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Technical Report Series

DISTRICT GROUNDWATER BROCHURE
MAHESANA DISTRICT
GUJARAT

Compiled By

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Ministry of Water Resources

CENTRAL GROUND WATER BOARD

West Central Region

Ahmedabad

March 2014

MAHESANA DISTRICT AT A GLANCE

SL No.	Items	Statistics	
1	**General Information**		
	i) Geographical area (Sq. Km)	**4,371**	
	ii) Administrative Divisions (As on 3/2011) Number of Talukas Number of Villages	 **9** **593**	
	iii) Populations (As per 2011 census)	**20,27,727**	
	iv) Average Annual Rainfall (mm)	**827**	
2.	**GEOMORPHOLOGY**		
	Major Physiographic Units	**Alluvial plain**	
	Major Drainages	**Rupen & Khari**	
3.	**LAND USE (Sq. Km)**		
	a) Forest area b) Net area sown c) Cultivable area	**72** **3,516** **4,509**	
4.	**MAJOR SOIL TYPES: Sandy soil, rocky soil**		
5.	**AREA UNDER PRINCIPAL CROPS (sq.km)**		
	Rice-80, Jowar-10, Bajra-720, Wheat-520, Total Cereals-1370, Gram-10, Other Pulses-260, Total Pulses-260, Total Food Grains-1630, Groundnut-30, Seasemum-130, Rapes and Mustard-420, Total Oil Seeds-990.		
6.	**IRRIGATION BY DIFFERENT SOURCES**		
	(Areas and numbers of structures)	**No.**	**Area (Sq. Km.)**
	Dugwells	**8,202**	**206**
	Tube wells/Borewells	**11,220**	**2289**
	Tanks/Ponds/Water conservation structures		**18**
	Canals		**206**
	Other Sources		**9**
	Net Irrigated area (sq. km.)	**2186**	
	Gross Irrigated area (sq. km.)	**2733**	
7.	**NUMBERS OF GROUND WATER MONITORING WELLS**		
	CGWB (As on 31-03-2012) No of Dug Wells No of Piezometers	**60** **16** **44**	
8.	**PREDOMINANT GEOLOGICAL FORMATIONS:**		
	Alluvium in major parts, granite, gneiss in eastern and north eastern part of district.		

9.	**HYDROGEOLOGY**
	➢ **Major Water Bearing Formation:** Groundwater occurs in unconfined to confined condition in Quaternary alluvium and under unconfined condition in granite gneiss in limited area.

Depth to water Level during 2011-12		
Period	**Phreatic Aquifer (DTW)**	
	Minimum	**Maximum**
Pre Monsoon	2.15 (Budasan)	34.35 (Rampur Kot Juna Pz I)
Post Monsoon	1.10 (Visnagar IV)	33.77 (Rampur Kot Juna Pz I)

Long Term (10 Years) Water Level Trend (2003 to 2012)		
Trend	**Pre-Monsoon**	**Post- Monsoon**
Rise (m/Yr)	0.0048 (Asjol) to 7.4589 (Vijapur I)	0.0096 (Jaska Sy_4) Pz II to 2.6633 (Mahesana IV)
Fall (m/Yr)	0.0803 (Karali II) to 3.5682 (Motipura Pz III	0.0803 (Karali II) to 3.5682 (Motipura Pz III)

10.	**GROUND WATER EXPLORATION BY CGWB (As on 31-03-2012)**	
	No of wellsdrilled (EW, OW, Pz, SH, Total) EW 12,OW 9, PZ 15, SH 1, Total:.37	
	Depth Range(m)	22 - 610
	Discharge (Litres per minute)	180 - 2496
11	**GROUND WATER QUALITY**	
	Presence of chemical constituents more than permissible limit)	Fluoride:189 Villages Salinity :107 Villages Nitrate : 18 Villages
	Type of water	Predominant bicarbonate-Chloride type
12.	**DYNAMIC GROUND WATER RESOURCES (2011)- in MCM**	
	Annual Replenishable Ground Water Resources (MCM)	880.25
	Net Ground water Availability (MCM)	836.24
	Projected Demand for Domestic and industrial Uses upto 2025 (MCM)	74.55
	Stage of Ground Water Development (%)	116.08%
13	AWARENESS AND TRAINING ACTIVITY (as on 3/2012)	
	Mass Awareness Programmes organized No of Participants	1 300 Thol Village
	Water Management Training Programmes	Not Organised

	organized (No of Participants)	
14	**EFFORTS OF ARTIFICIAL RECHARGE & RAIN WATER HARVESTING (31-3-2014)**	
	Projects completed by CGWB (No & Amount spent)	Nil
	Projects under technical guidance of CGWB (Numbers)	Nil
15	**GROUND WATER CONTROL AND REGULATION (3/2012)**	
	Number of OE Blocks	8 (Becharaji, Kadi, Kheralu, Mahesana, Satlasana, Unjha, Vijapur, Visnagar)
	Number of Critical Blocks	1 (Vadnagar)
	Number of Semi Critical Blocks	Nil
	Number of Safe Blocks	-
	Number of Saline Blocks	3 (Becharaji, Kadi, Mahesana)
	No. Of Blocks Notified by CGWA	Nil
16	MAJOR GROUND WATER PROBLEMS AND ISSUES	
	i) Declining Groundwater levels/ Piezometric heads in user aquifers ii) Increasing depth of tubewells iii) Increasing instances of high fluoride iv) Groundwater contamination due to unplanned construction and poor technical design of tube wells v) Awareness amongst villagers on water conservation techniques vi) Demand supply management	

DISTRICT GROUNDWATER BROCHURE
MAHESANA DISTRICT

1.0 Introduction

Mahesana district occupies 4371 sq. km. area between 23°00’ and 24°09’ north latitudes and 71°26’ and 72°51’ east longitudes in the northern part of Gujarat state. It falls in the survey of India degree sheet numbers 45D and 46A. It is bounded by Banaskantha and Patan in north, Patan and Surendranagar in west, Ahmedabad and Gandhinagar in south and by Sabarkantha in east. It has nine talukas, having 593 villages. total population of the district as per 2011 census is **20,27,727.**Location Map of the district is presented as Figure-1 and Administrative Map as Figure-2..

Rivers Rupen and Khari drain part of the district. Both these rivers are ephemeral in nature and flow only during good monsoon years. The river Sabarmati forms the eastern boundary of the district with very limited catchment area in the district. Major part of the area in the district is devoid of any drainage network and does not fall in any catchment.

The surface water resources of the district are very limited. Groundwater is the main source of irrigation, about 93% of the area is irrigated by groundwater.

Studies/Activities by CGWB

Before central Ground Water Board came to existence, Heron & Ghosh, 1938 (GSI) carried out geological mapping in the north eastern part of the district. Auden, 1938 carried short term investigation of the subsoil water in the district. The first Hydrogeological investigation was carried out by B. K. Baweja during 1953-55. V. V. Rane, 1962-63 (GSI), investigated the causes of decline of water level and discharge of tubewells. M.M. Oza, 1963-67 (GSI), continued hydrogeological studies and broadly identified three aquifer systems in the district.

CGWB under UNDP assisted phase II programme carried out extensive hydrogeological studies including exploratory drilling in the area. A phreatic and confined aquifer system was deciphered down to the explored depth of 600m.

Arun Kumar (1979-80), CGWB, carried out reappraisal hydrogeological study, covering parts of Mahesana and Banaskantha districts. P. N. Phadtare (1981), CGWB, compiled “hydrogeology of Gujarat State” and discussed groundwater resource potential of the district based on earlier studies.

During 1980-85, CGWB with UNDP assistance carried out pilot project for artificial recharge of groundwater to figure out technical feasibility and economic viability of the various artificial recharge techniques/experiments in the alluvial area of the district.

Groundwater exploration by test drilling in the district commenced in fifties and was continued till 2002-2003. Apart from the exploratory wells Piezometer of various depths are also constructed in the district for periodic monitoring of the ground water regime in the district and is continued till date.

2.0 Rainfall and climate

The district has semi arid climate. Extreme temperatures, erratic rainfall and high evaporation are the characteristic features of this type of climate. Climatological data of Deesa IMD station (1951-1980) which is nearest is given in the table 1.

