AQUIFER MAPPING AND GROUNDWATER MANAGEMENT PLAN JALORE DISTRICT, RAJASTHAN

Western Region, Jaipur

केन्द्रीय भूमि जल बोर्ड

जल शक्ति मंत्रालय, जल संसाधन, नदी विकास और गंगा संरक्षण विभाग

भारत सरकार सरकार

Central Ground Water Board

Ministry of Jal Shakti,
Department of Water Resources,
River Development and Ganga Rejuvenation
Government of India

Report on

AQUIFER MAPPING AND GROUND WATER MANAGEMENT PLAN

JALORE DISTRICT, RAJASTHAN

(10640 sq.km)

AAP 2021-22

पश्चिमी क्षेत्र, जयपुर

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JALORE DISTRICT, RAJASTHAN
(10640 sq.km.)

CONTRIBUTORS

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1.0 Introduction

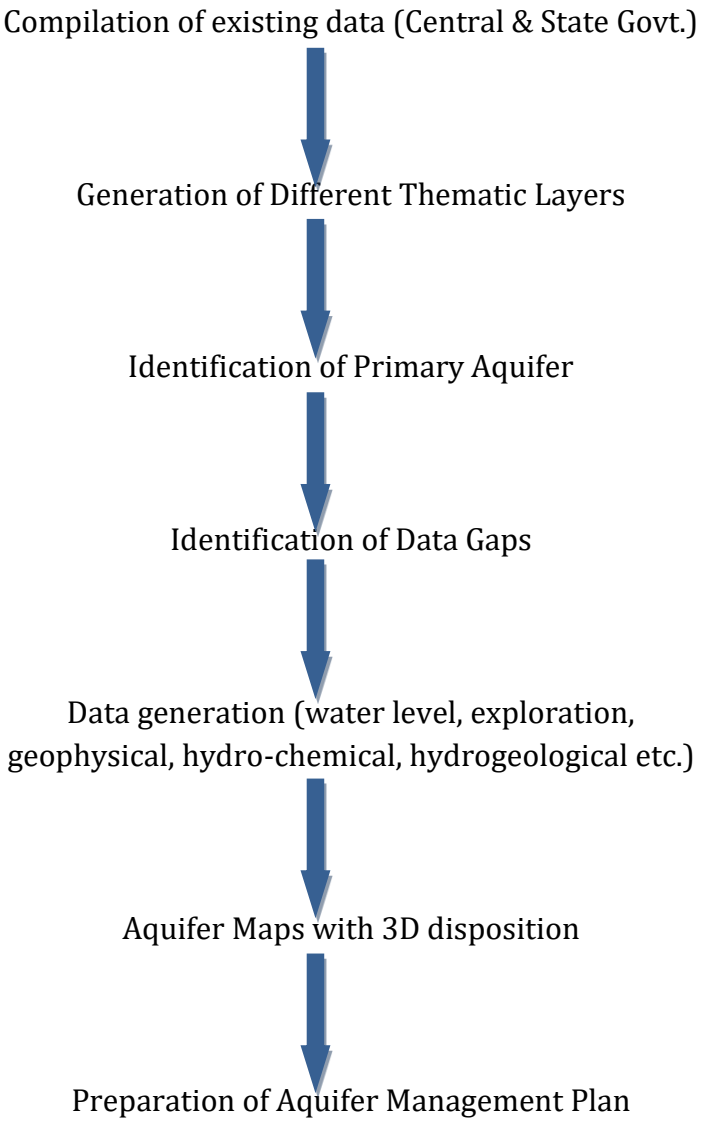
Various developmental activities over the years have adversely affected the groundwater regime in the state. There is a need for scientific planning in development of groundwater under different hydrogeological situation and to evolve effective management practices with involvement of community for better ground water governance. In view of sprouting challenges in the ground water sector in the state there is an urgent need for comprehensive and realistic information pertaining to various aspects of groundwater resource available in different hydrogeological setting through a process of systematic data collection, compilation, data generation, analysis and synthesis. Hence, aquifer mapping and management of the study area is the need of the hour.

1.2 Scope of the study

Aquifer mapping can be understood as a scientific process wherein a combination of geological, geophysical, hydrological & chemical fields and laboratory analyses are applied to characterize the quantity, quality, and sustainability of ground water in aquifers. Aquifer mapping is expected to improve our understanding of the geological framework of aquifer, their hydrologic characteristics, water level in aquifer and how they change over time and space and the occurrence of natural and anthropogenic contaminants that affect the portability of groundwater. Results of these studies will contribute significantly to resource management tools such as long-term aquifer monitoring network and conceptual and quantitative regional groundwater flow models to be used by planners, policy makers and other stake holders. Aquifer mapping at appropriate scale can help to prepare, implement, and monitor the efficacy of various management interventions aimed at long term sustainability of our precious groundwater recourses, which in turn will help to achieve drinking water scarcity, improved irrigation facilities and sustainability of water resource in the state.

