hills and Amba Dungar, all have plateau or ridge type features and are few tens of meter height than surrounding rocky dissected plain. The highest plateaus are in south eastern part of the district, marked with rift valley of the Narmada River towards south.

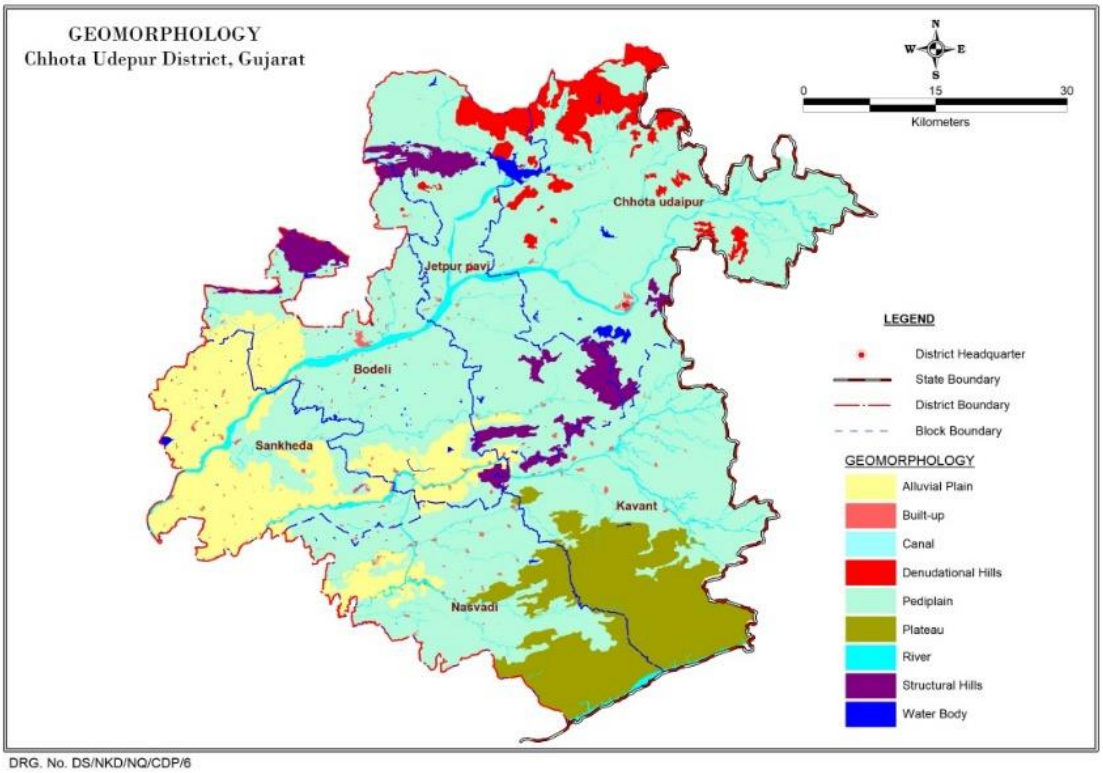


FIGURE 4 GEOMORPHOLOGIC MAP OF CHHOTA UDEPUR DISTRICT

DRAINAGE PATTERN:

The Orsang and the Heran are the chief rivers of the district, flow along the northeastern to southwestern direction along with small tributaries.

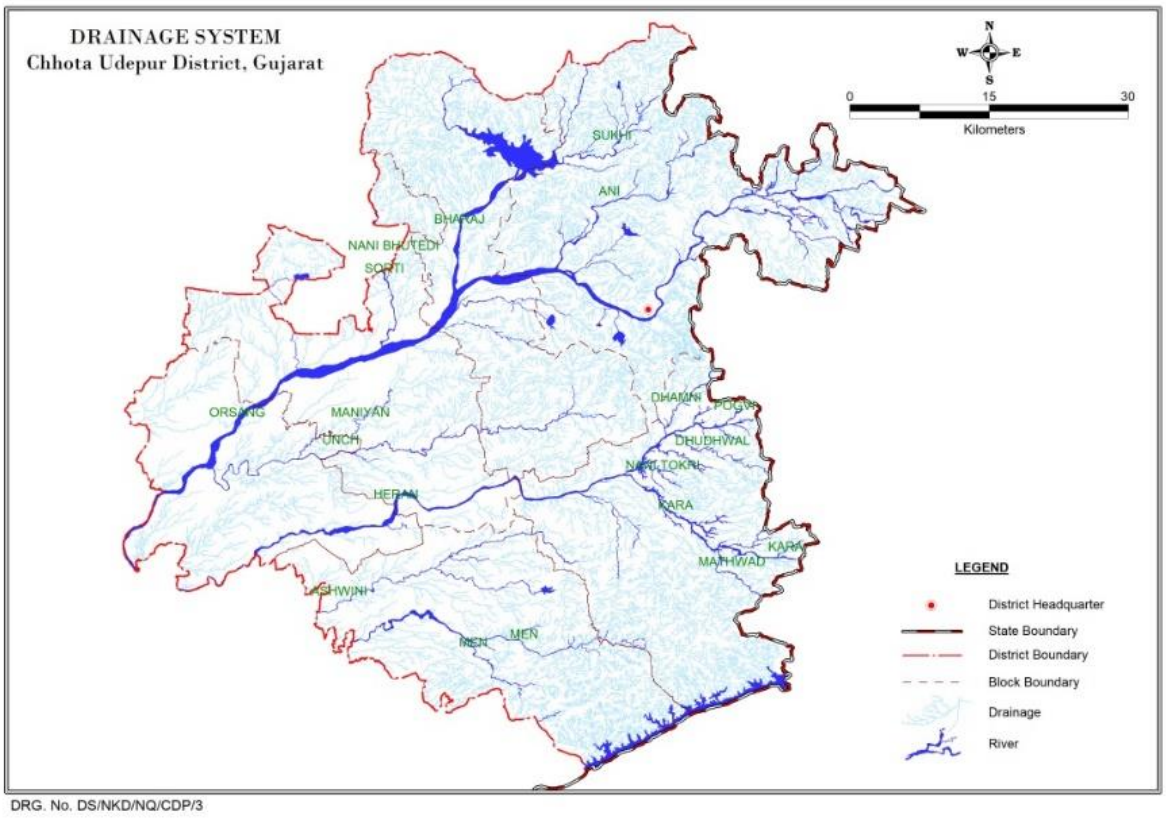


FIGURE 5- DRAINAGE MAP OF CHHOTA UDEPUR DISTRICT

SOIL TYPE:

The soils of Vadodara district can be broadly classified into three groups. They are medium black soils, hilly light soil and sandy loam soil. Major soil features are indicated in below table no. 2.

Major Soils (common names like red sandy loam deep soils (etc.,)*	Area (‘000 ha)	Percent (%)of total
Medium black soil	210.808	61
Hilly light soil	60.501	18
Sandy loam soil	72.297	21

TABLE 2- MAJOR SOIL FEATURES

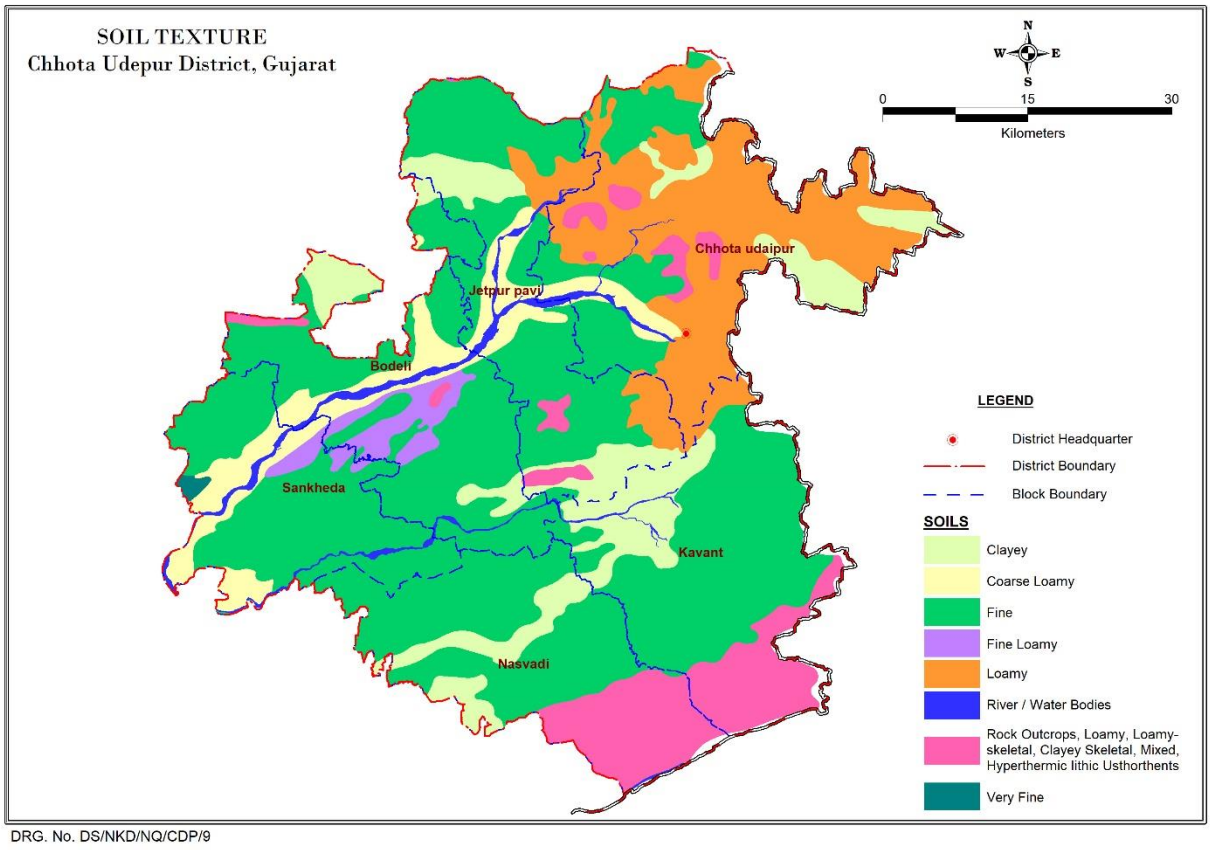


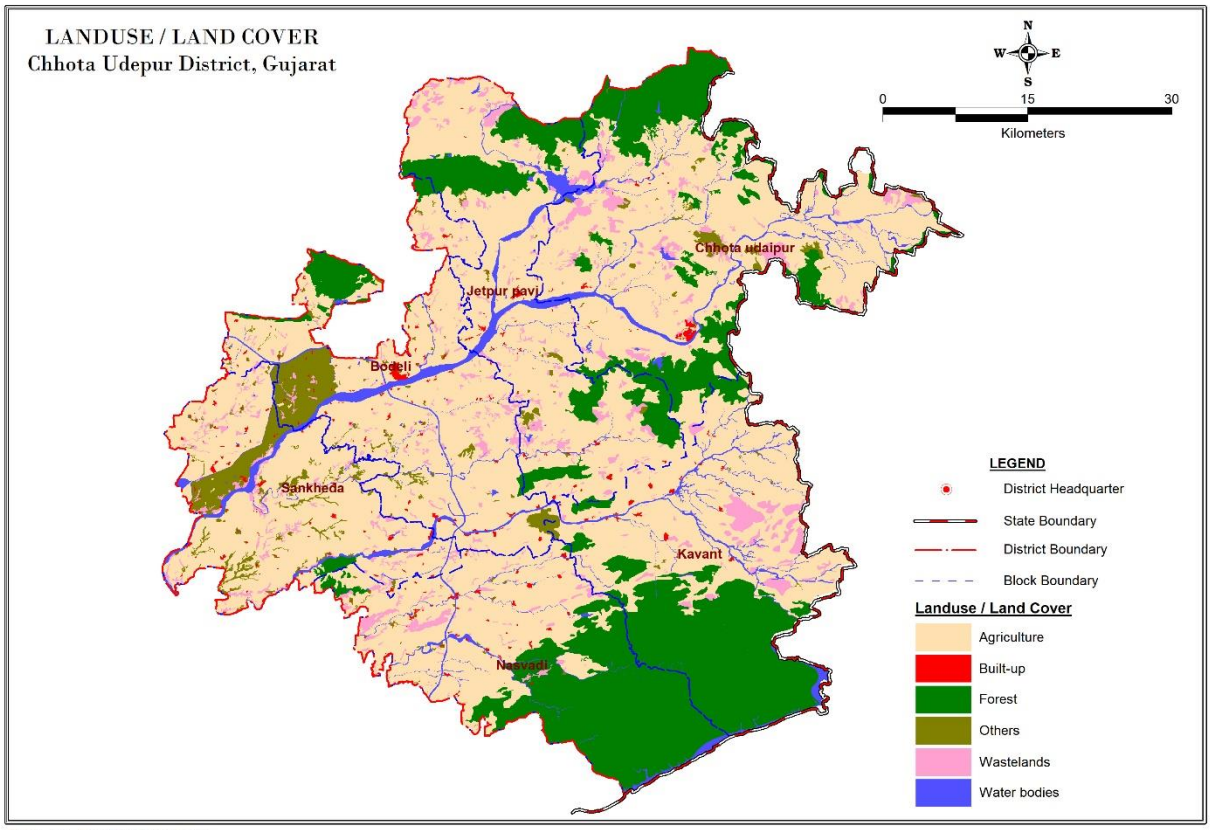
FIGURE 6- SOIL MAP OF CHHOTA UDEPUR DISTRICT

LANDUSE PATTERN:

The data on land utilization and irrigated are shows that, Geographical area covers 339529 hectares where forest areas cover 66667 hectares. Where area sown more than once covers 42322 hectares & gross cropped area is 232600 hectares. Brief account of land use classification for the district, in general, is given in table No.3