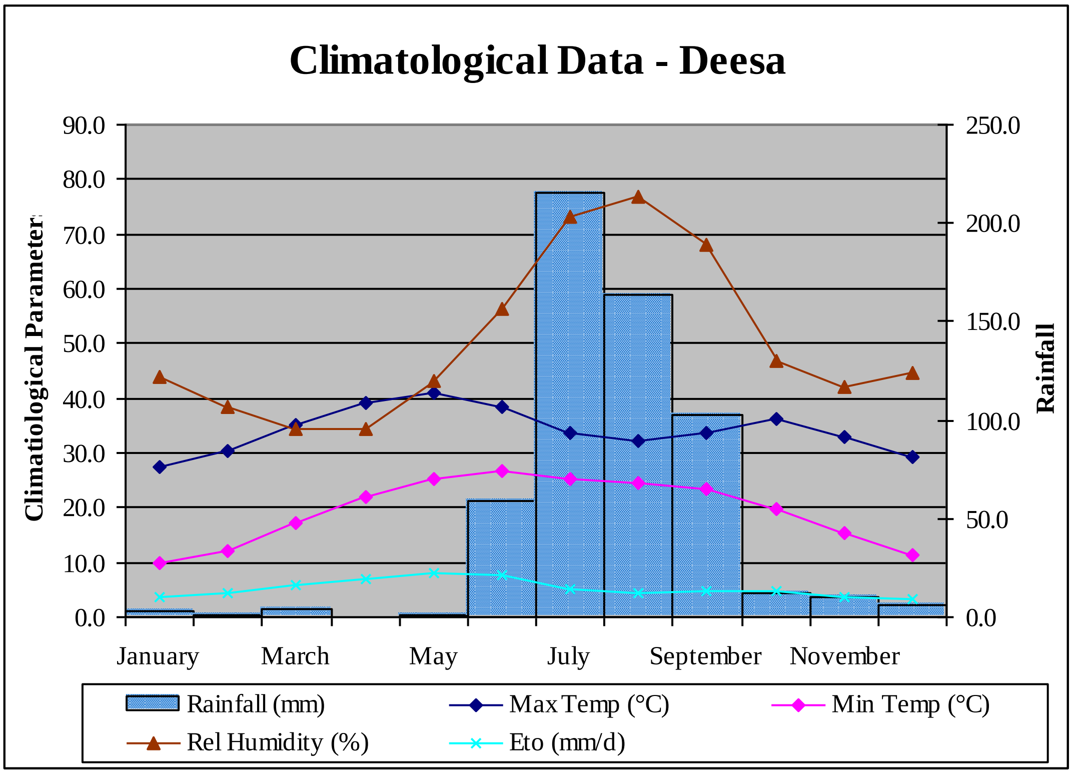


Table 1

Month	Maximum Temp. (° C)	Minimum Temp. (° C)	Humidity (%)	Wind Speed (kmpd)	Sunshine (Hours)	Evapotranspiration (mm/Day)	Rainfall (mm)
January	27.3	9.8	44	129.4	8.9	3.5	2.7
February	30.2	12.0	38.5	127.7	9.5	4.3	0.9
March	35.1	17.1	34.5	136.3	10.1	5.7	4.3
April	39.0	21.9	34.5	134.6	10.8	6.8	0.1
May	41.0	25.3	43.0	184.6	11.4	8.2	1.4
June	38.5	26.7	56.5	246.7	8.7	7.5	59.2
July	33.6	25.4	73.0	201.8	5.3	5.0	215.7
August	32.2	24.5	77.0	162.2	5.4	4.4	163.2
September	33.7	23.5	68.0	122.5	7.9	4.8	102.2
October	36.1	19.7	47.0	100.1	9.6	4.7	12.6
November	33.0	15.2	42.0	103.5	9.3	3.8	10.2

December	29.3	11.2	44.5	115.6	8.9	3.3	6.3
Total							578.8
Average	34.1	19.4	50.2	147.1	8.8	5.2	

3.0 Geomorphology and Soil Type

Geomorphologically the district can be divided into three major zones

a) **Dissected hilly terrain:** The north eastern part of Satlasana taluka which is made up of Delhi metasediments and post Delhi intrusives is characterised by high hills and linear ridges with narrow intermontain valleys.

b) **Piedmont plain with inselbergs:** A belt of about 20-30 km width fringing the hilly terrain in the north eastern part of the district is characterised by moderate relief (2m/km) and is comprised of shallow alluvium with boulder/gravel beds and occasional inliers of older rocks.

c) **Alluvial plain:** It is a vast sandy tract characterised by gently sloping, slightly rolling to undulatory topography owing to presence of sand dunes. the most prominent unit and covers the most part of the district.

In major part the soils are sandy in nature. In general the soils are poor to medium in fertility and water retention capacity. Most soils have good aeration, porosity and permeability. The hydraulic conductivity of the soils ranges from as low as 0 for saline and alkali soils in the western part to more than 7cm/hr for calcareous sandy soils in the north and west. Soils of the district fall in five broad categories as below.

I) Saline and alkali soils: These are typically deep, grey calcareous sandy clay loams of low permeability.

II) Calcareous sandy loams: These are generally Deep, light grey or brown sandy loams of moderate to good permeability and drainage.

III) Calcareous sandy soils: These are mostly pale yellow and brown sands & loamy sands of good depth and high permeability.

IV) Non calcic brown soils: These are characterised by pale brown to brown deep loamy sands and sandy loams of adequate to good permeability.

V) Non calcic red brown soils: These are of mixed colluvial and alluvial derivations from rocks of the Aravali system. Mostly deep loamy sands to sandy loams with adequate to good hydraulic conductivity.

4.0 Ground Water Scenario

4.1 Hydrogeology

Precambrian hard rocks, semi-consolidated Mesozoic and tertiary formations and unconsolidated quaternary alluvial deposits form 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 individual aquifer and/or ground water quality of the formation water.

Occurrence of groundwater can be divided in two groups .Hydrogeological Map of the district is presented in figure-3

a) Ground water in fissured formation (Hard rock): The north-eastern part of the district mainly in Satlasna taluka is occupied by metasediments and Post Delhi intrusives. The occurrence and movement of ground water is governed by secondary porosity i.e. thickness and extent of weathering and size& interconnections of fractures/joints.

These formations generally don't form good aquifer system. The depth of dugwells range from 15-30 mbgl and of borewells from 100-120 mbgl.Depth to water level in the dug wells varies from 5 -14mbgl and in borewells fro 15to 60 mbgl. The yield of wells range from 30-120m^3 /day with an average of 75m^3/day.

b) Groundwater in porous formations (Sedimentaries): Major part of the district is underlain by post Miocene alluvium and older sedimentary formations. These sediments are mainly consisted by Coarse sand, gravel, kankar, silt, clay and clay stones. Groundwater occurs both under phreatic and confined conditions in arenaceous horizons within sedimentaries. The occurrence and movement of groundwater is mainly controlled by intergranular pore spaces.

Two major aquifer units have been identified the upper unit is mostly phreatic but becomes semi confined to confined in some parts. It is designated as aquifer A and consists of relatively coarse grained sediments. The lower unit comprising a few hundred metre of alternating sand and clay beds form confines aquifer system. It is subdivided into B, C D and E in post Miocene sediments and aquifer F and G in the Miocene sediments. Himmatnagar sandstone (Cretaceous) forms local aquifer in the north eastern part and has been designated as aquifer H. The post Miocene aquifers are generally coarse to fine grained sand with occasional gravel beds. The Miocene aquifers are mainly fine to medium grained sand, sandstone interbedded with clay, clay stone and siltstone. Himmatnagar sandstone is generally coarse grained and friable.

4.1.1 Aquifer parameters:

Unconfined aquifer: Aquifer A: Specific capacity of phreatic aquifer in the district ranges from 31m^3/hr/m to less than 1 m^3/hr/m and transmissivity from 30m^2/day to 1000m^2/day.

Confined Aquifers

Aquifer B: Specific capacity ranges from 1.8m^3/hr/m to 49m^3/hr hr/m. Transmissivity ranges between 47 and 3400 m^2/day, however it is mostly between 200-600m^2/day. Storativity ranges from 0.6 -12.3x10^{-4}.