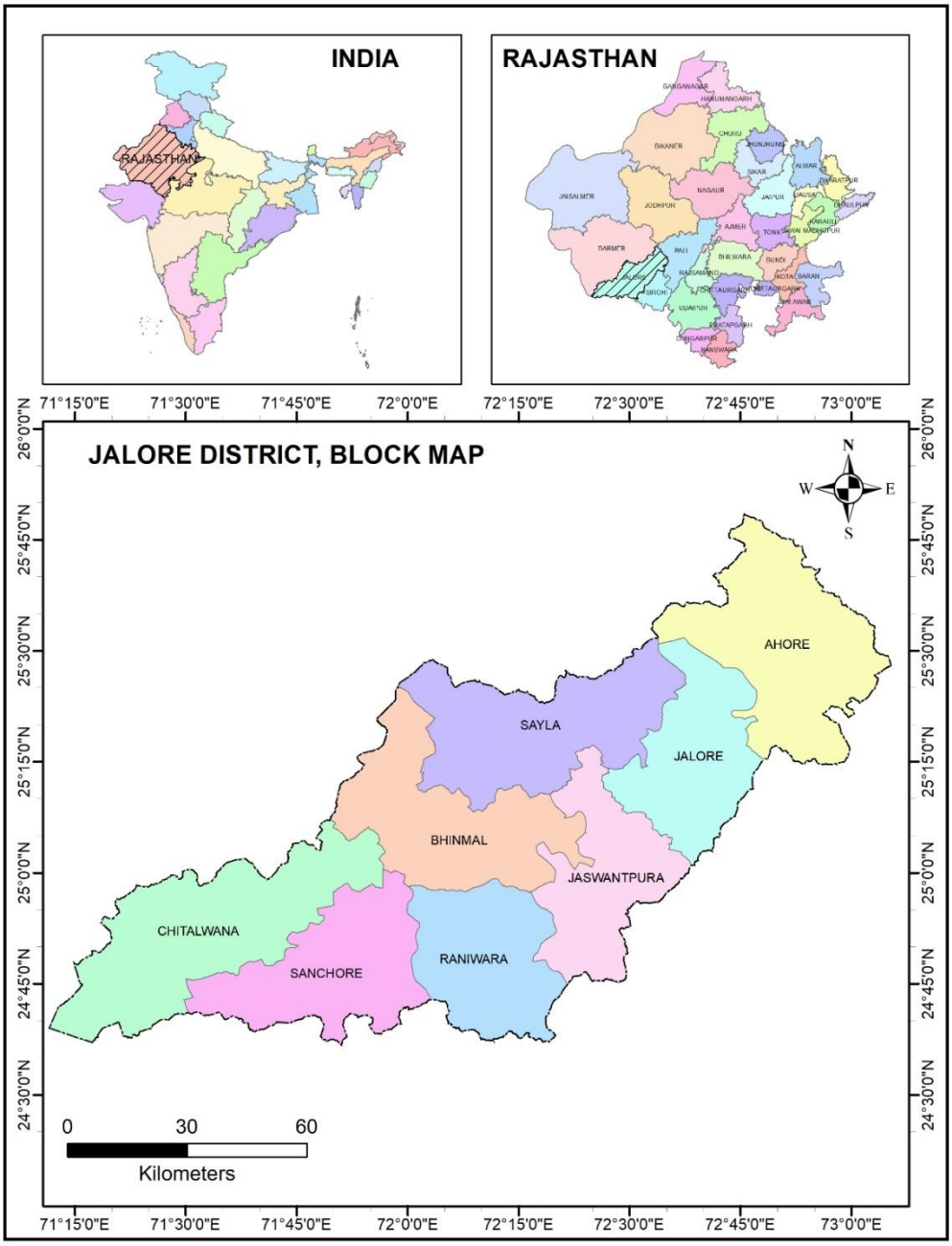
1.3 Approach & Methodology

Aquifer mapping is an attempt to integrate the geological, geophysical, hydrological & chemical field and laboratory analyses and are applied to characterize the quality, quantity and sustainability of groundwater in aquifer. Under the National Aquifer Program, it is proposed to generate Aquifer Maps on 1:50000 scale, which basically aims at characterizing the aquifer geometry, behavior of groundwater levels and status of groundwater development in various aquifer system to facilitate planning of their suitable management. The major activities involved in this process encompass compilation of existing data, identification of data gaps, generation of data for feeling data gaps and preparation of different aquifer layers.



1.4 Study Area

The district derives its name from the town of Jalore, which is the headquarters of the district administration. District is located between latitudes 24º 37' 00" to 25º 49' 00" and longitudes 71º 11'00" to 73º 05'00" with an area of 10,640 Sq. kms (3.11% of the State).



The district is part of Jodhpur Division. The district is composed of five sub-divisions viz. Jalore, Ahore, Bhinmal, Sanchore, Raniwara which cover nine tehsils viz: Jalore, Ahore, Bhinmal, Sanchore, Raniwara, Sayala, Bagora, Jaswantpura and Chitalwana and eight blocks viz: Jalore, Ahore, Bhinmal, Sanchore, Raniwara, Sayala, Chitalwana & Jaswantpura. Total number of villages in the district is 802 and it also has 3 urban towns. Total population of the district as per Census 2011 is 1828730 with male and female population of 936634 and 892096 respectively. Administrative divisions of Jalore district are depicted in the index map.