Land Use (2019-20) (Ha)													
Sr. No.	Taluka Name	Area according to village papers (Ha)	Area under Forest (Hec)	Barren & uncultivable land	Land put to non agricultural uses	Culturable waste	Permanent pastures & other grazing lands	Land under scattered trees and shrubs	Current fallow	Other fallow	Net area sown	Area sown more than once	Gross Cropped area (12+13)
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Bodeli	51400	2540	1700	4200	160	1350	0	120	0	31174	7978	39152
2	Chhota Udepur	62410	18650	4324	4422	1110	2850	0	206	0	33793	8199	41992
3	Jetpur-Pavi	62500	10280	2703	5618	510	2140	0	227	0	33250	6655	39905
4	Kavant	58510	15772	2975	2770	1220	3020	0	455	0	33161	6171	39332
5	Nasvadi	53479	16422	1122	3051	780	2660	0	0	0	30535	7010	37545
6	Sankheda	51230	3003	1534	4865	93	1180	0	314	0	28365	6309	34674
Total		339529	66667	14358	24926	3873	13200	0	1322	0	190278	42322	232600

TABLE 3- LAND USE PATTERN IN CHHOTA UDEPUR DISTRICT



DRG. No. DS/NKD/NQ/CDP/8

FIGURE 7- LAND USE MAP OF CHHOTA UDEPUR DISTRICT

Area and production under major crops (2019-20)					
S No.	Name of Crop	Sown Area (Hector)	Irrigation Area	Production (metric Tonne)	Procution Per Hectare (kg)
1	2	3	4	5	6
1	Grain				
	Rice	16271	6282	210.22	1292
	Wheat	1258	1258	36.92	2935
	Juwar	283	71	3.45	1220
	(Millet) Bajri	14	0	0.28	2019
	Corn	44235	13584	872.31	1972
	Other grains (Adad, Math, Guar)	0	0	0	0
	Total	62061	21195	1123.18	9438
2	Pulses				
	Mung	623	164	3.64	585
	Tuvar	16826	7992	194.85	1158
	Gram	1702	1702	19.49	1145
	Other Pulses	0	0	0	0
	Total Pulse	19151	9858	217.98	2888
3	Sugarcane	0	0	0	0
	Spices(Cumin,rich,Aniseed ,parsley)	0	0	0	0
	Fruits	0	0	0	0
	Vegetables	17185	17185	0	0
	Others	0	0	0	0
	Total	17185	17185	0	0
	Total Foodable crop(1+2+3)	98397	48238	1341.16	12326
4	NonFood Crop				
	Cotton	87090	41083	600.92	690
	Other	0	0	0	0
	Total	87090	41083	600.92	690
5	Edible Oilcrops				
	Ground Nuts	538	85	8.54	1588
	Tal	1165	50	4.49	38
	Other	0	0	0	0
	Total Edible oilcrops	1703	135	13.03	1626
6	Non Edible Oilcrops				
	Castor	77	12	1.53	1982
	Others	0	0	0	0
	Total	77	12	1.53	1982
	Total Nonedible(5+6)	1780	147	14.56	3608
7	Other NonFood Crop				
	Other Intoxicating crops	0	0	0	0
	Grass	26483	7564	0	0
	Other	0	0	0	0
	Total other Nonfood Crops	26483	7564	0	0
	Sum of Sown	213750	97032	1956.64	16624

TABLE 4- AREA AND PRODUCTION UNDER MAJOR CROPS (2019-20)

Sl. No.	Taluka Name	Area Under Food Crop	% of food crop against sown area	Grains (Sq. km.)							
				Rice	Wheat	Jav	Sorghum	Bajri	Corn	Other Grain	Total Grain (5 to 11)
1	2	3	4	5	6	7	8	9	10	11	12
1	Bodeli	13064	45	1805	964	0	206	0	4111	0	7086
2	Chhota Udepur	24455	70	7031	60	0	0	0	12539	0	19630
3	Jetpur-Pavi	16211	51	3571	42	0	0	12	10185	0	13810
4	Kavant	21436	62	3108	10	0	0	2	10249	25	13394
5	Nasvadi	11942	39	410	120	0	54	0	4729	0	5313
6	Sankheda	10930	36	346	62	0	23	0	2422	0	2853
	Total	98038	50.5	16271	1258	0	283	14	44235	25	62086

TABLE 5- TALUKA WISE FOOD CROPS

IRRIGATION

Sourse wise Irrigation (Area In Hector) 2019-20													
No.	Taluka Name	Net Irrigated area (Ha)						Gross Irrigated area (Ha)					
		Canal	Pond	Dug well	Other	Total	Percentage of Net irrigated area against net sown	Canal	Pond	Dug well	Other	Total	Percentage of irrigated area against net planting
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Bodeli	4550	250	6545	6212	17557	49	6825	375	9818	9318	26336	72
2	Chhota Udepur	0	162	4310	6314	10786	27	0	243	6465	9471	16179	42
3	Jetpur-Pavi	3250	350	4430	6847	14877	36	4875	525	6645	10271	22316	65
4	Kavant	0	140	3560	3832	7532	16	0	210	5340	5748	11298	34
5	Nasvadi	2460	170	3250	4220	10100	24	3690	255	4875	6330	15150	50
6	Sankheda	4430	210	3870	9664	18174	38	6645	315	5805	11496	24261	68
	Total	14690	1282	25965	37089	79026	31.66	22035	1923	38948	52634	115540	55.16

Source: AnkadiyaRoopRekha 2019-20

TABLE 6- SOURCE WISE IRRIGATION (HECTARE)

RAINFALL:

Taluka wise monthly rainfall (mm) year 2019							
Sr. No	Taluka	June	July	August	September	October	Total
1	Bodeli	148	469	635	267	39	1558
2	Chhota Udepur	177	305	1393	482	107	2464
3	Jetpur-Pavi	258	122	795	278	28	1481
4	Kavant	130	411	1489	364	34	2428
5	Nasvadi	83	316	721	283	15	1418
6	Sankheda	180	375	488	270	19	1332
Average Rainfall		162.67	333.00	920.17	324.00	40.33	1780.17

Source :AnkadiyaRoopRekha 2019-20

TABLE 7-TALUKA WISE MONTHLY RAINFALL (MM) YEAR 2019

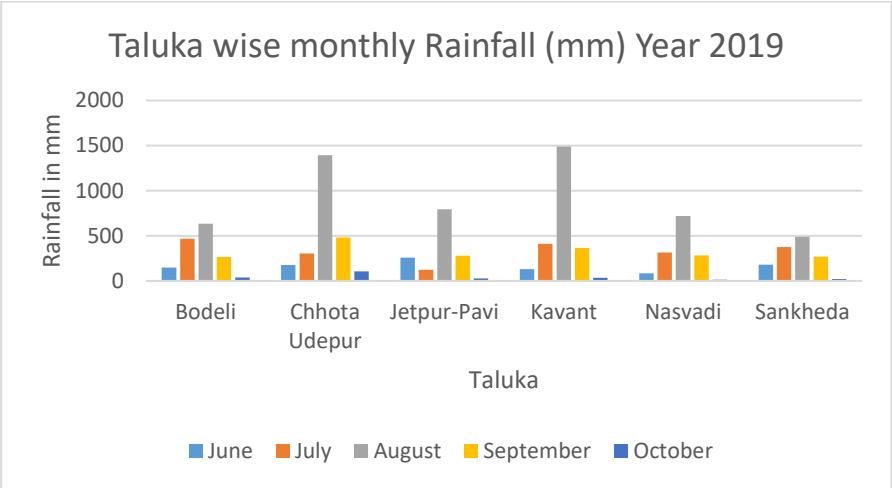


FIGURE 8- TALUKA WISE MONTHLY RAINFALL (MM) YEAR 2019

Taluka wise Yearly rainfall (mm)										
Sr. No	Taluka	2011	2012	2013	2014	2015	2016	2017	2018	2019
1	Bodeli	1052	1116	2184	1074	633	1051	990	656	1558
2	Chhota Udepur	720	503	1339	836	621	881	916	938	2464
3	Jetpur-Pavi	1075	986	1541	868	459	943	836	880	1481
4	Kavant	339	390	1535	599	894	962	615	701	2428
5	Nasvadi	1270	471	1249	777	426	607	557	559	1418
6	Sankheda	1052	1116	2184	1186	476	764	1096	810	1332
Average Rainfall		918	764	1672	890	585	868	835	757	1780

TABLE 8- TALUKA WISE YEARLY RAINFALL

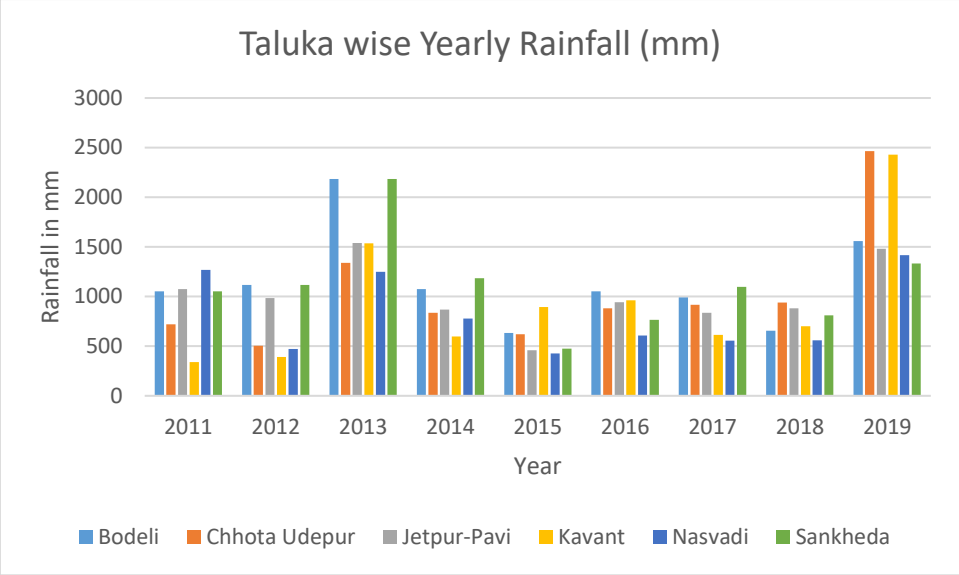


FIGURE 9- TALUKA WISE YEARLY RAINFALL

GEOLOGY

STRATIGRAPHIC SET UP

The rocks of the Chotta Udepur district shows an age from Proterozoic to Recent but a striking features of the district stratigraphy is the total absence of Paleozoic, and the development of only the uppermost Mesozoic rocks. The south westerly extended Precambrian basement of Peninsular India, the oldest rocks of Proterozoic age, are exposed in eastern and north eastern

part of the district. Post Cretaceous sediments & major volcanic rocks rest over this south westerly
extended Precambrian basement. Post Cretaceous sediments, Infratrappean and Intratrappean are exposed as scattered inliers while younger volcanic rocks unit as Deccan trap is well represented and so are the Tertiary and Quaternary, though the Tertiary records are not complete and fully exposed. The stratigraphic outline of the district is given in table no. 8.

Continental sediments – fluvio-marine, fluvial and aeolian	Quaternary
Marine and fluvio-marine sediments	Tertiary
.....Unconformity	.....
Basalts of the Deccan Trap with associated differentiates and intrusive bodies	Upper Cretaceous to Lower Eocene
.....Unconformity	.....
Marine, fluvio-marine and fluvial sediments	Cretaceous
.....Unconformity	.....
Crystalline rocks -Metasediments associated with granite, gneiss and other mafic rocks	Precambrian (Aravalli)