Aquifer C: Specific capacity calculated for wells at Saola and Charasan ranges from 21.3 and 2.8m^2/day/m respectively. Transmissivity was 94m^2/day at Charasan EW.

Aquifer D: Specific capacity calculated for EW at Dhinoj was found to be 1.3 m^3/hr/day, the transmissivity being 69m^2/day.

Aquifer E: No pumping test carried in this aquifer.

Aquifer F & G: Specific capacity calculated for wells at Charasan and Pilwai was 1.1 m^3/hr/m and 1.7m^3/hr/m respectively. Transmissivity was 59m^2/day and 70m^2/day.

4.1.2 SUBSURFACE GEOLOGY OF MAHESANA DISTRICT WITH DESCRIPTION OF AQUIFER PROPERTIES

Table 2

Stratigraphy	Formation group	Lithology	Depth to top of aquifer (m)	Thickness		Remarks
				Range (m)	Average (m)	
Recent to post Miocene	Aquifer A	Coarse sand, gravel, pebbles and fine and clayey sand	5-71	35-125	62	Variable water quality
	Aquitard I	Clay interbedded with sand and sandy clay	78-162	13-88	39	-
	Aquifer B	Medium to coarse sand and gravel interbedded with sandy clay	78-162	10-80	45	Generally good water quality
	Aquitard II	Clay interbedded with sand and sandy clay		13-80	37	-
	Aquifer C	Medium to coarse sand in north east and fine to medium in central part interbedded with sandy clay and clay	154-274	13-62	34	Generally good water quality
	Aquitard III	Clay interbedded		19-172	73	-

		with sand and sandy clay				
	Aquifer D	Medium sand interbedded with sandy clay	229-402	11-105	52	Variable water quality
	Aquitard IV	Clay interbedded with sandy clay		11-76	44	-
	Aquifer E	Fine to medium sand and sandy clay	300-542	15-57	24	Developed in central part . water quality good
Miocene	Aquiclude V	Grey clay and claystone		13-148	41	-
	Aquifer F	Fine to medium sand , sandstone interbedded with siltstone	200-574	7-68	39	Variable water quality
	Aquiclude VI	Clay and clay stone		34-49	40	-
	Aquifer G	Fine to medium sand , sandstone interbedded with siltstone	264-513	9-124	48	Water generally saline
Paleocene	-	Basalt			267	
Cretaceous	Aquifer H	Himatnagar sandstone	214-547	98-145	121	Variable water quality

Source : CGWB/UNDP Phase II

4.2 Ground Water Regime Monitoring

Groundwater regime monitoring are being carried out four times in a year during May, August, November & January. In all 60 hydrograph stations (16 Open wells & 44 purpose build Piezometers) spread over the entire district were monitored during the 2012. The groundwater level during the premonsoon period (May 2012) ranged from 2.15 m to 34.35 mbgl. Depth to water level map for the pre-monsoon period 2012 is given in figure – 4 . Shallowest water level of 2.15 mbgl was recorded in Budasan Village and the deepest water level of 34.35 mbgl was recorded in Rampur Kot Juna village of the district. The range of groundwater level in the district is table -4.

Table -3 Range Of Groundwater Level in Mahesana District During Pre monsoon May 2012.

District	No of well analysed	DTWL mbgl		No of well in different Ranges & %				
		Min	Max	0 to 2 (m)	2 to 5(m)	5 to 10(m)	10 to 20(m)	20 to 40(m)
Mahesana	23	3.55	34.35	NIL	4	7	9	3
				-	17.39%	30.04%	39.13%	13.04%

The groundwater level during the post-monsoon period (Nov 2012) ranges from 1.10 mbgl to 33.77 mbgl. Spatial distribution of groundwater level in the district is shown in figure -5. Shallowest water level of 1.10 mbgl was recorded in Visnagar village and the deepest water level of 33.77 mbgl was recorded in Rampur Kot Juna village of the district. The range of groundwater level in the district is given in table-5

Table -4 Range Of Groundwater Level In Mahesana District During Post Monsoon November 2012.

District	No of well analysed	DTWL mbgl		No of well in different Ranges & %					
		Min	Max	0 to 2 (m)	2 to 5(m)	5 to 10(m)	10 to 20(m)	20 to 40(m)	>40(m)
Mahesana	22	1.10	33.77	NIL	4	10	6	2	-
				-	18.18 %	45.45%	27.27%	9.09%	-

68.18% of the wells in the district showed rise in the groundwater level between May to November 2012. Rise in the district ranges from 0.32 to 9.46 m. fall is observed in 31.82% wells. Fall in the district ranges from 0.02 to 2.90 m.

Minimum rise of 0.32 m was recorded in Unava village and the Maximum rise of 9.46m was recorded in Kheralu village. Minimum fall of 0.02 m was recorded in Bhandupara and Tarabh villages and the Maximum Fall of 2.90 m was recorded in Budasan village.

Of the wells showing rise, 56.25% wells recorded rise between 0 to 2 m, 18.75 % wells recorded rise between 2 to 4m and 25% wells show rise of more than 4m between May to November 2012.

Of the wells showing fall, 57.14% wells recorded fall of 0 to m and 42.86% wells show fall between 2 to 4m. Water level fluctuation map for the pre and post-monsoon 2012 is given in figure-6.

Long term water level trend during pre-monsoon period (2003 to 2012) shows rise in water level between 0.0048 to 7.4589 m/yr and fall between 0.0803 to 3.5682 m/yr. Long term water level trend during post monsoon period shows rise in water level from 0.0096 to 2.6633m/yr and fall from 0.0803 to 3.5682m/yr.

Confined (Deep) Aquifer

Ground water from the confined aquifer system is under exploitation in a major way for various uses in the district. Tube wells range in depth from 120 to 300 m and have copious yield. The piezometric surface of confined aquifer ranges from less than 60 mbgl to to more than 150 m bgl. However, in major part, it is more than 90 m bgl. Because of excessive ground water development, consistent decline of piezometric surface is observed in the district.

4.3 Ground Water Resources

The ground water resources with talukawise details are presented below in table no 5 and presented as figure-7

Taluka Wise Ground Water Resources, Availability, Utilization and Stage of Ground Water Development (2011)															
District : Mahesana															
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	Becharaji	21.37	5.83	0.00	5.47	32.68	1.63	31.04	39.70	2.79	42.49	3.74	0.00	136.87	Over Exploited
2	Kadi	108.32	15.00	0.00	14.42	137.74	6.89	130.85	146.88	8.98	155.86	12.04	0.00	119.11	Over Exploited
3	Kheralu	71.21	6.24	0.00	6.80	84.24	4.21	80.03	90.42	3.47	93.89	4.65	0.00	117.31	Over Exploited
4	Mahesana	147.67	16.33	0.00	17.97	181.96	9.10	172.86	189.65	13.96	203.61	18.70	0.00	117.78	Over Exploited
5	Satalasana	48.21	5.85	0.00	5.18	59.24	2.96	56.28	56.20	2.30	58.50	3.08	0.00	103.95	Over Exploited
6	Vadnagar	51.59	4.92	0.00	18.58	75.09	3.75	71.33	61.80	3.95	65.75	5.30	4.23	92.17	Critical
7	Visnagar	87.48	9.58	0.00	23.47	120.53	6.03	114.50	123.25	7.67	130.92	10.29	0.00	114.34	Over Exploited
8	Vijapur	110.84	9.83	0.00	13.16	133.82	6.69	127.13	146.34	7.22	153.56	9.68	0.00	120.79	Over Exploited
9	Unjha	50.87	5.14	0.00	12.35	68.36	3.42	64.94	61.23	5.28	66.51	7.07	0.00	102.41	Over Exploited
District Total		**697.56**	**78.71**	**0.00**	**117.39**	**893.66**	**44.68**	**848.98**	**915.46**	**55.62**	**971.1**	**74.55**	**4.23**	**114.38**	**Over Exploited**

' Computation by RIF Method

4.4 Ground Water Quality

Ground Water Quality in the district can be divided into two groups for understanding viz. **Quality in phreatic aquifers** and **Quality in confined/user aquifers**

4.4.1 Ground Water quality in Phreatic aquifers: The ground water quality in phreatic aquifer shows wide variation in chemical quality. The entire district can be divided into three distinct zones as below.