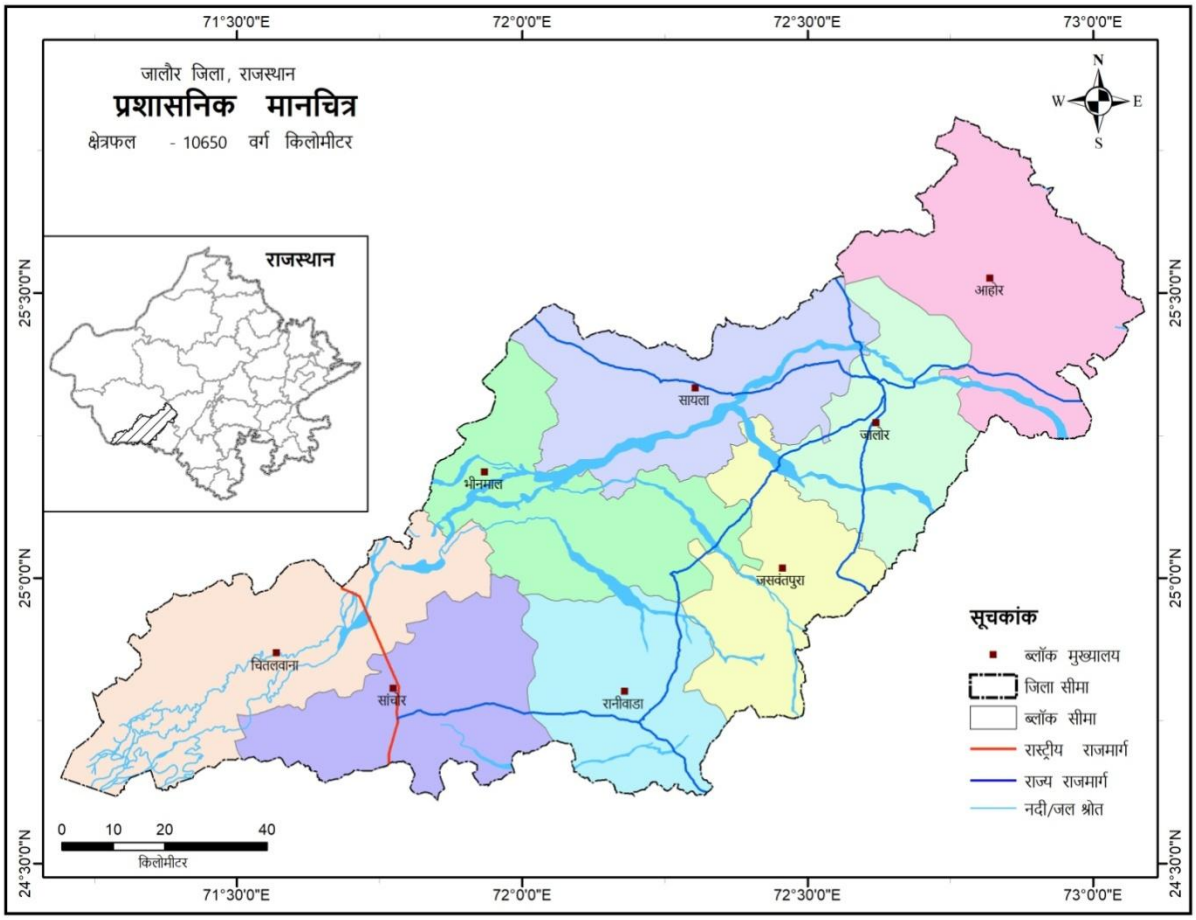


Figure1.2. Administrative Map of Jalore District

Data Availability and Data Gap Analysis:

The available data of the Exploratory wells drilled by Central Ground Water Board, Western Region, Jaipur, Geophysical Survey carried out in the area, Ground water monitoring stations and ground water quality stations monitored by Central Ground Water Board were compiled and analysed for adequacy of the same for the aquifer mapping studies. In addition to these the data on ground water monitoring stations and ground water quality stations of the State Government (GWD) was also utilized for data adequacy and data gap analysis. The data adequacy and data gap analysis was carried out for each of the quadrant falling in the study area in respect of various attributes of ground water and is presented in table 1.

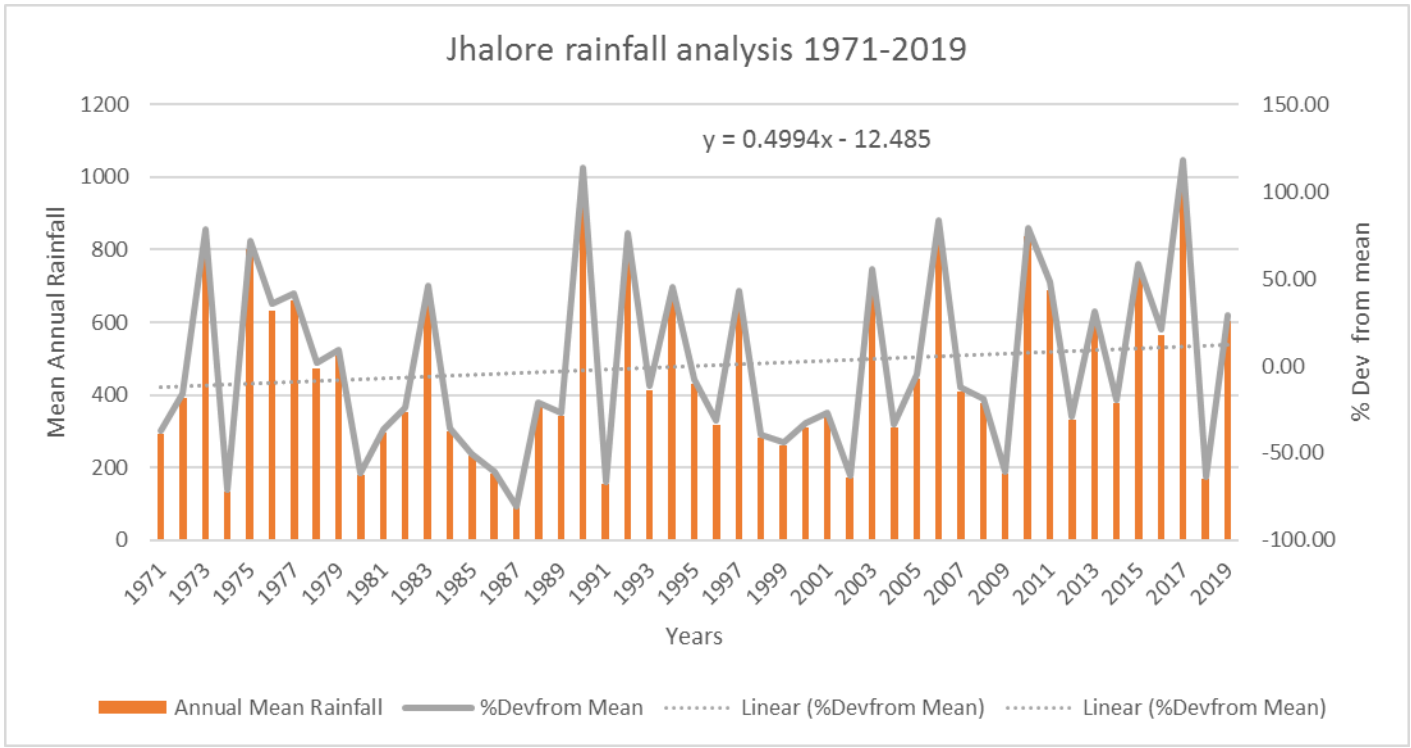
Table 1.1: Data Availability and Data Gap Analysis in Jalore District