TABLE 9- STRATIGRAPHIC OUTLINE OF THE CHOTTA UDEPUR DISTRICT

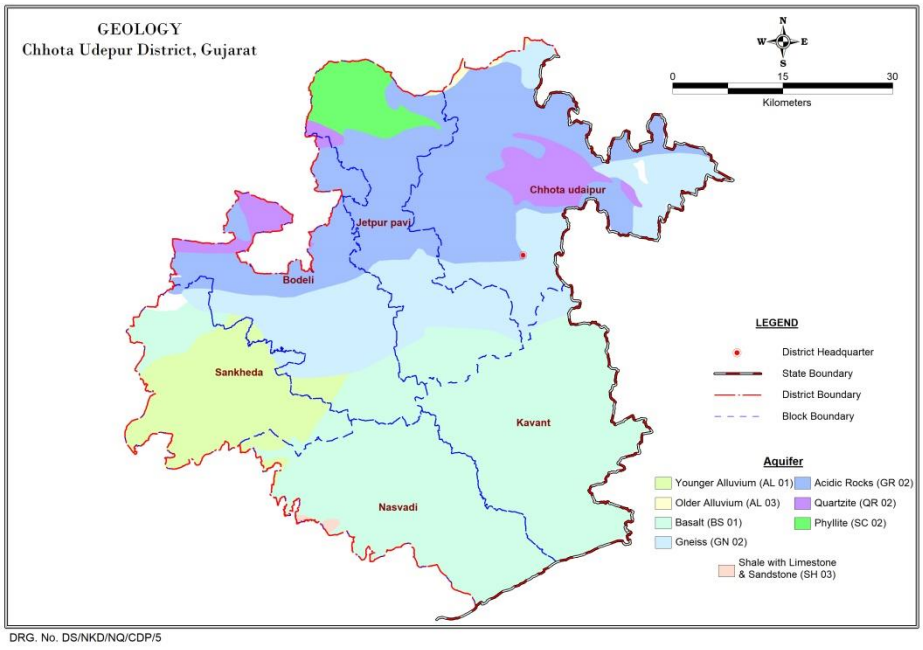
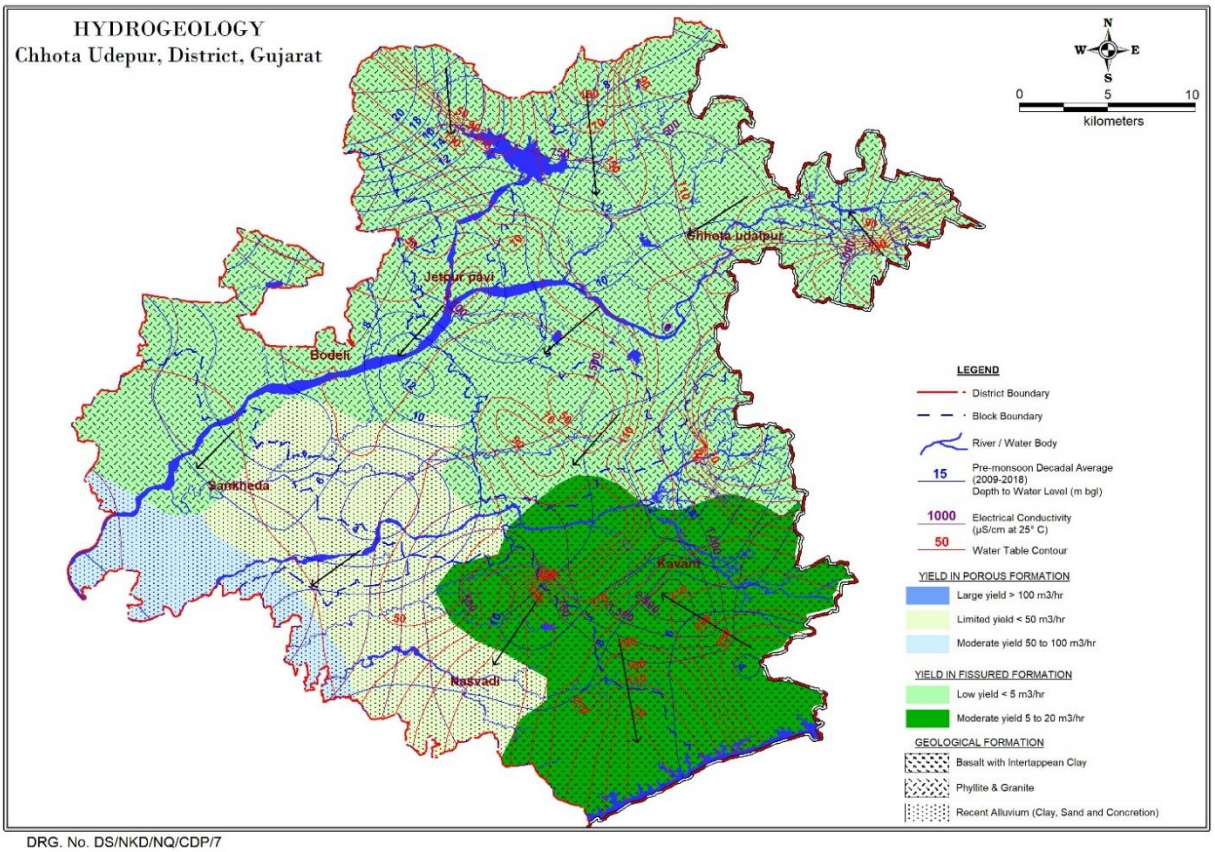


FIGURE 10- GEOLOGY MAP

HYDROGEOLOGY

OCCURRENCE & DISTRIBUTION OF GROUNDWATER

In Chotta Udepur district area, groundwater occurs both as unconfined and confined conditions. Saturated zones of unconsolidated shallow alluvium and weathered zones, shallow depth jointed and fractured rocks forms unconfined aquifers, whereas interflow zones of basalts, inter-trappean beds, deep seated fracture zones, shear zones in basalts, granites and gneisses give rise to semi confined to confined conditions. Generally the water table follows topographic configuration. In major part of the district, in north and almost in eastern half of the district, the hard rocks, such as phyllite, schist, granite, gneiss, basalt and other sediments form aquifers. The weathered basalts, granite, gneiss etc., covered by soil / muram and the valley fill & piedmont deposits forms potential aquifer in the vicinity of rivers and on vast undulating plains adjacent to hilly terrain but their regional continuity and extent are limited due to heterogeneous nature of deposits with limited thickness and as such rarely exceed a few square kilometers.



DRG. No. DS/NKD/NQ/CDP/7

FIGURE 11- HYDROGEOLOGY MAP

AQUIFER PARAMETERS:

Aquifer parameters are available from ground water exploration carried out in the hard rock area of the district as well as from the pumping tests carried out on exploratory wells in Meta-sedimentary, Basaltic and Alluvial terrain.

Aquifer Characterisation and Disposition									
Stratigraphy	**Aquifer Nomenclature**	**Lithological**	**Depth of occurrence**	**Thickness**	**Water Level (mbgl)**	**Quality**	**Discharge**	**Nature of A**	**Remarks**
						TDS			
		Characteristics	**Aquifer**	**Range**	**Range**	**Range**	**Range**	**quifer**	
			(mbgl)	**(m)**	**(mbgl)**	**(mg/l)**	**(lps)**		
Holocene	**Alluvium**	Alluvium - Sand, Kankar and Clay	upto 39	23-39	9.2 - 21.1	530- 1869	1 to 6	Phreatic	Good Quality
Upper Cretaceous to lower Eocene	**Weathered Basalt**	Basalts	upto 29	11--29	4.84 - 22.25	210 - 2446	1 to 2	Phreatic	Good Quality
	Fractured Basalt	Basalts	upto 187	41-170	4.10 – 53.60	240-1731	2 to 8	Confined	Good Quality
Proterozoic	**Limestone**	Limestone	187-200	13		820	6.7	Confined	Good Quality
	Weathered Granite	Granite	upto 32	9-30	4.42 - 13.42	279 - 3708	0.7 to 3.33	Phreatic	Good Quality
	Fractured Granite	Granite	14-45	31	6.90 - 24.90	250 - 2552	0.25-3	Confined	Good Quality
	Meta Sediments	Phyllite, mica schist, quartzite	Below 37						

TABLE 10- AQUIFER CHARACTERISTICS

DATA INTERPRETATION, INTEGRATION AND AQUIFER MAPPING:

In order to prepareed hydro geological cross section and 3D Model in the area, the existing data of lithologs of Exploratory wells studies carried out by CGWB were used. The data has been analyzed using Rockworks 16 software and is presented below in the Hydro-geological cross sections A-A' to D-D' and Solid Model of the district showing the depiction of weathered aquifers and fractured aquifers up to 200 m. Map showing section lines are presented in Fig. 10. The stratigraphic sections depicting weathered aquifer, fractured aquifer for Hard rock formations and unconfined aquifer for alluvium formation are placed at Figs 11-14. 3D Solid Model of Chotta Udepur district is depicted in Fig. 15 and 16, respectively.

S.No.	Data	Aquifer	Total Data Points	Source	
				CGWB	GWRDC
1	3D Aquifer Disposition Map	1 no	10	10	-
2	Hydrogeological Cross Sections	4 no	10	10	-
3	Fence Diagrams	1 no	10	10	-
4	Water Level Data	Combine	65	27	38
5	Water Sample Data	Combine	71	54	17

TABLE 11- DATA INTEGRATION FOR CHOTTA UDEPUR DISTRICT

CONCEPTUALIZATION OF AQUIFER SYSTEM IN 2D AND 3D MAP:

Based on litho logical formation, electrical Log and local ground water survey, four hydro-geological sections have been prepared along section lines shown in below figure to understand the subsurface disposition of aquifer system. Also 3-D Aquifer disposition map is prepared to know the aquifer geometry in the district.

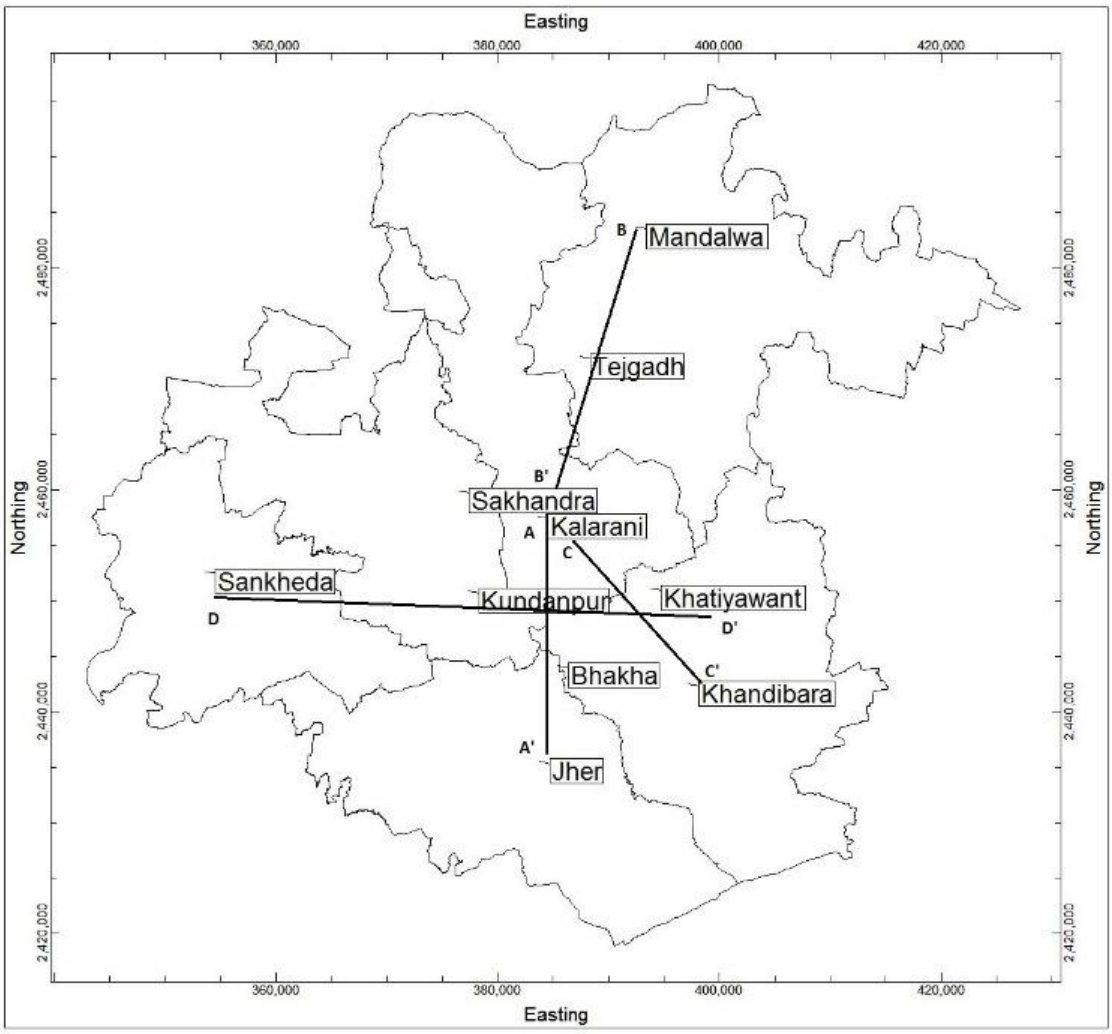
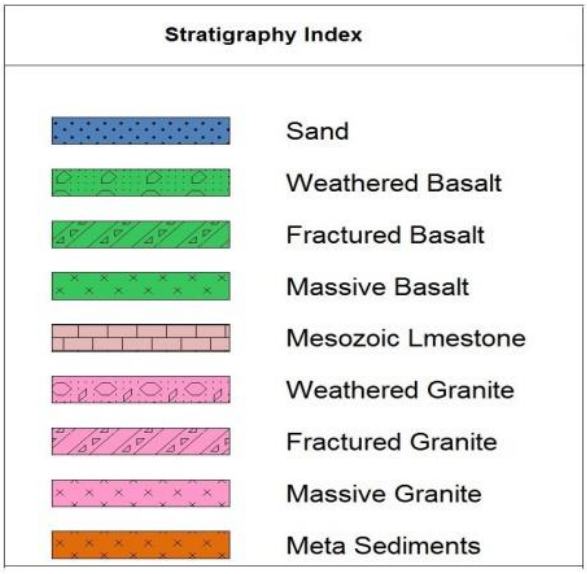


FIGURE 12- CROSS-SECTION LINE MAP OF CHOTTA UDEPUR DISTRICT & INDEX



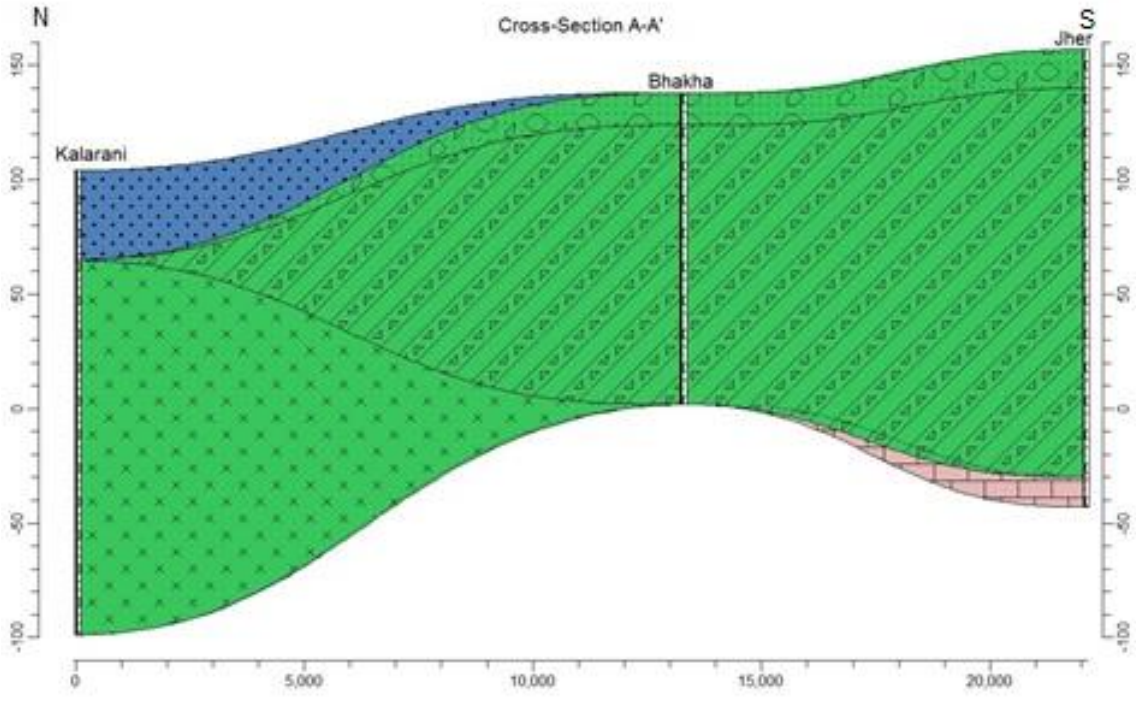


FIGURE 13- 2D AQUIFER CROSS-SECTION (A-A') MAP OF CHOTTA UDEPUR DISTRICT

Cross-section is drawn roughly n-s direction and start from kalarani to jher passing through bhakha. alluvium aquifer represent the phreatic aquifer at kalarani underlain by massive basalt. weathered basalt underlain by fractured basalt observed at bhakha & jher.