North eastern zone characterised by fresh water of bicarbonate type with TDS less than 1000 ppm.

Central zone with water of mixed, bicarbonate-chloride type with TDS up to 3000 ppm.

South western zone with water of chloride type containing TDS more than 3000 ppm.

4.4.2 Ground Water quality in confined aquifers: The ground Water quality in the deeper aquifers (with in about 300m depth) which may also be called user confined aquifer is generally fresh (TDS< 2000 ppm) in the north eastern and central parts and is good for drinking as wells as Irrigation purpose. Deterioration of ground water quality is observed from recharge area in the north-east to discharge area in south west.

4.5 Status of Ground Water Development (Taluka wise)

4.5.1 Feasibility, Yield potential, Depth and Dia of ground water abstraction structures

Table 6

Taluka	Wells feasible	Suitable drilling technique	Depth of well (m)	Diameter	Discharge (lpm)
Becharaji	Tubewells	Direct Rotary, Reverse Rotary	100-300	200-250 mm	600-1200
Kadi	Dugwell	Manual	15-30	2.5-5 m	200-300
	Tubewells	Direct Rotary, Reverse Rotary	100-300	200-250 mm	600-1200
Kheralu	Dugwell	Manual	10-25	2.5-5 m	200-300
	Tubewells/ Borewell	Direct Rotary, Reverse Rotary	50-150	200-250 mm	500-800
Mahesana	Tubewells	Direct Rotary, Reverse Rotary	100-300	200-250 mm	600-1200
Satlasana	Dugwell	Manual	10-25	2.5-5 m	60-100
	Borewells	Down the Hole Hammer (DTH)	50-100	200-250 mm	60-150
Unjha	Tubewells	Direct Rotary, Reverse	100-300	200-250 mm	600-1200

		Rotary			
Vadnagar	Dugwell	Manual	15-30	2.5-5 m	200-300
	Tubewells	Direct Rotary, Reverse Rotary	50-300	200-250 mm	500-800
Vijapur	Tubewells	Direct Rotary, Reverse Rotary	50-300	200-250 mm	500-800
Visnagar	Tubewells	Direct Rotary, Reverse Rotary	100-300	200-250 mm	600-1200

4.5.2 Drinking water wells and water supply based on groundwater sources

Table 7

Taluka	No. of Dugwell	No. of Tubewell	Depth Range (m)	Discharge range (LPM)
Satlasna	0	0	0	0
Kheralu	0	0	0	0
Unjha	0	0	0	0
Visnagar	0	44	130-300	400-800
Vadnagar	0	9	120-150	200-400
Vijapur	0	62	60-240	200-800
Mahesana	0	117	220-400	400->800
Becharaji	0	47	250-400	400->800
Kadi	0	120	220-300	400-800

Source: GWS&SB

4.5.3 Type of pumps and water lifting devices for Irrigation dugwells, shallow tube wells and deep tube wells

Table 8: Dugwells

Taluka	Electric pumps	Diesel pumps	Wind mills	Solar pumps	Man/Ani. Operated	Others	Total
Becharaji	0	2	0	0	0	0	2
Kadi	510	529	12	0	31	0	1082
Kheralu	2164	118	12	7	8	18	2327
Mahesana	25	77	1	1	2	9	115
Satlasana	2226	130	2	4	3	2	2367
Unjha	38	0	0	0	0	0	38
Vadnagar	1699	91	0	11	2	1	1804
Vijapur	17	0	0	0	0	0	17
Visnagar	5	55	0	0	5	6	71

Table 9: Shallow Tubewells

Taluka	Electric pumps	Diesel pumps	Wind mills	Solar pumps	Man/Ani. Operated	Others	Total
Becharaji	0	0	0	0	0	0	0
Kadi	179	446	0	0	12	0	637
Kheralu	0	0	0	0	0	0	0
Mahesana	4	0	0	0	0	0	4
Satlasana	0	0	0	0	0	0	0
Unjha	0	0	0	0	0	0	0
Vadnagar	0	0	0	0	0	0	0
Vijapur	65	2	0	0	0	0	67
Visnagar	0	0	0	0	0	0	0

Table 10: Deep Tubewells

Taluka	Submersible pumps	Turbine pumps	Others	Total
Becharaji	480	0	0	480
Kadi	1629	0	0	1629
Kheralu	1231	3	10	1244
Mahesana	2178	1	0	2179
Satlasana	528	25	2	555
Unjha	670	7	2	679
Vadnagar	458	0	0	458
Vijapur	1496	13	0	1509
Visnagar	1176	27	2	1205

4.5.4 Irrigation scenario from ground water sources

Dugwells

As per MI census 2000-01 there are 7823 dugwells out of which 2879 are in use. Irrigation potential created through these dugwells is 110.14 sq. km and potential utilized is 58.54 sq. km. area.

Shallow tubewells

As per MI Census 2000-01 there are 708 shallow tubewells out which 206 are in use. The irrigation potential created is 13.59 sq. km and utilized is 11.77 sq. km. area.

Deep Tubewells

As per MI census 2000-01 there are 9938 deep tubewells in the district out of which 9270 are in use. The irrigation potential created is 1902.20 sq. km. are and potential utilized is 1493.20 sq. km. area.

Following is the talukawise detail of irrigation potential for ground water sources presented in table no 11 .

Table 11

Taluka	Dugwells		Shallow tubewells		Deep tubewells	
	Potential created	Potential utilized	Potential created	Potential utilized	Potential created	Potential utilized
Becharaji	0.02	0	0	0	182.49	165.70
Kadi	2.54	1.97	8.70	7.08	361.52	247.35
Kheralu	57.30	35.51	0	0	158.68	90.71
Mahesana	1.47	1.08	0.32	0.28	449.29	374.93
Satlasana	20.09	0.04	0	0	47.23	28.24
Unjha	1.82	1.79	0	0	161.73	141.89
Vadnagar	25.17	16.68	0	0	59.55	44.24
Vijapur	0.49	0.47	4.57	4.41	187.42	163.41
Visnagar	1.24	1.00	0	0	294.29	236.73

5.0 Ground Water Management Strategy

5.1Ground Water Development

Eight talukas in the district are categorised as **Over exploited** and one as **critical** and as stage of development is 151.17% in the GWRE, 2004 report hence there is **no further scope** for development of the ground water resources.

5.2 Water Conservation and Artificial Recharge

The suitable recharge structures feasible in the district are Percolation tanks/ponds, Recharge wells, recharge shaft, check dams, nalla bunds and gully plugs etc depending on the terrain conditions.

In the phreatic aquifers with deep water levels and desaturation, spreading channels, recharge pits, recharge ponds etc are suitable to utilize surplus runoff and tail end releases from the canals.

In the confined aquifers artificial recharge by indirect injection technique is suitable that is dual purpose connector wells. These recharge wells should have screens against upper saturated aquifer and also against the targeted confined aquifer. it would function under gravity since the piezometric level of confined aquifer is much below phreatic water level.

Various rainwater harvesting schemes depending on the suitable hydrogeological conditions have been constructed in the district viz. Check dams, Recharge tube wells , deepening the of the village ponds etc and have shown good impact on the groundwater scenario. Following is the list which shows impact of the recharge structures on ground water in the district.

6.0 Ground Water Related Issues and Problems

Over exploitation of ground water is the single major issue in the district resulting in the fast depletion of this resource. Piezometric heads of deep confined aquifer has also declined sharply owing to the huge withdrawal. In many parts of the district phreatic aquifers are desaturated needing urgent attention.

Replacement wells, increase in well depth, prime mover, declining well yields are also the major issues.

Since groundwater is the main source for irrigation and the farmers don't have control over power supply, therefore they irrigate the crops when power supply is available rather than waiting for the wilting to start.

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

Control on the area under fodder crops like alfalfa is also to be done as this is water intensive crop and consumes much more water compared to other crops like wheat, bajra, castor, mustard etc.

Although ground water quality for irrigation practice is within the limit in most parts of the district but many parts of the district are having high fluoride (>1.5 ppm) content (more than 145 villages mostly in Kheralu, Kadi, Satlasana talukas) (Source: GWSSB)

Awareness among the people regarding rainwater harvesting and artificial recharge.