S.No	Study Aspect	Data Requirement	Data Availability	Data Gap
1	Rainfall and Other climatic Data	6 Meterological Stations in the area	Data partially available	Other Climatic data other than rainfall
2.	Soil	Soil Map and Soil infiltration rate	Soil Map	Soil Infiltration rate across the area
3.	Land Use	Latest land use Pattern in GIS Platform	Not available	Latest data in GIS platform required
4.	Geomorphology	Digitized Geomorphological Map	Available	-
5.	Geophysics	Geophysical Survey in all toposheets	Available 11 VES	Required 427 in total in every toposheet
6.	Exploration	Exploratory wells along with aquifer parameters	Exploratory wells along with aquifer parameters are only available for 08 EW.	Required
7.	Recharge Parameters	Recharge parameters of different soil and aquifer types based on field studies	Recharge parameters are given in Ground Water resource estimation	-
8.	Discharge Parameters	Discharge parameters for different GW abstraction structures	Discharge parameters are given in Ground Water Resource Estimation	-
9.	Monitoring	01 in every quadrant of toposheet	GWD and CGWB points available	At-least 55 points required.

2.0 Climate and Rainfall

The climate of Jalore study area is mainly dry with very hot summer and cold winter except during monsoon season when moist air of oceanic origin penetrates into the area. There are four seasons in a year. The hot weather season starts from mid March to last week of the June followed by the south-west monsoon which lasts up to September. The transition period from September to October forms the mild climate. The winter season starts late in November and remains up to first week of March.

2.1 Rainfall: The normal annual IMD (1901-1970) rainfall of the Jalore block area is 400.6 mm which is unevenly distributed over the area in 29 days. The south west monsoon, sets in from last week of June and withdraws in end of September, contributed about 94% of annual rainfall. July and August are the wettest month of the year. Rest 6% rainfall is received during non-monsoon period in the wake of western disturbances and thunder storms.



The annual rainfall of 49 years from 1971 to 2019 have been analyzed to know the behavior of rainfall (Figure). The analysis indicates that annual variation of rainfall is large and significant.

The average annual rainfall from 1971 to 2019 is 466.07 mm. The highest rainfall of 118% more than the average was recorded in 2017 whereas the lowest -80.45% less than the average was experienced in 1987 as show in Table.

The standard deviation of rainfall from 1971 to 2019 is 466.07 mm which indicates that 233.46 mm rainfall is assured. The coefficient of variation of rainfall is 52.04%. It indicates that rainfall in the area is highly variable.

The trend of annual rainfall by least square method shows decreasing trend of rainfall which is insignificant. The possibility of Excess, normal, and deficient rainfall are 36%, 16%, and 46% respectively as given in Table 3.

Rainfall study for 49 years depicts that only 47% of the years i.e.., 1971 1974 1980 1981 1982 1984 1985 1986 1987 1988 1989 1991 1996 1998 1999 2000 2001 2002 2004 2009 2012 2014 2018, experienced drought conditions. It means that study area is classified under chronically drought affected area. The probability of mild and severe drought is 18.3% and 18.3% respectively. One drought of mild intensity may be possible after 5 or 6 years. In 9-years 1982 1988 1989 1996 2000 2001 2004 2012 2014 this area is affected with drought of mild intensity. And One severe drought would be possible within 5 to 6 years.

2.2 Temperature: The cold weather season generally starts by mid November when temperature begins to drop rapidly . January is the coldest month of the year with mean daily maximum and minimum temperature being about 30 ^{o}C and 3.0^{o}C respectively. In association with passing of western disturbances, the distrct gets affected with the severe cold wave conditions and on such occasion minimum temperature may go down to freezing point of water. The rise in minimum temperature from 3^{o}C in January to 44.6^{o}C in June is observed.