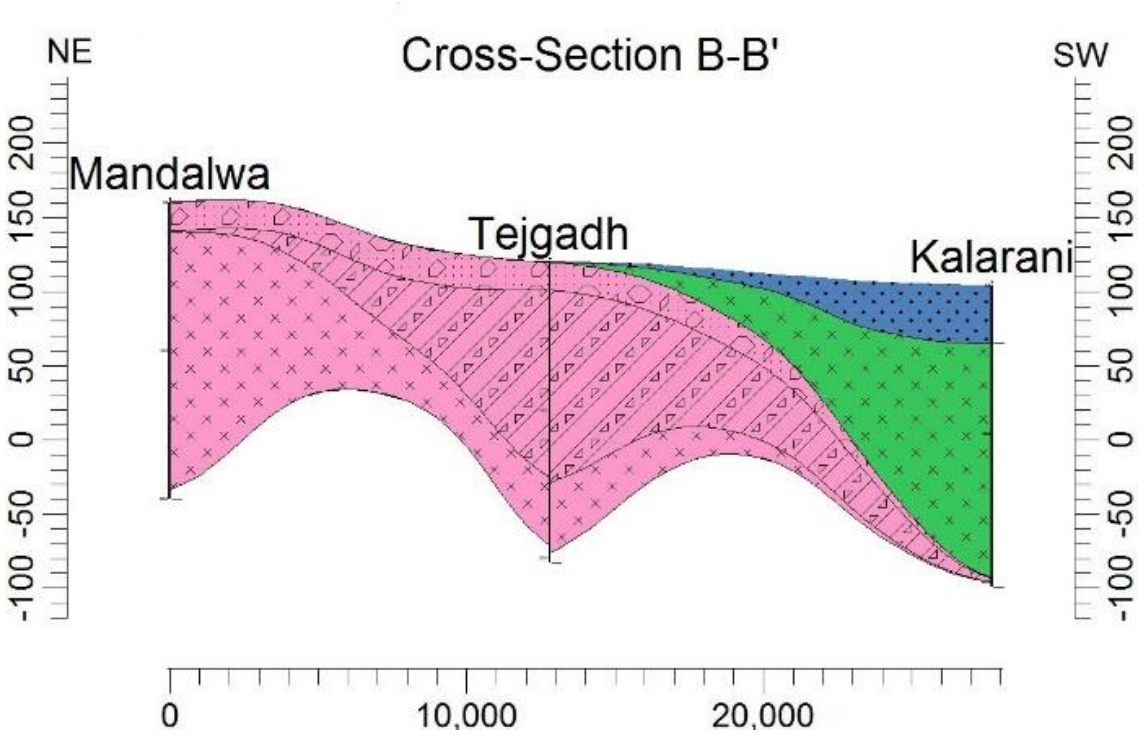


FIGURE 14- 2D AQUIFER CROSS-SECTION (B-B') MAP OF CHOTTA UDEPUR DISTRICT

Cross-Section is drawn along NE-SW direction and start from Mandalwa to Kalarani passing through Tejgadh. Section is represented geologically; in north eastern side at village Mandalwa & Tejgadh are weathered, fractured and massive Granite showing variation in thickness. Alluvium aquifer represent the phreatic aquifer at Kalarani underlain by massive basalt.

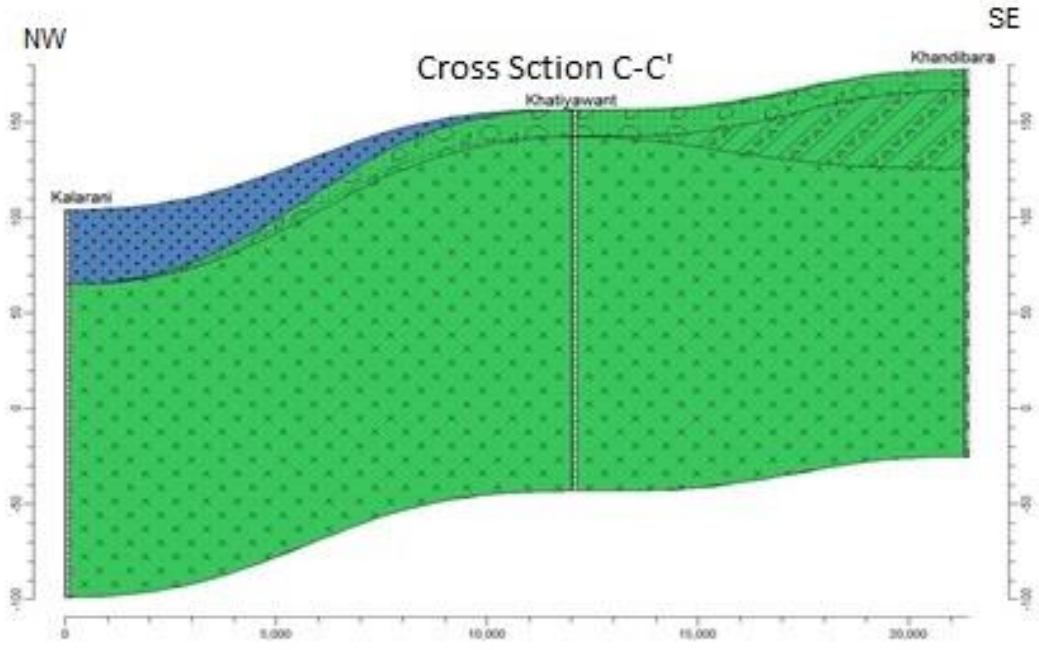


FIGURE 15- 2D AQUIFER CROSS-SECTION (C-C') MAP OF CHOTTA UDEPUR DISTRICT

Section is drawn roughly NW-SE direction and start from Kalarani to Khandibara passing through Khatiyawant. Hydrogeological cross section showing alluvial aquifer, weathered, fractured and Massive basalt.

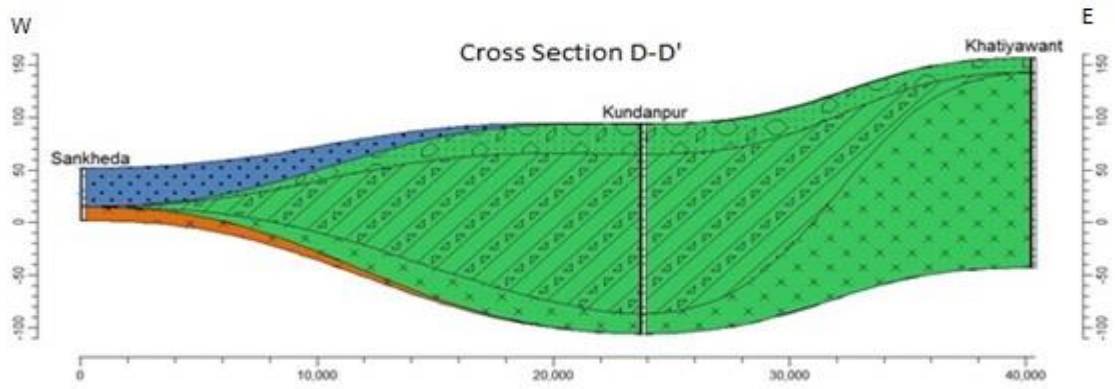


FIGURE 16- 2D AQUIFER CROSS-SECTION (D-D') MAP OF CHOTTA UDEPUR DISTRICT

Section is drawn roughly W-E direction and start from Sankheda to Katiyawant passing through Kundanpur. Weathered and fractured basalt is the hard rock aquifer system at Kundapur and Khatiyawant location. Alluvial aquifer system observed at Sankheda underlain by metasediments.

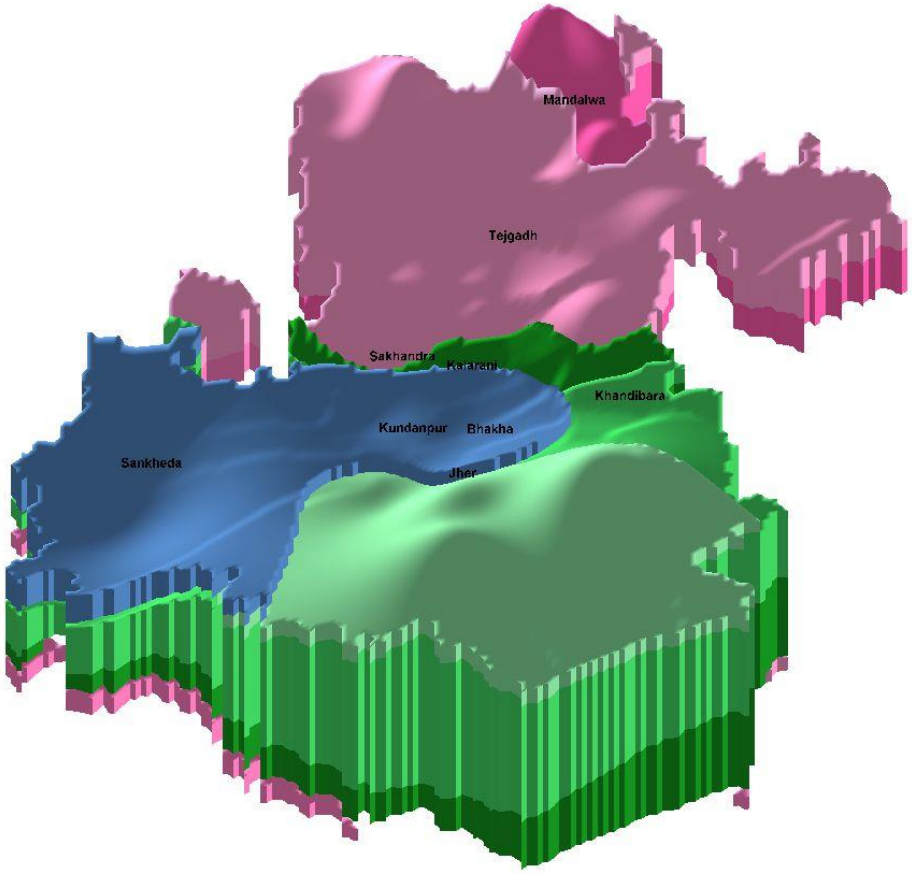


FIGURE 17- 3D AQUIFER DISPOSITION DIAGRAM OF CHOTTA UDEPUR DISTRICT

This 3D model is prepared in Rockwork-16 Software. This diagram is prepared to know the aquifer geometry in the district.

GROUNDWATER REGIME MONITORING

Central Ground Water Board periodically monitors 27 Ground Water monitoring wells (25 DW, 2 PZ) in the Chhota Udepur district, four times a year i.e. in January, May (Pre-monsoon), August and November (Post-monsoon). There are 12 Dug wells & 22 Piezometers from GWRDC Ltd. These water level data have been used for preparation of depth to water level maps of the district to understand the behavior of ground water regime.