7.0 Awareness and Training Activity

Till now one mass awareness programme has been conducted in the district at Village **Thol**, Taluka Kadi on 29/3/2006 where about three hundred villagers and school children participated.

No Water management training programme has been conducted in the district by CGWB.

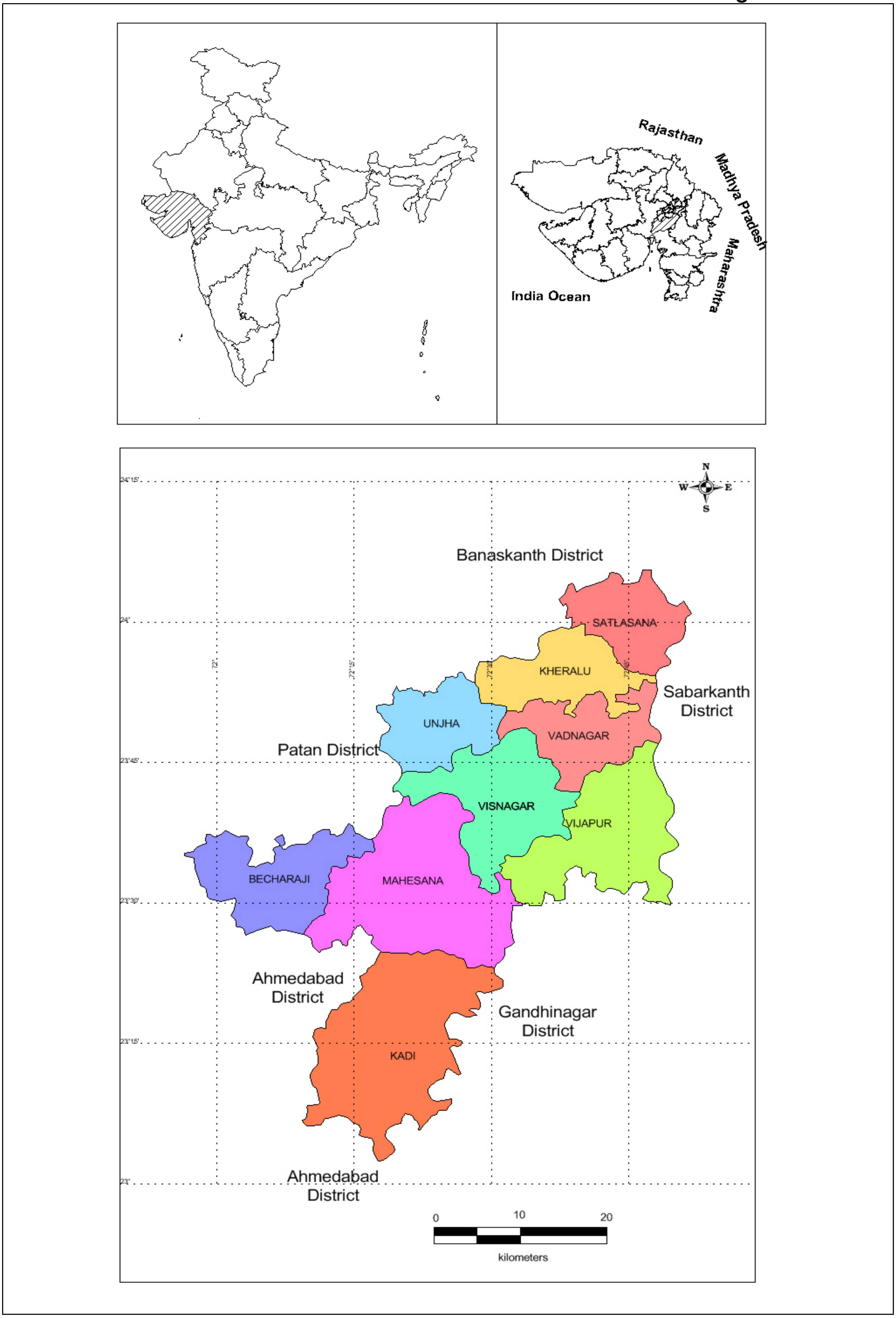
8.0 Areas Notified by CGWA/SGWA

None

9.0 Recommendations

- There is an urgent need for management of resources for sustainable development.
- Suitable ground water legislation may be enforced and all future ground water exploitation by deep tube wells be completely banned
- Creating awareness among the farmers regarding water conservation through judicious use of water and adoption of efficient irrigation techniques like drip/sprinkler irrigation.
- The land holding of the group of farmers under public tubewell irrigation should be brought under the provision of the change in crops, irrigation practices and installation of drip/sprinkler irrigation technique. soft term institutional finances to the farmers and liberal subsidies in equipments are suggested.
- Resorting to artificial recharge practices by diverting surplus run-off during monsoon into ponds, percolation tanks,. Spreading basins, abandoned dugwells etc.
- Taking up artificial recharge on large scale through appropriate techniques on a local scale with active community participation.
- Institutional finance and appropriate technology should be freely made available to any individual or cooperative group of farmers that undertake resource augmentation and management measures.

Figure-1



Rajasthan
Madhya Pradesh
Maharashtra
India Ocean
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W
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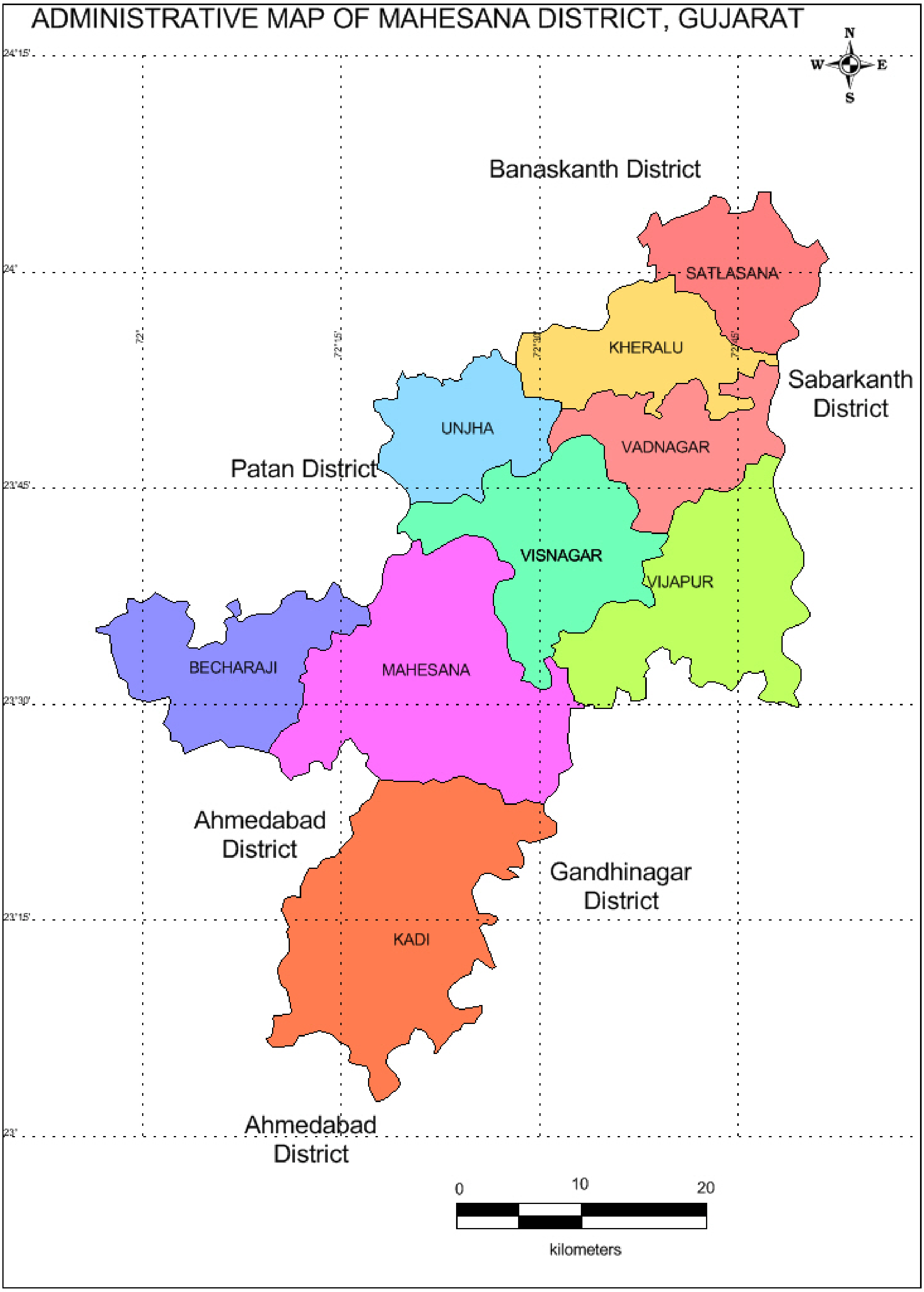
Banaskanth District
SATLASANA
KHERALU
Sabarkanth
District
UNJHA
VADNAGAR
Patan District
VISNAGAR
VIJAPUR
BECHARAJI
MAHESANA
Ahmedabad
District
Gandhinagar
District
KADI
Ahmedabad
District
0
10
20
kilometers