The temperature starts rising rapidly from March to June. June is the hottest months of the year. When the area experiences daily mean maximum and minimum temperature of 44.7^{o}C and 22.3C respectively. The variation in maximum temperature from January to June is about 20.2^{o}C. From about April hot westerly dust ladden winds locally known as *'Luh'* begin to blow and the weather becomes very hot under heat wave conditions. In May and June maximum temperature may generally go above 45^{o}C. Occasional dust storms and thunder storms causes drop in temperature.

With the onset of the south-west monsoon currents into the area at the end of June, there is appreciable decline in the day temperature whereas nights temperature remain as high as in summer. The increased moisture content in the air causes the weather sultry and unpleasant. After the withdrawal of monsoon by about mid-September there is decrease in the day temperature but night temperature drops down steeply from 25.2 to 5 ^{o}C c Table 5 and Fig3 shows variation of temperature**.**

2.3 Humidity: The air is generally dry over the district during greater part of the year. During the southwest monsoon the humidity is high and generally being 67% to 52%. Humidity generally decreases in the post monsoon season. May and April are the driest months of the year when relative humidity being about 31% or less in the afternoon. Table 5 and Fig 3 shows variation of humidity.

2.4 Cloudiness : During the south west monsoon the skies are heavily clouded or overcast particularly in July and August. Rest of the year sky is mostly clear or lightly clouded except for a brief spells of one or two days in association with the passage of western disturbances during winter season.

2.5 Winds : Winds are generally light with some strengthening of speed during summer and early part of the south west monsoon season. The maximum wind speed of 9.3 km./hr. is recorded in June. while minimum wind speed of about 1.7 km./hr. is during November to January. In southwest monsoon season winds direction is mostly southerly or southwesterly. Rest of the year winds are predominantly easterly or northeasterly or calm Table 5 and Fig 4 shows variation of monthly wind speed .

Rainfall Analysis (in mm) of 49 years:

Mean	466.07			
STD Deviation	242.61			
Assured Rainfall (std-mean)	223.46			
Coefficient of Variance% (std/mean)	52.05415338			
Rainfall	Number of Years	Possibility of occurrence (per year)		
Excess	18	36.73		
Normal	8	16.33		
Deficient	23	46.94		
Draught	Number of Years	Possibility of occurrence (per year)		
Mild	9	18.37		
Severe	9	18.37		
Moderate	5	10.20		
Maximum Rainfall	1016 mm	In 2017 year		
Minimum Rainfall	91 mm	In 1987 year		

Table 5 Normal of temperature, relative humidity and wind speed at Jalore District

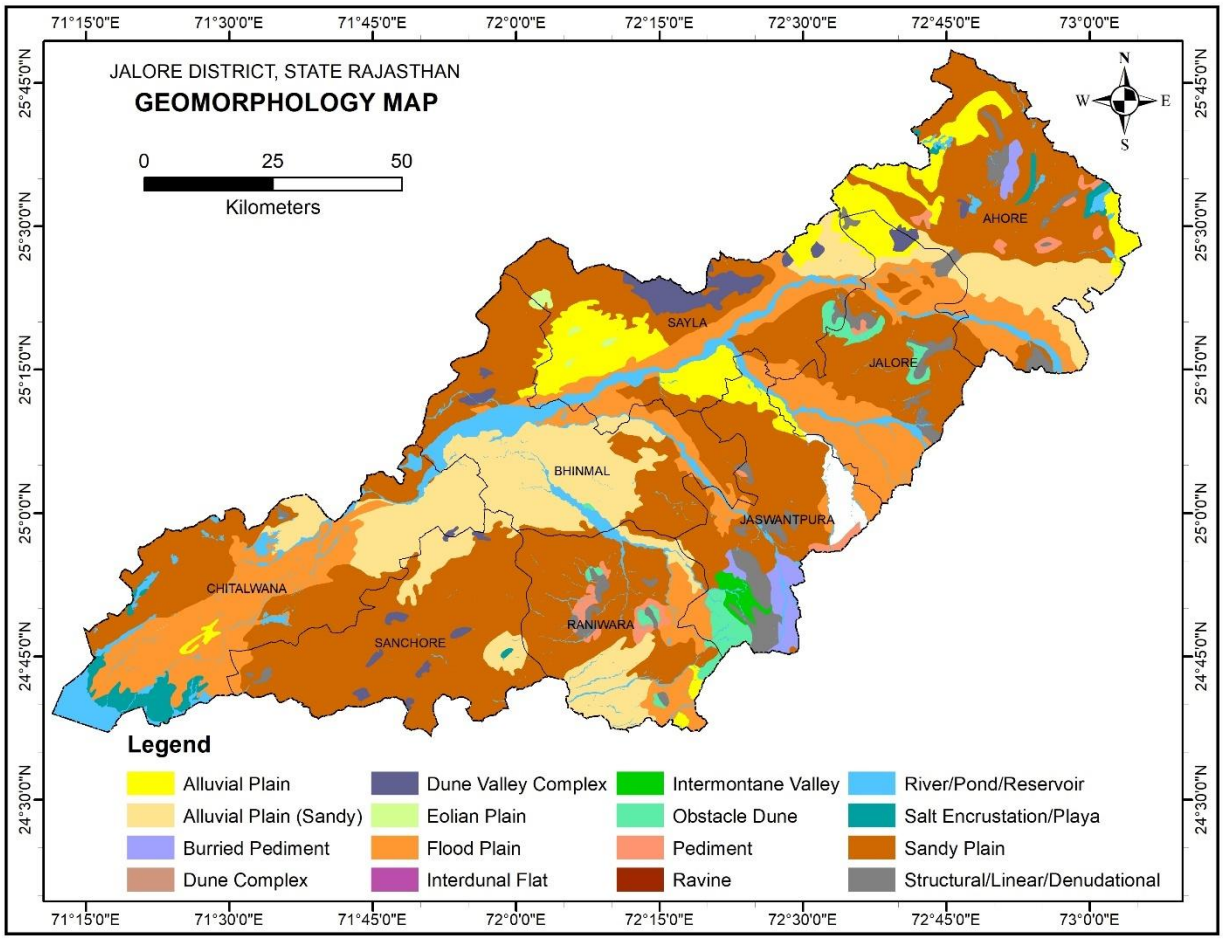
Months	**Temperature mean daily ºC**		**Relative Humidity in %**		**Wind speed in km./hr.**	
	Max.	**Min.**	**At 8.30 hrs.in%**	**At 17.30 hrs. in %**		
January	**31.3**	**5.9**	**62**	**40**	**2.6**	
February	**34.3**	**8.2**	**57**	**38**	**3.3**	
March	**39**	**12.6**	**51**	**34**	**5**	
April	**43.3**	**17.2**	**48**	**31**	**5.8**	
May	**45**	**22.8**	**57**	**34**	**9.3**	
June	**44.6**	**22.2**	**66**	**40**	**9.2**	