Depth to Water Level Pre monsoon (May 2019)

The depth to water levels in Chhota Udepur district during May 2019 ranges between 4.1 (Laved, Bodeli block) and 53.6 mbgl (Kavant, Kavant block). In general, the depth to Water levels between less than 2 mbgl to more than 40 mbgl is observed in the district. The Deeper water levels between more than 20 mbgl are observed in isolated patches in Sankheda, Nasvadi, Jetpur Pavi & Kavant block. The pre-monsoon depth to water level map is depicted in Fig. 18

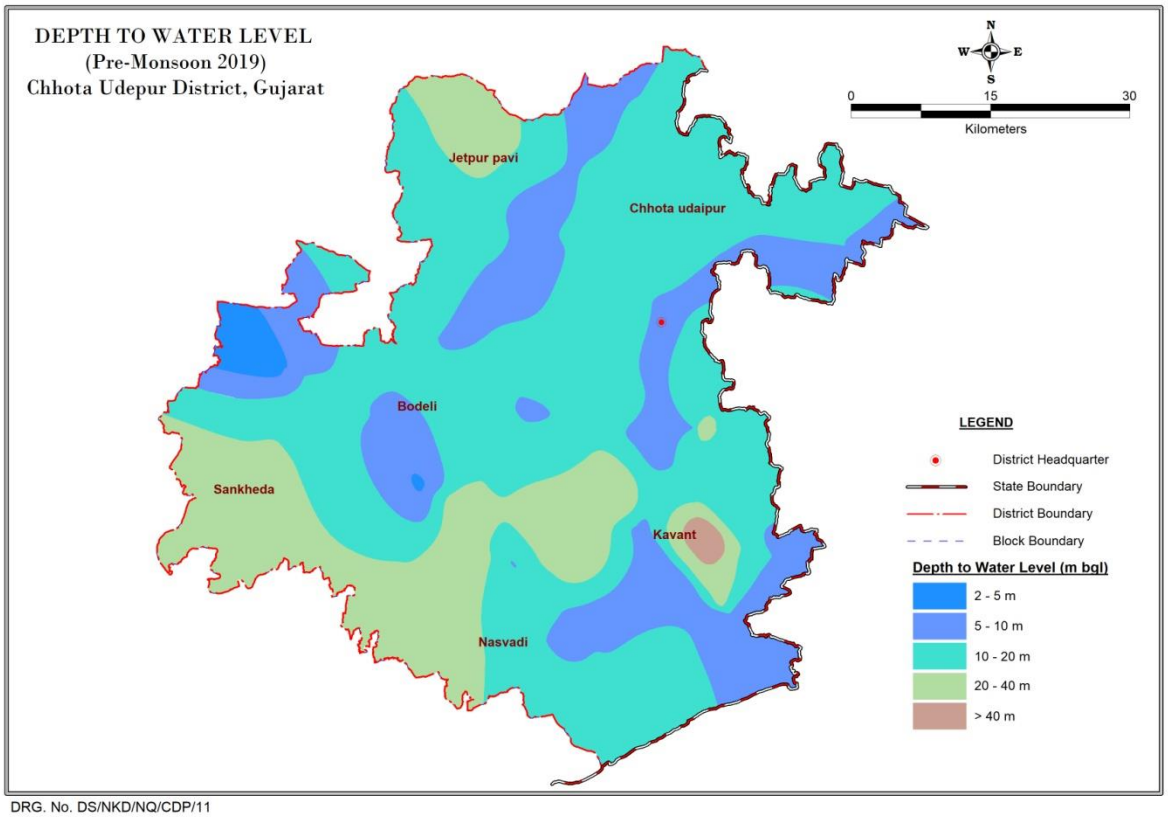


FIGURE 18- DEPTH TO WATER LEVEL MAP PRE MONSOON (MAY 2019)

Depth to Water Level Post monsoon (November 2019)

The depth to water levels in Chhota Udepur district during November 2019 ranges between 0.50 (Kheda, Jetpur Pavi block) and 18.1 mbgl (Sankheda, Sankheda block). In general, the depth to Water levels ranges between less than 2m bgl to 20 mbgl is observed in the district. The Deeper water levels between more than 10 mbgl are observed in isolated patches in

Sankheda, Kavant, Naswadi and Chhota Udepur block. The post-monsoon depth to water level map is depicted in Fig. 19.

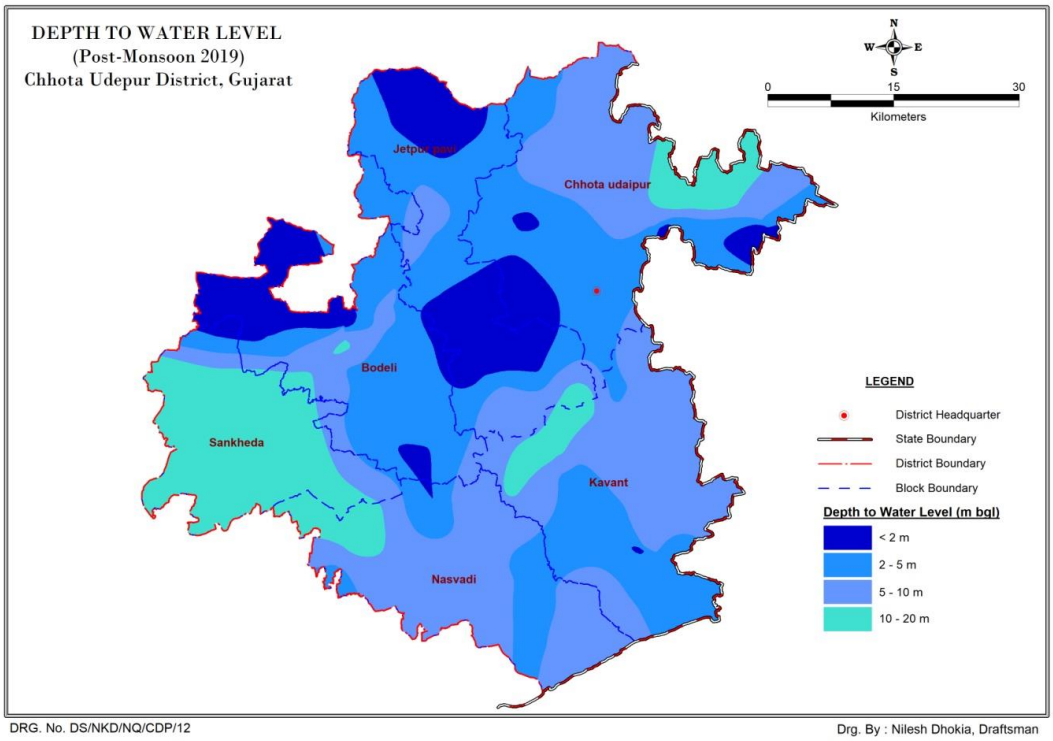


FIGURE 19- DEPTH TO WATER LEVEL MAP POST MONSOON (NOV 2019)

Water table and groundwater movement

The elevation of water table in Pre monsoon 2019 is observed higher along Northern & south eastern art of districti, where water table contour ranges in between 29.90 m amsl to 251m amsl which flowing towards N & NW direction in the northern and central part of the district, whereas it flows in sourthern direction in southern part of district.

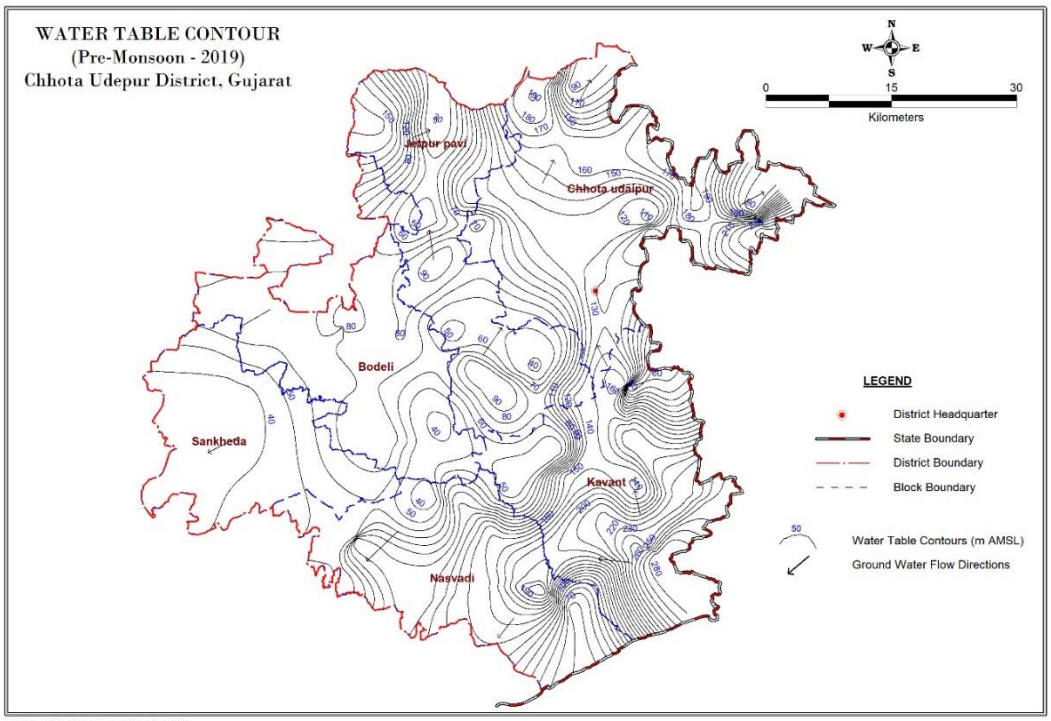


FIGURE 20- WATER LEVEL CONTOUR MAP (PRE-MONSOON_2019)

Pre Monsoon Depth To Water Level Decadal Mean (2010-2019): The pre monsoon depth to water level Decadal Mean 2010-2019 ranges between less than less than 2m to 40m bgl. The shallower water levels less than 10 mbgl were observed in the south-eastern, western & northern part of district. Major part of the district covered by water level ranges between less than 2 m bgl to 20m bgl. Water level more than 20m bgl were observed in patches in south western, central and northern part of district.

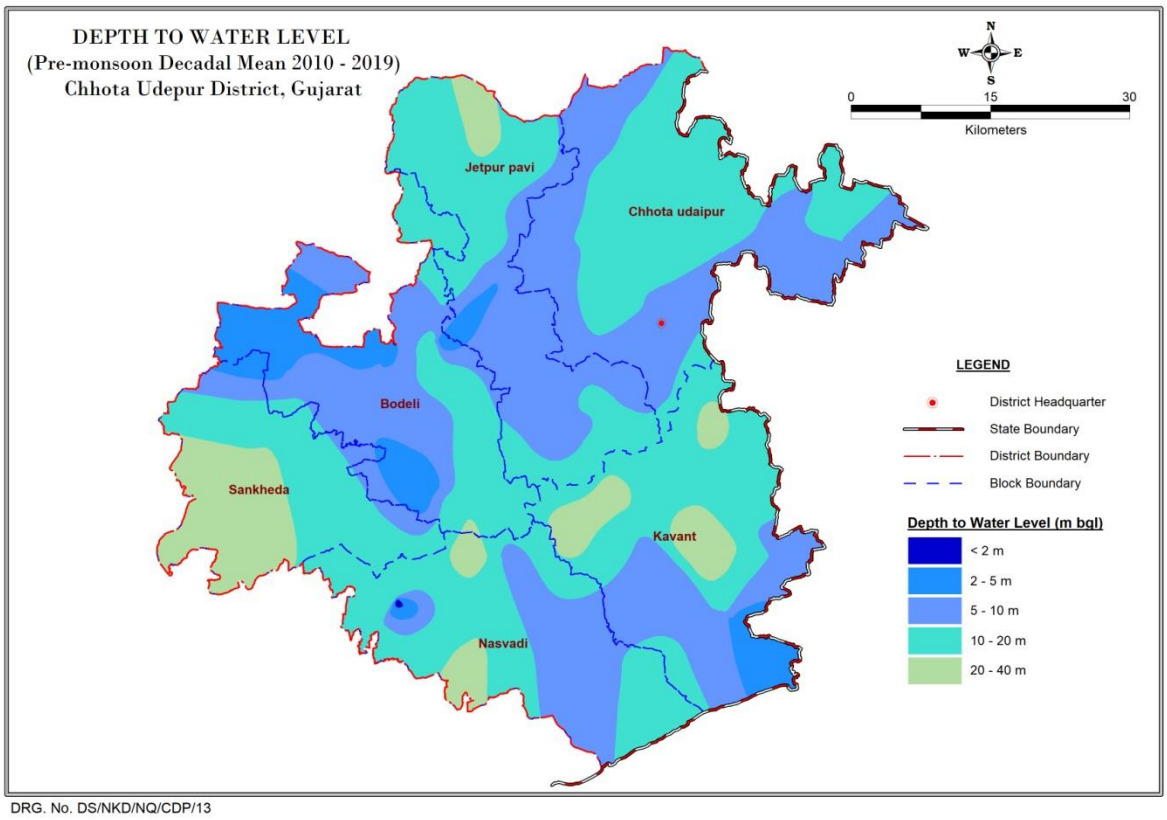


FIGURE 21- PRE MONSOON DEPTH TO WATER LEVEL DECADAL MEAN (2010-2019)

Decadal Mean Post Monsoon (2010-2019): The post monsoon depth to water level Decadal Mean 2010-2019 ranges between less than less than 2m to 20m bgl. The shallower water levels less than 2 mbgl were observed in the western part of district. Major part of the district covered by water level ranges between less than 2 m bgl to 10m bgl.