Figure-2


ADMINISTRATIVE MAP OF MAHESANA DISTRICT, GUJARAT
N
W
E
S
24°15'
24°
23°45'
23°30'
23°15'
23°
72°
72°15'
72°30'
72°45'
Banaskanth District
SATLASANA
KHERALU
Sabarkanth District
UNJHA
VADNAGAR
Patan District
VISNAGAR
VIJAPUR
BECHARAJI
MAHESANA
Ahmedabad District
Gandhinagar District
KADI
Ahmedabad District
0
10
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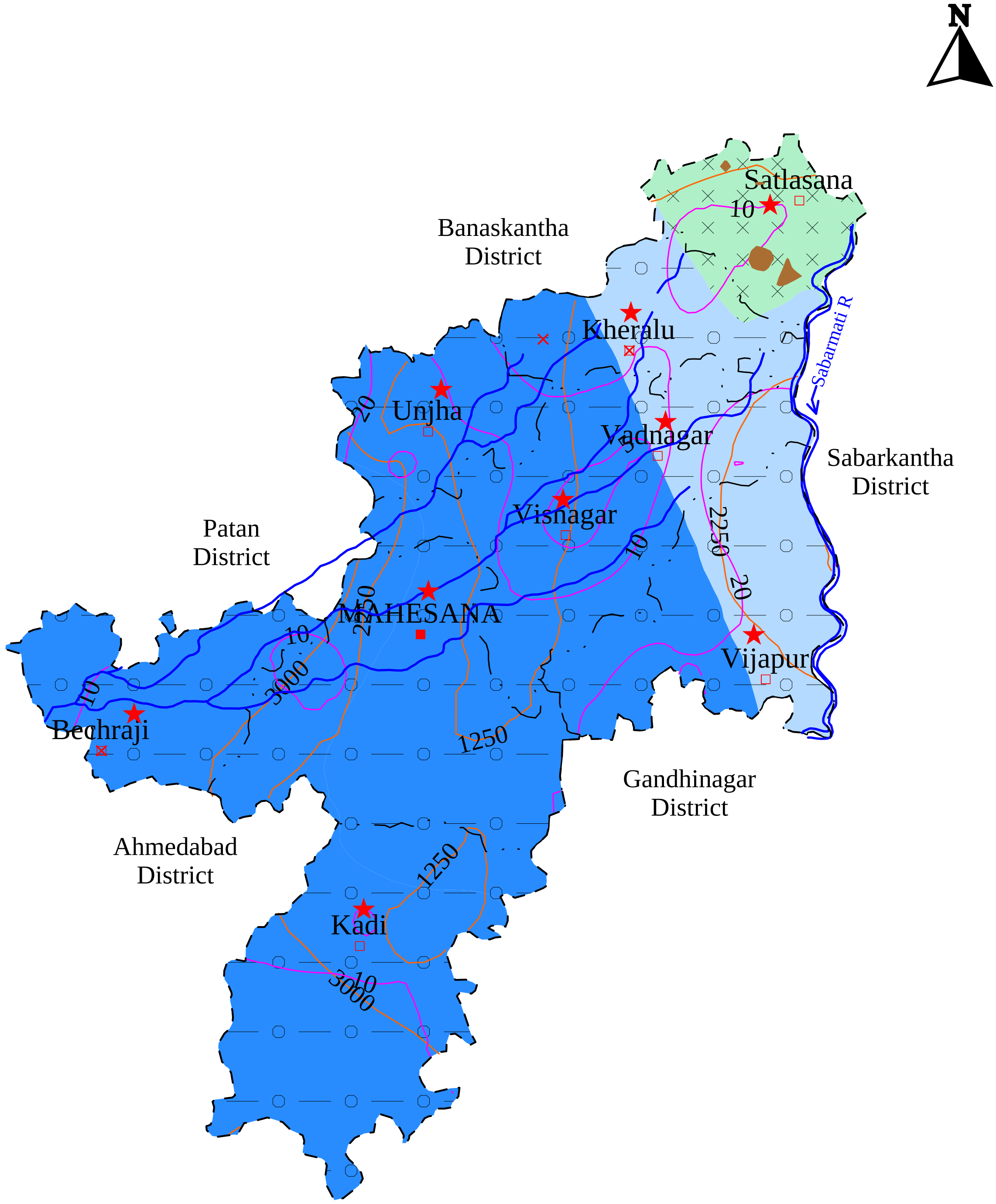
kilometers

HYDROGEOLOGICAL MAP

MAHESANA DISTRICT, GUJARAT

Figure-3



Mahesana District

Legend

	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 50-150	200-300 500-800	Percolation Tanks/ Ponds, Recharge Wells,
Soft Rock Aquifer	Dug Well Tubewell	Manual Direct Rotary Reverse Rotary	15- 30 100-300	200-300 600-1200	Percolation Tanks/ Ponds, Recharge Wells, Recharge Shaft
Hard Rock Aquifer	Dug Well Borewell	Manual Down the Hole Hammer (DTH)	10-25 50-100	60-100 60-150	Percolation Tanks/ Ponds, Recharge Wells, Check Dams, Nalla Bunds.
Hilly Areas	Not Suitable				Check Dam, Nalla Bund, Gully Plug

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)		Over Exploited Taluka
	Drainage		District/Taluka HQ

Other Information

Geographical Area	**4,371 sq. km**
No of Blocks/ Talukas	**9**
Population (2011 Census)	**20,27,727**
Average Annual Rainfall	**827 mm**
Range of Average Temperature	**21-31 °C**
Major Drainage System	**Sabarmati, Rupen**
Major/ Medium Irrigation Scheme	**Dharoi**
Major Geological Formation	**Soft Rock: Alluvium** **Hard Rock: Grainte, Meta Sediments**
Utilizable Ground Water Resources	**848.98 MCM/Yr**
Net Ground Water Draft	**971.1 MCM/Yr**
Stage of Ground Water Development	**116.08 %**
Blocks Showing Intensive Ground Water Development	**Bechraji, Kadi, Kheralu, Mahesana, Satlasana, Unjha, Vadnagar, Vijapur, Visnagar**