July	**41.1**	**22.2**	**76**	**58**	**7.7**
August	**37.7**	**22**	**79**	**63**	**7.3**
September	**39.7**	**22**	**70**	**52**	**6.3**
October	**40**	**16.3**	**56**	**39**	**3.3**
November	**36.3**	**10.1**	**57**	**40**	**1.7**
December	**31.4**	**6.3**	**61**	**40**	**2**

TOPOGRAPHY DISTRICT

3.1 Geomorphology

The district is characterized by landscape of alluvial plains of hill ranges, and isolated hillocks. Jalore district has almost an even topography in its western section, the lowest point being around 17.0 meter above mean sea level and is marked by sand dunes. The sand dunes trend NE-SW, indicating prevalent wind direction in the area. The eastern section is dominantly hilly, forming the flank of Mount Abu range and the highest point is 991 m above mean sea level (amsl). The elevation of the area ranges from more than 600 m amsl in the east to 75m amsl in the west at the confluence of the Luni and Jawai-Sukri Rivers. Generally the terrain slopes westwards. The valley floor has an area elevation ranging from 60m amsl to 215m amsl. The hill tops are normally shaped by weathering phenomena, which have caused tors and boulders of various shapes and sizes. These features are well developed in the eastern part of the area. In the mid eastern and western parts, sand dunes are a common topographic feature. Jalore district is often called “Delta of West Rajasthan” and all the principal rivers of western Rajasthan flow through this district.



Geomorphologically, the alluvial valley floor belongs to mature landscape system and present landform units are the products of the past meandering courses and wide flood plains. Additionally, there are innumerable old channels buried under wind blown sand.

Physiographically, the district is covered in baggar type where in its southern part is plain area and shows normal elevation upto 150 m asl, while the northern part which is in touch with Sirohi and Pali district is bit hilly and the elevation ranges from 150 to 300 m asl.

3.2 Drainage

Jalore district falls in parts of Luni basin (82.8%), Other Nallahs (16.9%) and Outside Basin(0.3%). Tehsil wise distribution of basin area is given in Table 2.

Table 2: Tehsil wise distribution of basins

Sl.No	Name of Tehsil	Area in Sq. Km.		
		Luni	Other Nallahs	Out side Basin
1	Ahore	1536.4	-	-
2	Bhinmal	2653.6	-	4.1
3	Jalore	2277.2	-	-
4	Raniwara	494.9	-	513.8
5	Sanchore	1857.9	33.9	1286.8

The Jalore district forms a part of the Central Luni Basin and is drained by the Luni drainage system, which passes only through the southwestern tip of the district near Sanchore before shedding its load into Runn of Kutch, originating from the Aravalli hill ranges. The main rivers in the district are Jawai, Sukri, Khari, Bandi and Sagi, which are tributaries of the Luni River and form a trellis pattern of drainage flowing due northwest. All rivers are ephemeral with graded and meandering courses and wide flood plains.

3.3 Soils & Irrigation Practices

Soils are shallow with deep gravel encrusted with CaCO3. The texture of the soils in general varies from sandy to sandy loam but in deltaic areas of the Luni River south to southwest of Sanchore, the soils are loamy alluvium. The pH value ranges from 7.0 to 9.0 and in general, the soils have a higher pH. The nature of the soils can be broadly described as fine-sorted sand on the dunes and coarse to medium textured soils on the plains with a tendency for increase in fine particles. The soils in the eastern part of the district are shallow, covering partly weathered rocks and calcareous gravelly material. Soils along the hill slopes are also mostly shallow consisting of weathered rock and calcareous gravelly materials. The fertility status of the soils in general is low and the proportion of organic matter varies from 0.2 to 1.0 per cent. The soils of the district can be broadly divided into three types.

1.Aridisols: (a) Camborthids

(b) Calciorthids

2.Entisols: Torripsamments

3.Aridisols and Entisols: (a) Torripsamments

(b) Calciorthids

(c) Paleorthids.