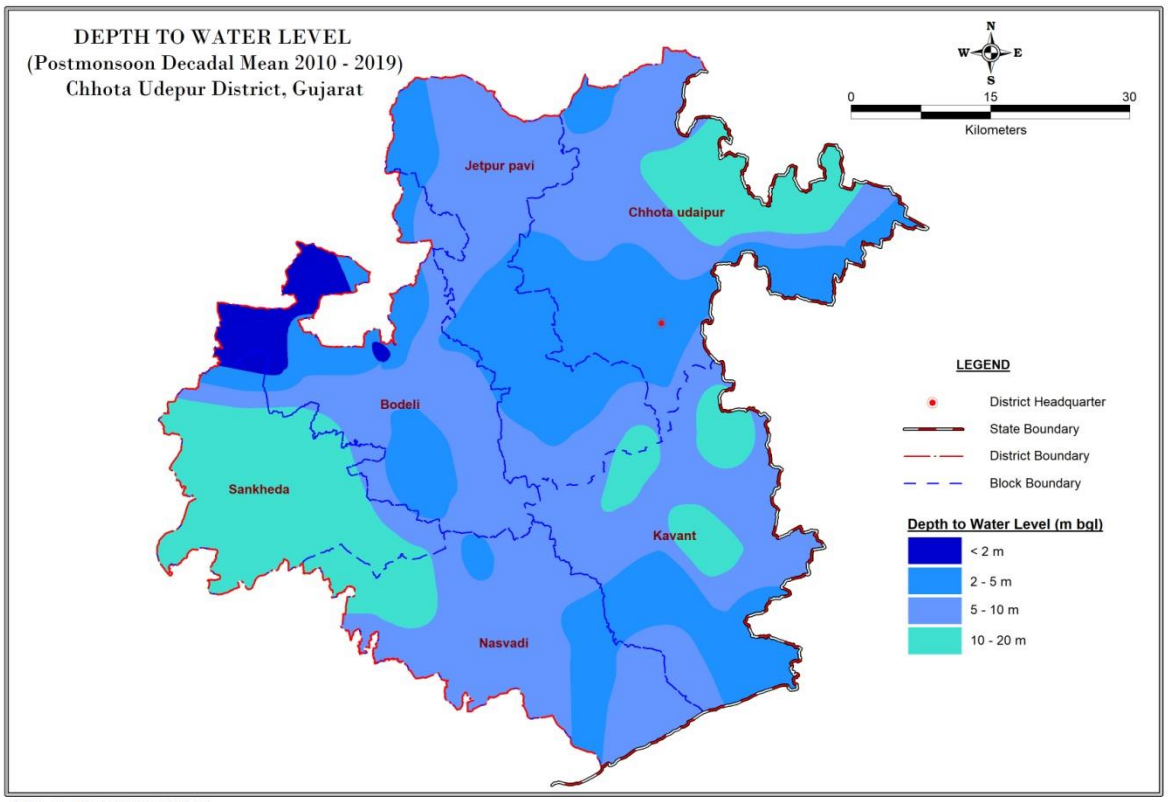


FIGURE 22- PRE MONSOON DEPTH TO WATER LEVEL DECADAL MEAN (2010-2019)

GROUND WATER QUALITY

Water sampling is being done every year from Ground Water Monitoring wells during pre-monsoon period (May). The data gap analysis has been carried out to find out the adequacy of information on water quality and identified 31 additional locations for unconfined aquifers. Ground water quality data of 40 monitoring wells of CGWB and GWRDC representing unconfined aquifer have been utilised to decipher the quality scenario of shallow aquifer.

Parameter	Unit	Minimum	Maximum
EC	µS/cm	416	5535
TH	mg/l	110	1380
TDS	mg/l	210	3708
CO3	mg/l	0	64
HCO3	mg/l	98	976
Cl	mg/l	28	1021
SO4	mg/l	10	353
NO3	mg/l	0.6	776
Ca	mg/l	12	220
Mg	mg/l	2	202
Na	mg/l	16	702
K	mg/l	0.24	45
F	mg/l	0.10	6.4
SAR		0.4	14.9
Alk'y	mg/l	80	800

TABLE 12- RANGES OF BASIC CHEMICAL ANALYSIS

Hydrogen Ion Concentration (pH)

The pH is an indicator of acidity of the water. The shallow ground water in the district is generally alkaline with pH more than 7. The value of pH ranges between 7.00 (Chisadaya & Jabugam) & 8.73 (Damapura) in the district.

Carbonate (CO3) and Bicarbonate (HCO3)

The shallow ground water in Aravali district does Carbonate ranges from 24 mg/l (Lagami & Bhagwanpura) to 66 mg/l (Dampura). The Bicarbonate concentration in district are varies in between 98 mg/l (Vagudan) to 976 mg/l (Bhindol).

ELECTRICAL CONDUCTIVITY (EC)

The concentration of EC in shallow aquifer varies between 416 (Lagami, Chotta Udepur block) and 5535 (Bodeli, Sankheda block). Out of 54 samples collected from dug wells and shallow tube wells, concentration of EC >3000 µS/cm has been observed in 4 wells in village Bodeli, Sankheda block, Panwad & Devat (Thadgam), Kavant block, Ghamodi, Chhota Udeupur

block. In general the ground water is potable in entire part of district. The distribution of electrical conductivity in shallow aquifers is shown in **Fig. 23**.

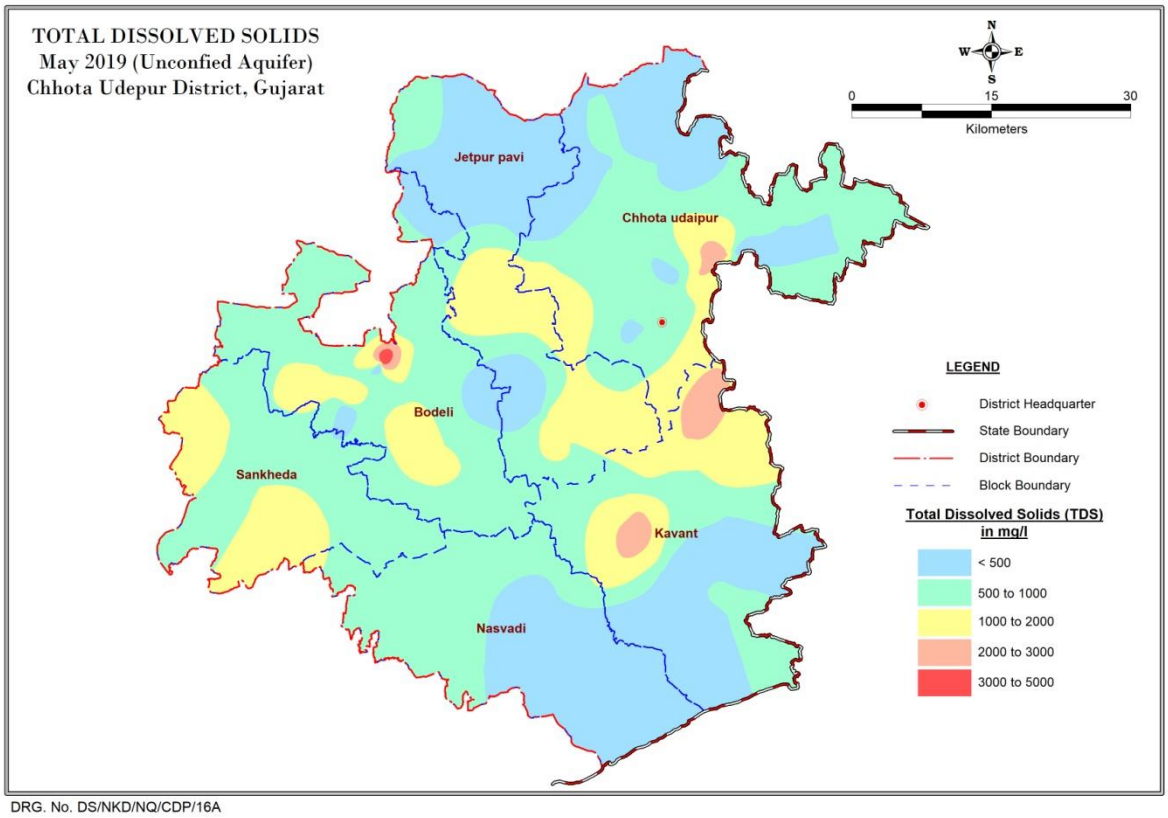


FIGURE 23- ELECTRICAL CONDUCTIVITY MAP OF CHHOTA UDEPUR DISTRICT.

NITRATE:

Nitrogen in the form of dissolved nitrate nutrient for vegetation, and the element is essential to all life. The major contribution in ground water is from sewage, waste disposal, nitrate fertilizer and decaying of organic matter. The concentration of nitrate concentration in shallow aquifer varies between 0.60 (Lagami, Chhota Udepur block) and 775 (Bodeli, Sankheda block). 29 water samples show the nitrate concentrations exceeding the desirable limit of 45 mg/l out of 54 water sample. The distribution of nitrate in shallow aquifers is shown in Fig. 24.

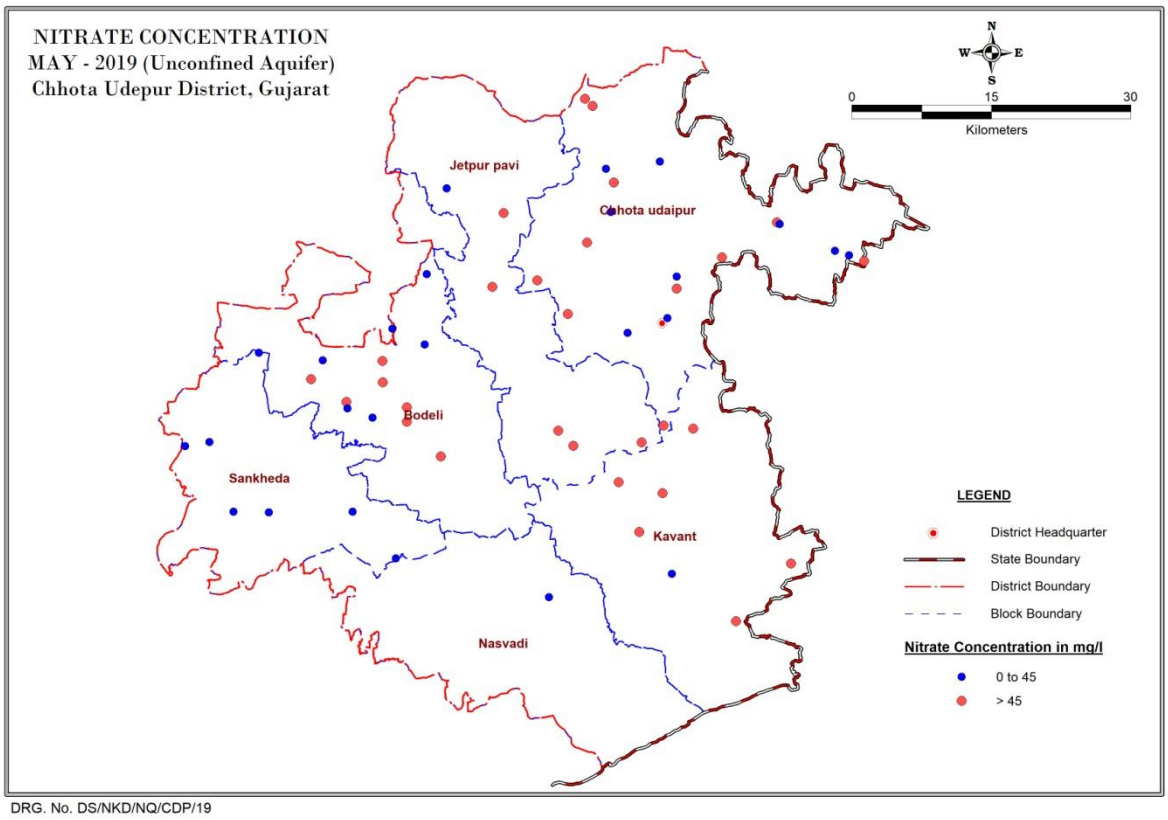


FIGURE 24- NITRATE CONCENTRATION MAP OF CHHOTA UDEPUR DISTRICT

FLUORIDE*:*

The major contribution in ground water is from geogenic sources by weathering of meta-sediments in Hard rock terrain. The concentration of fluoride concentration in shallow aquifer varies between 0.10 (Saidivasana, Kavant block) and 6.4 (Asar, Chhota Udepur block). In shallow aquifer out of 54 samples were analyzed; 17 water samples show the fluoride concentrations exceeding the permissible limit of 1.5 mg/l. The distribution of fluoride in shallow aquifers is shown in Fig. 25.

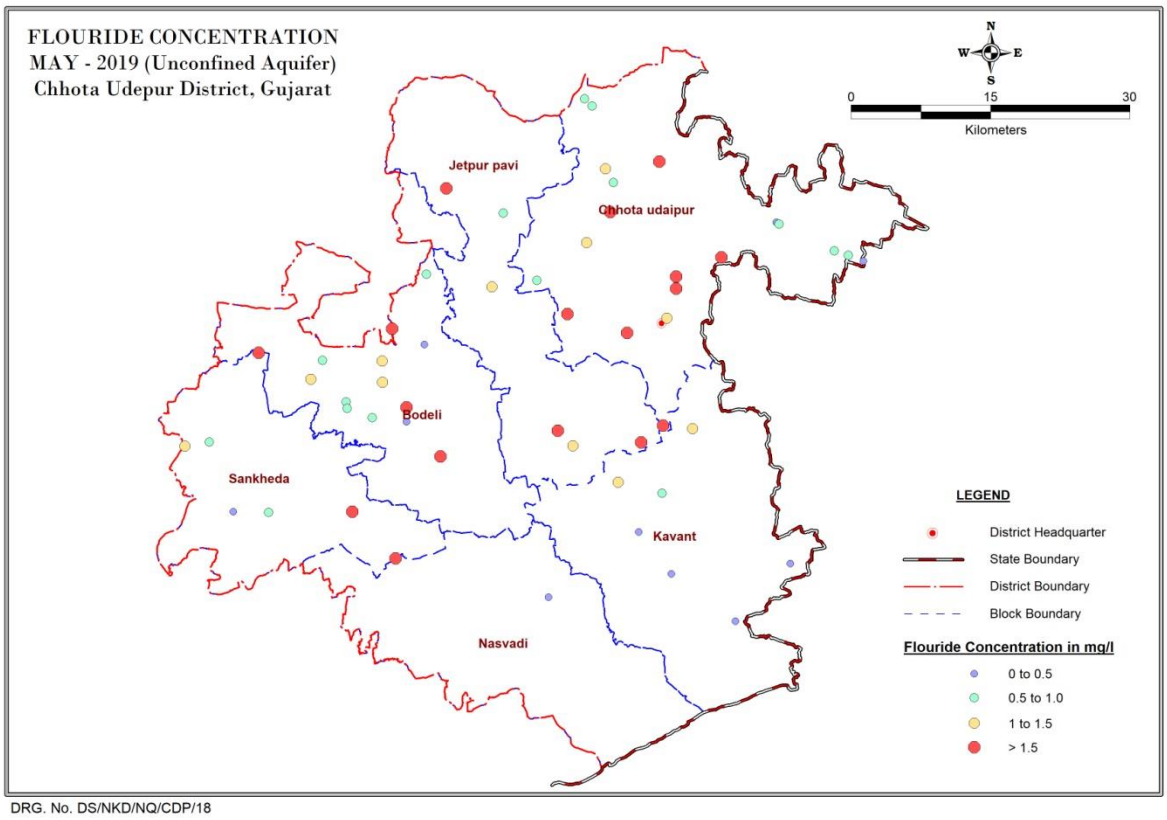


FIGURE 25- FLUORIDE CONCENTRATION MAP OF CHOTTA UDEPUR DISTRICT

Sulphate (SO4)

In the district, Sulphate concentration varies from 10 mg/l (Lagami) to 353 mg/l (Kali Talavadi).