Figure-4

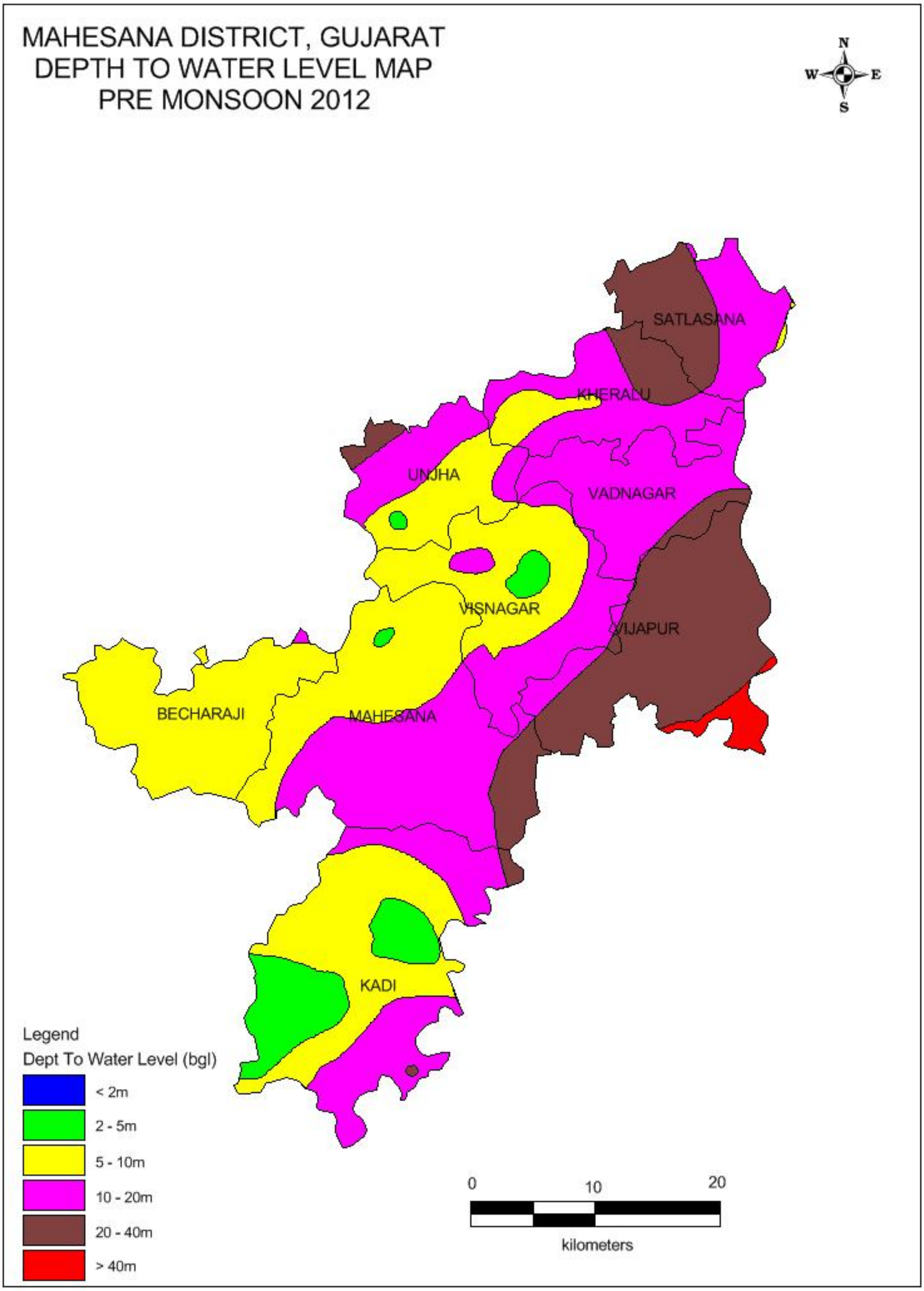
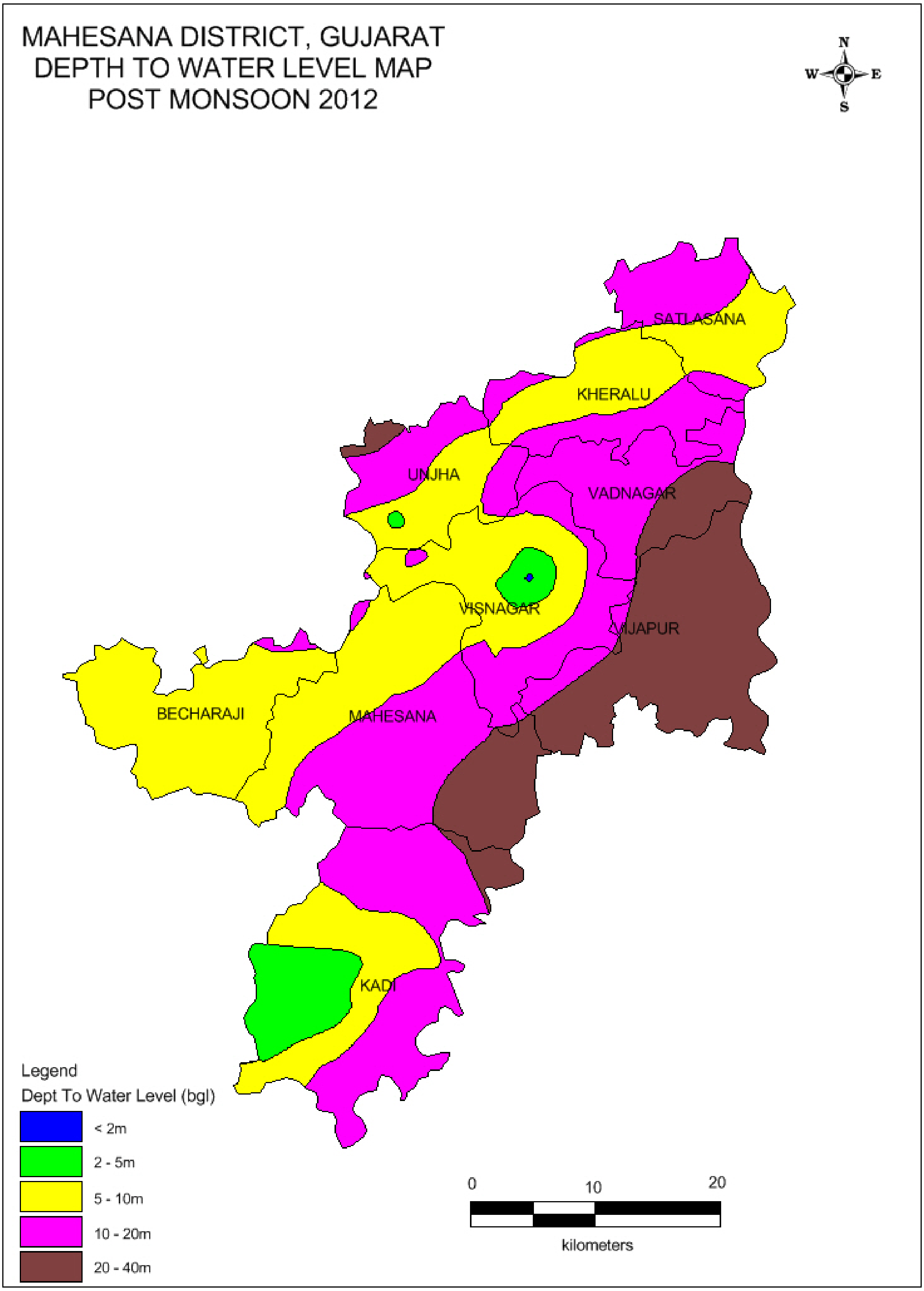

MAHESANA DISTRICT, GUJARAT
DEPTH TO WATER LEVEL MAP
PRE MONSOON 2012
N
W
E
S
SATLASANA
KHERALU
UNJHA
VADNAGAR
VISNAGAR
VIJAPUR
BECHARAJI
MAHESANA
KADI
Legend
Dept To Water Level (bgl)
< 2m
2 - 5m
5 - 10m
10 - 20m
20 - 40m
> 40m
0
10
20
kilometers

Figure-5



MAHESANA DISTRICT, GUJARAT
DEPTH TO WATER LEVEL MAP
POST MONSOON 2012
N
W
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S
SATLASANA
KHERALU
UNJHA
VADNAGAR
VISNAGAR
VIJAPUR
BECHARAJI
MAHESANA
KADI
Legend
Dept To Water Level (bgl)
< 2m
2 - 5m
5 - 10m
10 - 20m
20 - 40m
0
10
20
kilometers