3.4 Land Use

Land Use

The socio-cultural and economic factors have significantly influenced over land use both in rural and urban areas in the district. Land forms, slope, soils and natural resources are some of the important which control the land use pattern of the district. The land use pattern of district is based on the statistical outline of the district is presented in Table 3.3

Table 3.3: Land Use Pattern of Jalore District

S.No.	Land Use	Area in hectare	%
1	Total geographical area (as per village papers)	1056611	
2	Forest	23634	2.24
3	Uncultivable land	123000	11.64
4	Land not cultivated including pasture land; barren land; trees, grooves & orchards	68527	6.49
5	Fallow and current fallow land	199804	18.91
6	Net sown area (subtracting double)	641646	60.73
7	Gross sown area	896341	
8	Area sown more than once	254695	24.10

Agriculture

Agriculture activity in the district is, by and large, confined to traditional kharif cultivation depending on monsoon rainfall and rabi cultivation is prevailing in areas where irrigation

facilities are available. The major crops grown in the area are given in table no. 3.4 and season-wise crops are presented in table 3.5.

Table 3.4: Major crops of Jalore District

Food Grain	Jowar, Bajra, Wheat, Barley, Maunth, Moong
Cereals	Gram, other kharif cereals, other rabi cereals
Oil seeds	Rai & Mustard, Til, Ground Nut, Arandi/Taramira
Non-food grains	Cotton ,fodder and isabgol

Table 3.5: Season-wise crops Pattern of Jalore District

Season	Crops covered
Kharif	Jwar, Bajra, Maunth, Moong, Til, Moongfli, Arandi, Gwar
Rabi	Wheat, Barley, Gram, Alsi, Rai/Raida/Mustard, Arandi, Pomegranate, vegetables, Cumin seeds
Zaid	Fruits like watermelon, Gwar, Vegetables, Bajra, fodder

Apart from these, vegetable and fruits are also being produced in the district. Onion, Cauliflower are main vegetables and Aonla, Ber are main fruits which are produced in district

Irrigation

Open wells/Dug-cum-Borewells and Tube well are the main source of irrigation in the district and canal water is main source of water in south- western part of district. During 2019-20, the net irrigated area in the district was 348702 hectares of which 77.75 percent was irrigated by open wells/dug-cum-borewells and tube well. Other sources constituted canals/other sources and the percentage of area irrigated by them are 22 percent. The area irrigation by different means of irrigation in 2019-20 in the district is as given below, figures in the brackets indicate the percent of area irrigated by difference sources to total area irrigated in that category

Table 3.6: Details of Area irrigated with sources in Jalore District

	Dugwells	**Tubewells**	**Canals**	**Other**	**Total**
Net Sown Area	98419	172727	77530	26	348702
Gross Sown Area	115643	210963	82772	26	409404

4.0 Hydrogeological Framework

4.1 Geology:

Geological set-up of the district is represented by Quaternary alluvium and various igneous and meta-sedimentary rocks. Vast area is covered by Quaternary alluvium and wind blown sand. In the southeastern part of the district around Jaswantpura, Delhi supergroup rocks comprising of phyllite, schist and Erinpura granite and gneisses are exposed. Erinpura granite and gneisses are also exposed near Jalore town. Younger Alluvium mainly occurs along river courses and stream channels.