Calcium (Ca)

Calcium concentration in district varies between 12 mg/l (Peetha village) and 220 mg/l (Bodeli)). The concentration of calcium is found within permissible limits in the district (permissible limit as per BIS norms is 200 mg/l) except one location i.e. Bodeli village.

Magnesium (Mg)

The Concentration of Magnesium in areas ranges from 02 mg/l (Narvaniya) to 202 mg/l (Bodeli). In 06 isolate villages namely Bodeli(202 mg/l), Devat (Thadgam) (173 mg/l), Govindpura(175 mg/l), Panwad (131 mg/l), Makhni (107 mg/l), Sajva Thambhala (109 mg/l) the concentration of Magnesium is more than maximum permissible limits of 100 mg/l (as per BIS norms).

Sodium (Na)

Sodium concentration in the district varies between 16 mg/l (Moti Chikhali) and 702 mg/l (Ghamodi).

Potassium (K)

The concentration of Potassium in shallow ground water ranges from 0.24 mg/l , Kanakuva to 45 mg/l Pavi (Jetpur).

Map of Chloride (Cl)

As per the BIS standards [IS 10500: 2012] for drinking water, Acceptable limit and Permissible limit of Chloride (mg/l) are 250 mg/l and 1000 mg/l respectively. It is depicted from the map shown in figure-23, A very small patches in Bodeli taluka shows Cl concentration is more than permissible limit.

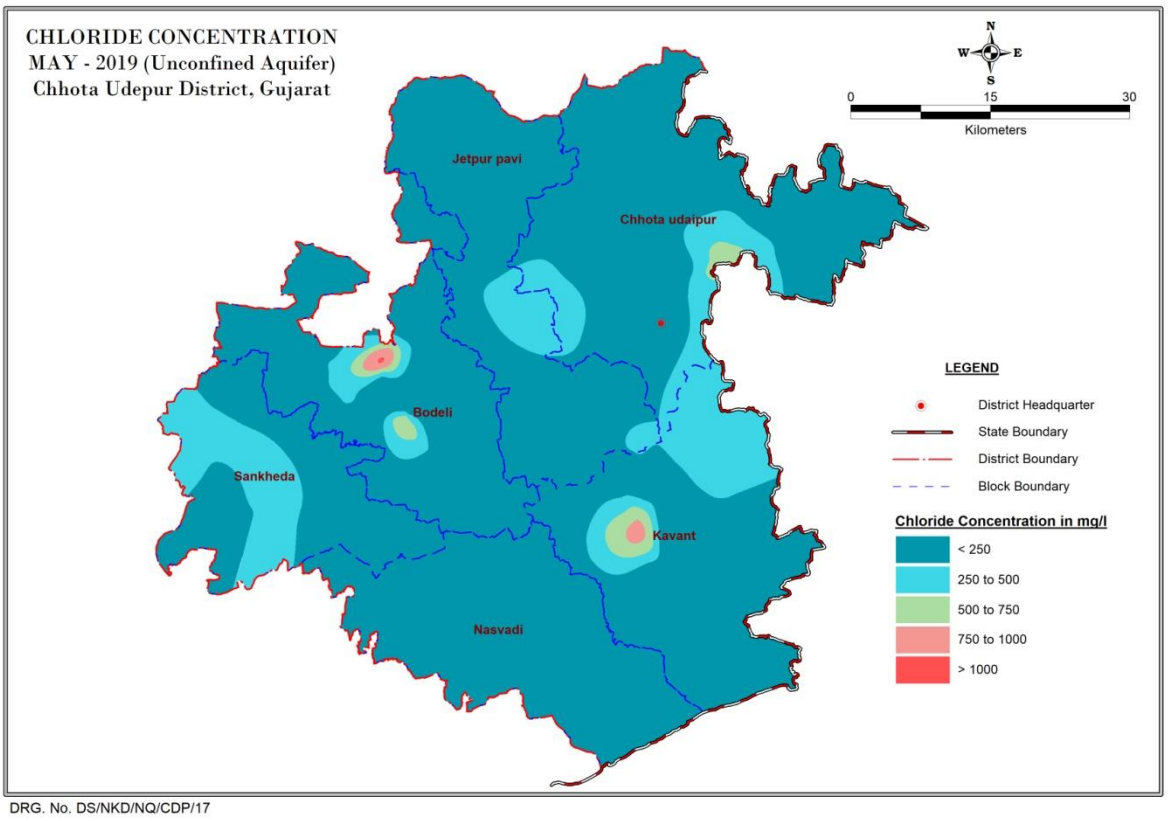


FIGURE 26 MAP SHOWING TALUKA WISE CHLORIDE (CL) CONCENTRATION IN CHOTA UDEPUR DISTRICT.

GROUNDWATER RELATED ISSUE

Low Ground water development

As per GWRE 2017 the net annual ground water availability of the district is 338.45 mcm/year. The net annual drafts of 162.62 MCM/year leaves a balance of 175.83 mcm/year of ground water available for future development.

Low Ground water Development: Stage of Ground water development of the district is 48.05%, however talukas wise it ranges from 34.67% (Sankheda taluka) to 59.39% (Bodeli taluka).

Water quality (Geogenic and Anthropogenic)

Ground water in both shallow and deeper Aquifers is Potable and fit for domestic, drinking, irrigation and other industrial purposes , however Fluoride in 17 location and Nitrate in 29 location observed beyond permissible limit (As per the BIS standards [IS 10500: 2012] for drinking water) in Shallow aquifers identified in localized isolated villages.

Sustainability

Most part of the district has secondary porosity in the form of weathered & fractured rock which forms the good repository or major aquifer of groundwater. Yield in these formation varies varies from very low yield. The yield from bore wells have reduced in a lean period, recoupment time in some phreatic aquifer is very low that’s the reason people residing there constructed large diameter of well for maximum storage.

GROUND WATER RESOURCES

The water resources of a district are an essential factor for its development. Ground water is becoming an important component of the water resources over surface water due to its some inherent advantage. Realistic estimation of groundwater resource forms the fundamental basis for its sustainable management and lays the basic foundation for future developmental planning. Therefore a proper assessment of the groundwater resources of the district is essential for its development.

Groundwater recharge to shallow aquifer in the district is mainly through infiltration from rainfall, return flow from applied irrigation, seepage through canal ,tank, river/stream beds. The confined aquifer gets major part of recharge from the recharge area occurring outside the district. Recharge to confined aquifer also occurs due to difference in head existing between the aquifers, the aquifers with lower head gets recharge from aquifer having higher head.

The assessment of ground water resources involves a relatively complex process of computation after duly considering the various factor related to inflow and outflow of this natural resources Earlier the ground water resources for the state was estimated based on GEC-1984 norms and guidelines. Subsequently a committee was formed in 1997 to update ground water resources based on revised Methodology (Ground Water Resources Estimation Committee, 1997 – GEC – 1997).Based on the GEC-1997 norms. Wherein it was envisaged that the Ground water through rainfall recharge during monsoon to be computed considering the following; Rainfall infiltration factor method & Water level fluctuation method.GEC-1997 has recommended to categorize the assessment sub unit based on the stage of ground water development and the long term ground water level trend.

The groundwater resources for the district have been computed as on march 2017 by the Government of Gujarat in association with the CGWB based broadly on the guidelines and recommendations of GEC-97. The unit of assessment of ground water resources has been the administrative unit (Taluks). Out of the 10 talukas for which resources is computed 2 talukas are in over exploited category, 2 taluka are in critical, 1 taluka in semi critical and 4 is in safe stage of ground water development.

Ground Water Recharge

The Annual Ground Water Recharge varies from 1769.39 ha.m (Jambughoda taluka) to 9646.77ha.m (Godhra Taluka). The Gross Annual Ground Water Recharge in the district is 42268.85 ha.m. The net available recharge after leaving natural discharge from monsoon period varies from 1680.91 ha.m (Jambughoda taluka) to 9164.43 ha.m (Godhra Taluka). The net available recharge in the district is 40155.39 ha.m.

Ground Water Draft

The ground water draft from irrigation and Domestic /Industrial sources is presented in Table: 14. The Existing Gross Ground Water Draft for all uses varies from 679.10 ha.m (Jambughoda taluka) to 2826.20 ha.m (Halol Taluka). The Gross Ground Water Draft for All uses in the district is 14677.42 ha.m.

Level of Ground Water Development & Stage

The stage of ground water development at year 2017, for all the talukas of the Panchmahal district computed range from 27.45 % to 43.53 % and 7 units of assessment (talukas) have been categorized as Safe, based on the stages of ground water development and the long-term trend of pre and post monsoon ground water levels. The average stage of groundwater development for district is 36.55%. Taluka wise ground water resources and categorization for each assessment unit is presented in table 11.

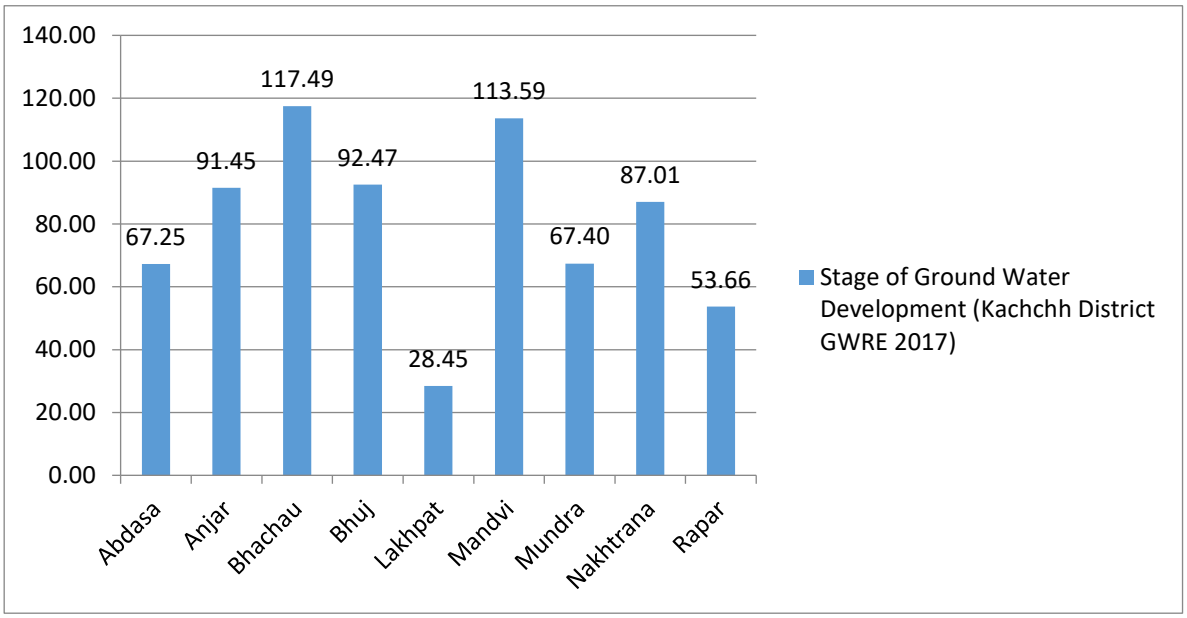


FIGURE 27- MAP SHOWING TALUKA WISE CHLORIDE (CL) CONCENTRATION IN CHOTA UDEPUR DISTRICT.