Figure-6

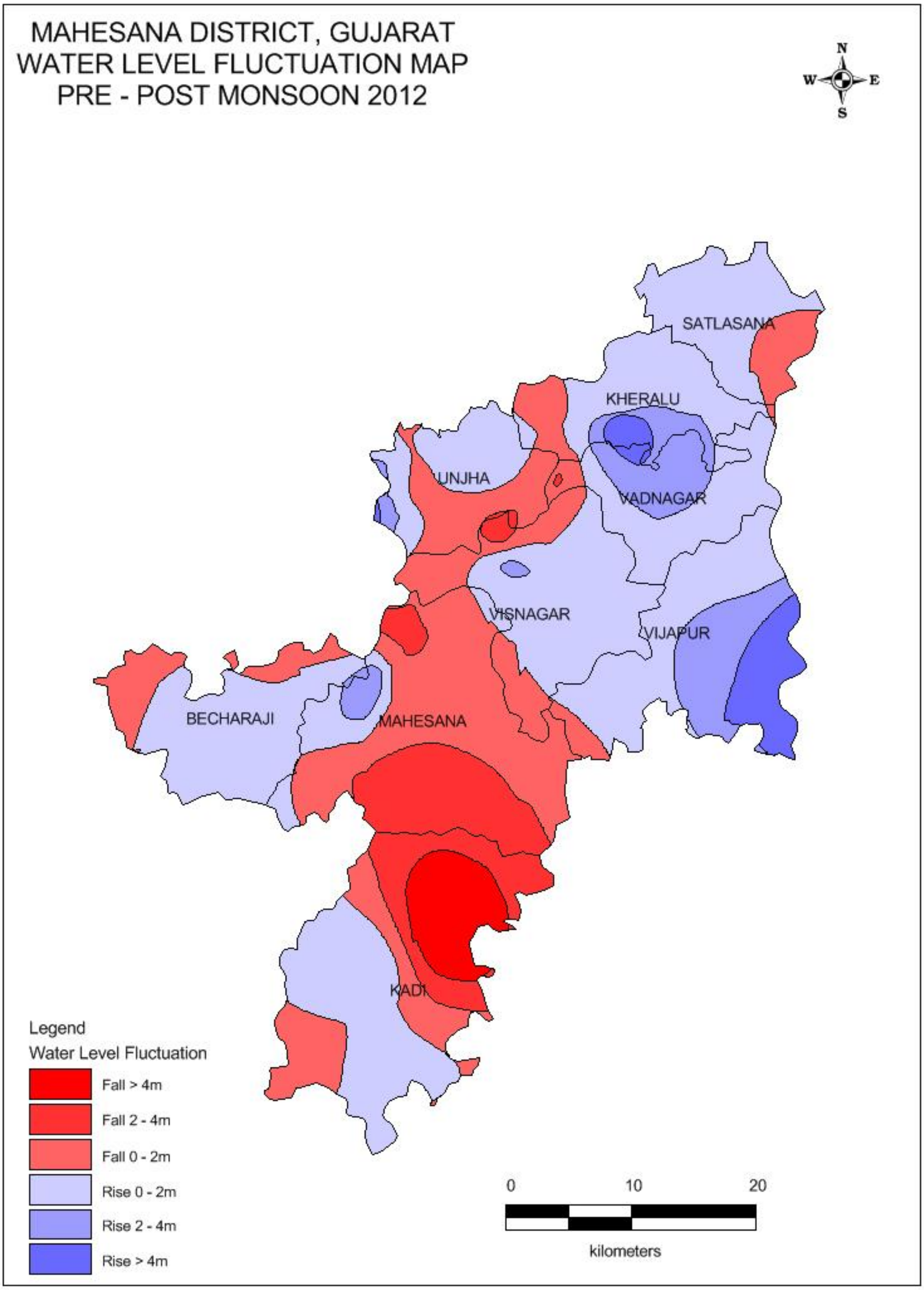
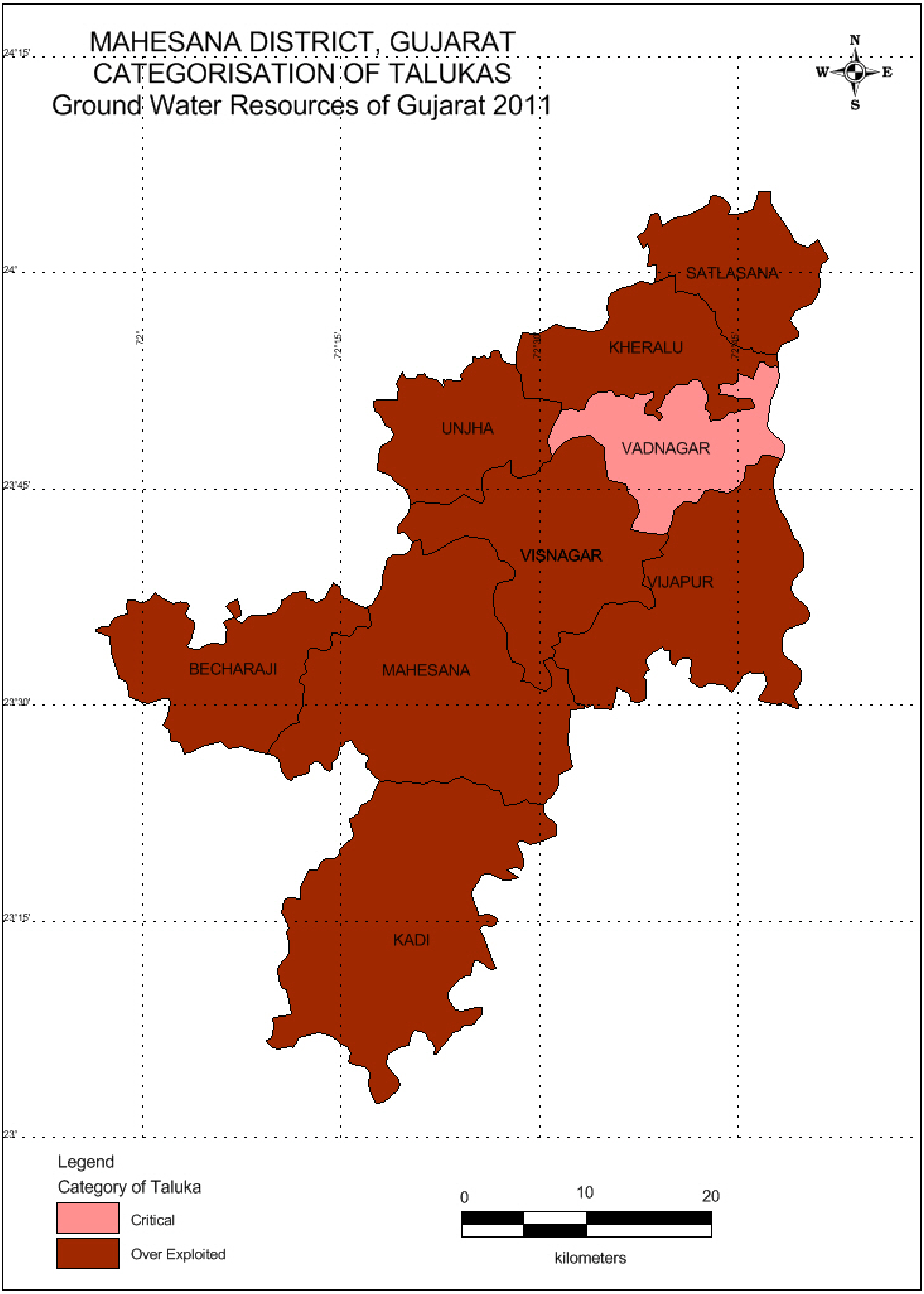

MAHESANA DISTRICT, GUJARAT
WATER LEVEL FLUCTUATION MAP
PRE - POST MONSOON 2012
N
W
E
S
SATLASANA
KHERALU
UNJHA
VADNAGAR
VISNAGAR
VIJAPUR
BECHARAJI
MAHESANA
KADI
Legend
Water Level Fluctuation
Fall > 4m
Fall 2 - 4m
Fall 0 - 2m
Rise 0 - 2m
Rise 2 - 4m
Rise > 4m
0
10
20
kilometers

Figure-7


MAHESANA DISTRICT, GUJARAT
CATEGORISATION OF TALUKAS
Ground Water Resources of Gujarat 2011
N
S
W
E
SATLASANA
KHERALU
UNJHA
VADNAGAR
VISNAGAR
VIJAPUR
BECHARAJI
MAHESANA
KADI
Legend
Category of Taluka
Critical
Over Exploited
0
10
20
kilometers