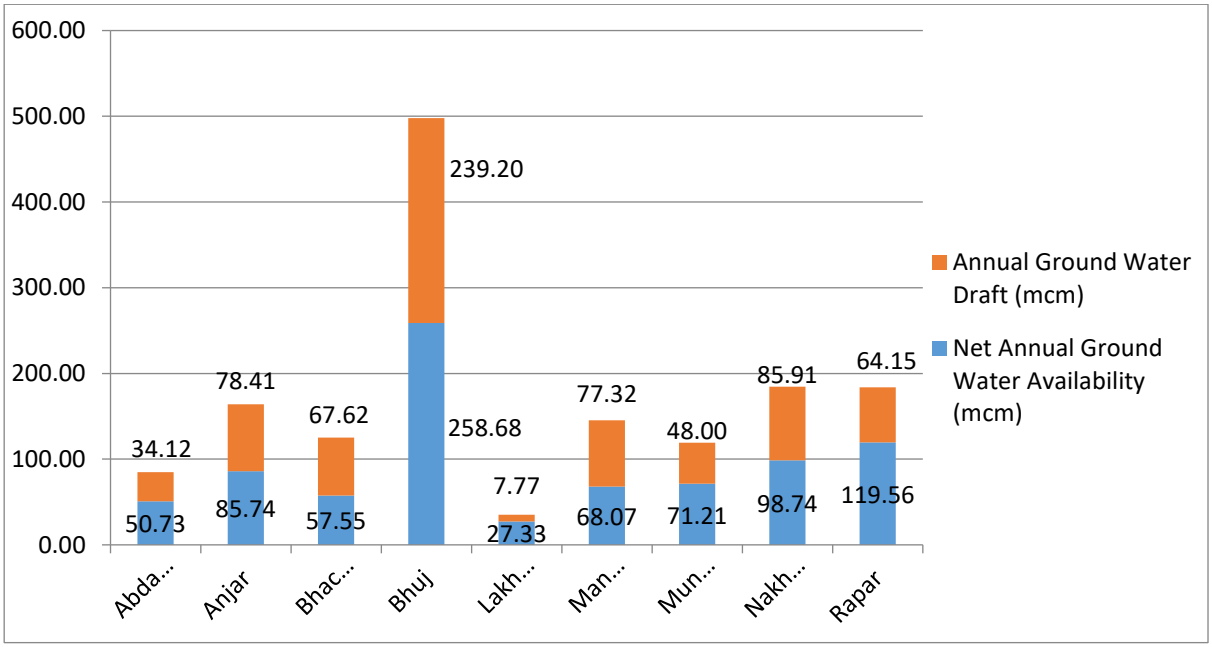


FIGURE 28- ANNUAL GROUND WATER DRAFT (MCM) VS NET ANNUAL GROUND WATER AVAILABILITY (MCM)

Taluka Wise Ground Water Resources, Availability, Utilization and Stage of Ground Water Development (2017)

District : Chhotaudaipur

Sr. No.	Taluka	ANNUAL REPLENISHABLE GROUND WATER RESOURCE (mcm)					Natural Discharge during non-monsoon season (mcm) (5 % of 7)	Net Annual Ground Water Availability (mcm) (7- 8)	ANNUAL GROUND WATER DRAFT (mcm)			Projected Demand for Domestic and Industrial uses upto 2025 (mcm)	Ground Water Availability for future irrigation (mcm) {(9)-(10+13)}	Stage of Ground Water Development (%) (12/9) * 100	Category
		Monsoon		Non Monsoon		Total Annual Ground Water Recharge (3+4+5+6)			Irrigation	Domestic And Industrial uses	Total (10 + 11)				
		Recharge from rainfall	Recharge from other sources	Recharge from rainfall	Recharge from other sources										
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Jetpur Pavi	42.64	13.66	0.00	15.03	71.33	3.57	67.76	37.20	2.76	39.96	3.26	27.30	58.98	Safe
2	Chhotaudaipur	63.49	8.45	0.00	5.74	77.68	3.88	73.79	25.87	3.76	29.63	4.44	43.49	40.15	Safe
3	Kavant	41.33	10.13	0.00	2.88	54.34	2.72	51.62	24.05	3.67	27.71	4.32	23.26	53.68	Safe
4	Sankheda	17.71	15.81	0.00	31.06	64.58	3.23	61.35	19.64	1.64	21.27	1.93	39.79	34.67	Safe
5	Nasvadi	14.04	12.46	0.00	14.75	41.25	2.06	39.18	15.05	2.42	17.47	2.86	21.28	44.59	Safe
6	Bodeli	12.40	12.71	0.00	21.97	47.08	2.35	44.73	23.94	2.63	26.57	3.10	17.69	59.39	Safe
District Total		**191.60**	**73.24**	**0.00**	**91.43**	**356.26**	**17.81**	**338.45**	**145.73**	**16.89**	**162.62**	**19.91**	**172.81**	**48.05**	**Safe**

GROUND WATER MANAGEMENT PLAN AND SUSTAINABLE DEVELOPMENT

The management plan has been proposed to manage the ground water resources and to arrest further decline in water levels. The management plan comprises two components namely supply-side management and demand side management. The supply side managements proposed based on surplus surface water availability and the unsaturated thickness of aquifer whereas the demand side management is proposed by use of micro irrigation techniques and change in cropping pattern.

GROUND WATER RELATED ISSUES:

1. **Low Ground water development**
2. **Low Yield and Sustainability of the Wells.**
3. **Ground water Quality**

Groundwater management plan: Ground water management plan (Both supply side and Management side) needs to be prepared with an aim to enhance the groundwater usage for creation of additional irrigation potential for the district for uplifting the economic condition of the farmers.

SUPPLY SIDE MANAGEMENT

The supply side management of ground water resources can be done through the artificial recharge of surplus runoff available within river sub basins and micro watersheds. Also, it is necessary to understand the unsaturated aquifer volume available for recharge. The unsaturated volume of aquifer was computed based on the area feasible for recharge, unsaturated depth below 5mbgl and the specific yield of the aquifer. The Table no 13 gives the block wise volume available for the recharge.

Block	Recharge though defunct tube Wells in hard rock capacity to recharge @ 3Ham	Recharge though Recharge Shaft in hard rock capacity to recharge @ 3Ham
Bodeli	4	81
Naswadi	3	72
Sankheda	3	72
Kavant	3	67
Chotta Udaipur	5	10
Jetpur Pavi	3	72
Total	22	478

TABLE 13- PROPOSED GROUND WATER RECHARGE INTERVENTIONS

GROUND WATER DEVELOPMENT PLAN

As per GWRE 2017 all the 06 no blocks of Chhota Udepur district are under safe category Ground water stage of development ranges from 34.67 % (Sankheda) to 59.39 % (Bodeli). To elevate the stage of ground water development to 70%, 1927 nos. of Dug wells (20m depth) and 600 no Bore wells (100m depth) are proposed as feasible extraction structures. The extraction structures will result in additional ground water draft of 1430 hams which will create 2860 ha additional irrigation potential for the district.

Block	**Feasible Extraction structures to elevate the Stage of GW development to 70%**	
	No. of dug wells, 3 lack/unit	**No. of Bore wells, Unit cost 1.5 lacs**
Bodeli	200	50
Naswadi	300	100
Sankheda	300	100
Kavant	577	200
Chotta Udaipur	450	120
Jetpur Pavi	100	30
Total	1927	600

TABLE 14- PROPOSED GROUND WATER DEVELOPMENT PLAN INTERVENTIONS

DEMAND SIDE MANAGEMENT

Even though the stage of ground water development in the district is low, however to manage the resources perceiving the future demand, following water use efficiency interventions are proposed.

- 3306 Ha area is proposed for on farm activities (Laser levelling/Bench terracing/Contour banding) and 1255 no of farm ponds are recommended which will serve dual purpose of irrigation and recharge to ground water.
- Ground water recharge of 330.6 ham (through on farm activities and Farm Pond) is expected for the district.
- 554.14 hams saving of ground water through WUE measures & farm ponds activities are expected for the district.

Block	On farm Activities (Area in ha)	Farm Pond (30 m x 30m x 1.5 m)
Bodeli	383	55
Naswadi	361	60
Sankheda	471	357
Kavant	577	200
Chotta Udaipur	621	280
Jetpur Pavi	893	303
Total	3306	1255

TABLE 15- PROPOSED WUE INTERVENTIONS IN CHHOTA UDEPUR DISTRICT

EXPECTED BENEFITS:

The impact of groundwater management plans on the groundwater system in the district after its implementation is evaluated and the outcome shows significant improvement in groundwater scenario in all blocks as given in the Table 16.

Table : 3 Projected Status of Groundwater Resource after implementation of GW Management Plan, Chotta Udaipur District (Gujrat)

Taluka Name	Net G.W. Availability (Ham)	Additional Recharge from Recharge interventions (ham)	Additional Recharge from Return flow of GW Irrigation	Total Net G.W. Availability after intervention (Ham)	Existing G.W Draft for all purpose (ham)	Conservation of Ground water through on farm activity & farm ponds (ham)	G.W Draft from Extraction structures (ham)	Net GW draft after interventions (ham)	Present stage of G.W. Development (%)	Projected stage of G.W. Development after construction of extraction structures (%)	Projected stage of GW development after construction of extraction structures & implementation of conservation measures(in %)	Projected stage of GW development after construction of extraction structures & implementation of conservation & Recharge measures (in %)	Additional Irrigation Potential Created (Ha)
Bodeli	4473	293.30	14	4780.30	2657	36.19	140	2760.81	59.39	62.34	61.00	57.75	280
Naswadi	3918	258.10	23	4199.10	1747	36.64	230	1940.36	44.59	50.16	48.79	46.21	460
Sankheda	6135	287.1	31	6453.1	2127	134.16	310	2302.84	34.67	39.52	37.06	36.00	620
Kavant	5162	267.7	26	5455.7	2771	90.82	260	2940.18	53.68	58.42	56.05	53.89	520
Chotta Udaipur	7379	107.1	39	7525.1	2963	117.80	390	3235.20	40.15	45.20	43.25	43.00	780
Jetpur Pavi	6776	287.1	10	7100.3	3996	138.53	100	3957.47	58.98	60.36	57.56	55.74	200
Total	33843	1500	143	35514	16261	554	1430	17137	49	52.67	50.62	48.77	2860

TABLE 16- PROJECTED STATUS OF GROUNDWATER RESOURCE AFTER IMPLEMENTATION OF GROUND WATER MANAGEMENT PLAN

- Projected stage of development after construction of extraction structure is is 52.67 % in Chhota Udepur district.
- Projected stage of development after implementation of conservation and recharge measures is 48.77 %

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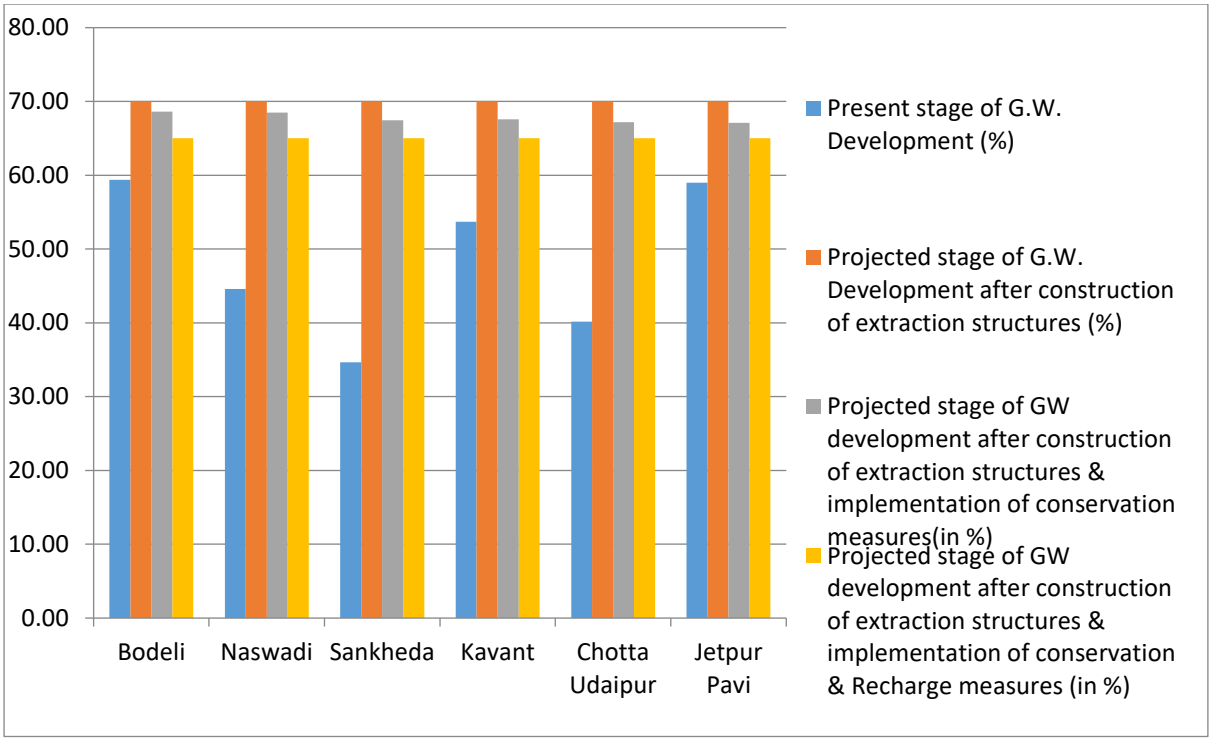

FIGURE 29- PROJECTED STAGE AFTER IMPLEMENTATION OF GROUND WATER MANAGEMENT PLAN

CONCLUSION AND RECOMMENDATIONS

- The district is to consist of the six talukas of Chhotaudepur, Pavi Jetpur, Kawant, Naswadi, Sankheda and the newly created Bodeli taluka.

- The eastern portion of the district comprising the Chhota Udepur, the Kavant, the Jambughoda and the Naswadi taluka is hilly terrain with several ridges, plateaus and isolated relict hills have elevation in range of 150 to 481 m amsl. The south eastern plateau have the highest peaks of the district – Amba Dungar & Mandai Dongar 637 m amsl.
- As per GWRE 2017 the net annual ground water availability of the district is 338.45 mcm/year. The net annual drafts of 162.62 MCM/year leaves a balance of 175.83 mcm/year of ground water available for future development.

- To elevate the stage of ground water development to 52.67 % in the district, 1927 no Dug wells (20 m depth) and 600 no Bore wells (100m depth) are proposed as feasible extraction structures.

- Artificial recharge structures like recharge shafts 478 nos. and Defunct Tube well 22 nos. are suggested in supply side management plan.

- To prevent Over Exploitation, water conservation activities like On farm activities 3306 nos, farm ponds 1255 nos are suggested in demand side management plan.

- As a conservation measure, farmers should be encouraged and educated to adopt modern irrigation techniques like drip, sprinkler irrigation etc. to effect minimum withdrawal and maximum utilisation of groundwater.

- The water quality in general is good. However higher EC values and fluoride concentration is observed in isolated pockets. Ground water in such areas may be used after blending with surface water. In areas where ground water has higher concentration of Nitrate is observed, necessary sanitation measures should be adopted.

- If surface water is not available in aforesaid areas with quality issues there water supply tube wells may be constructed tapping deeper aquifer after casing the Phreatic aquifer.