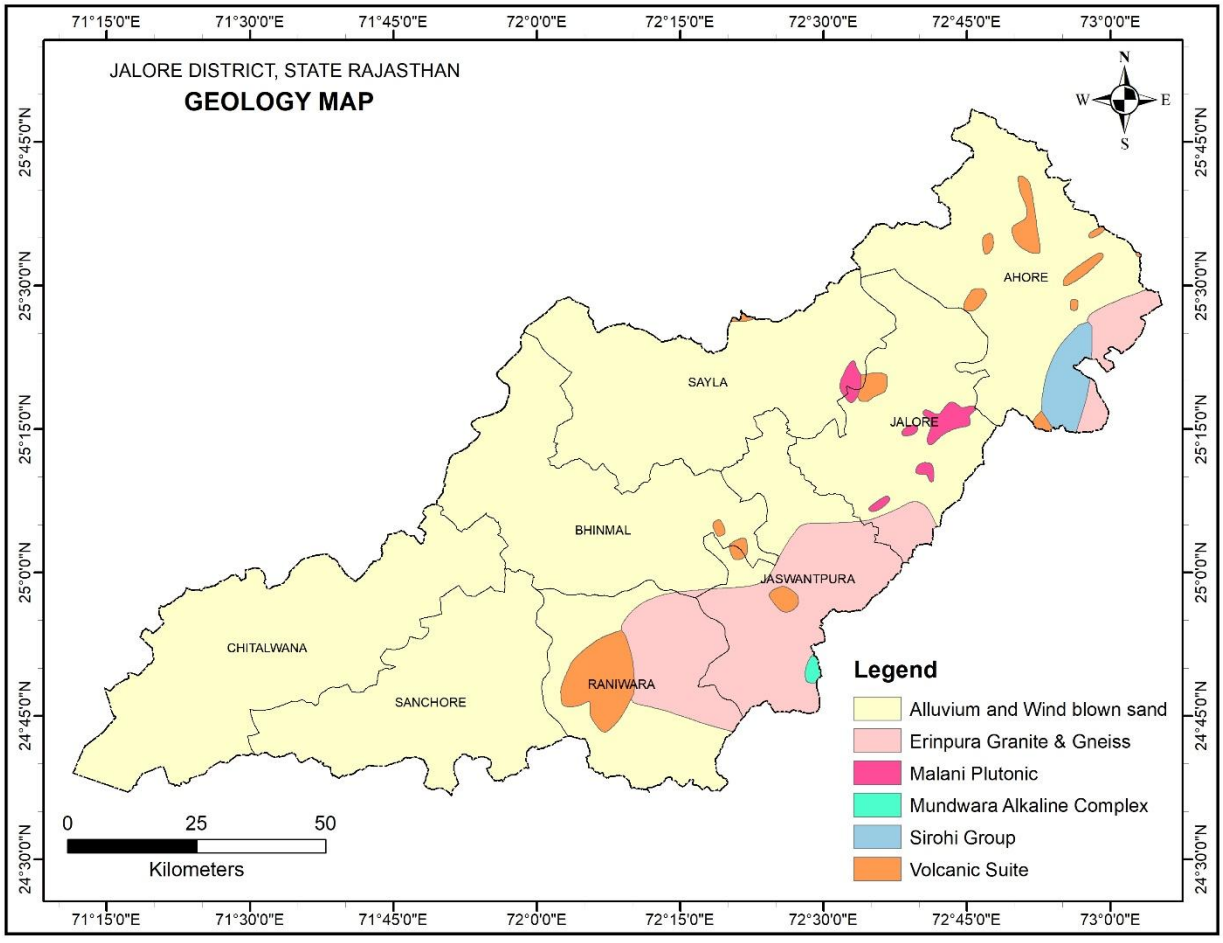
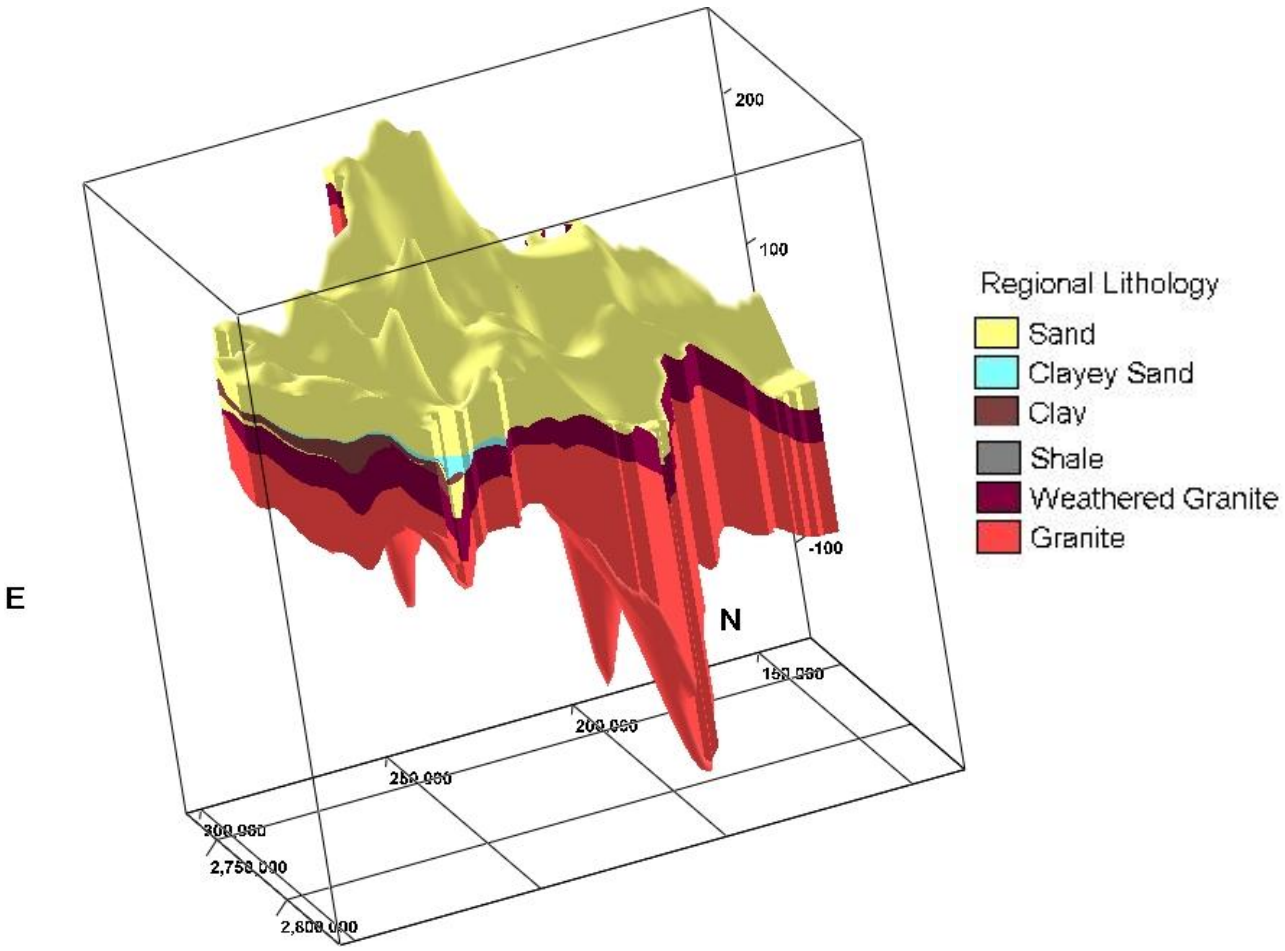


Figure 1.3: Geology of Jalore District

Data from 187 wells were taken to study the stratigraphy and aquifer characteristics of the district. The 187 wells are constructed wide spread in the district and represents overall aquifer disposition of the district. Out of the 187 wells, data of 16 wells from CGWB and 171 wells constructed from Ground Water Department, State of Rajasthan was taken.

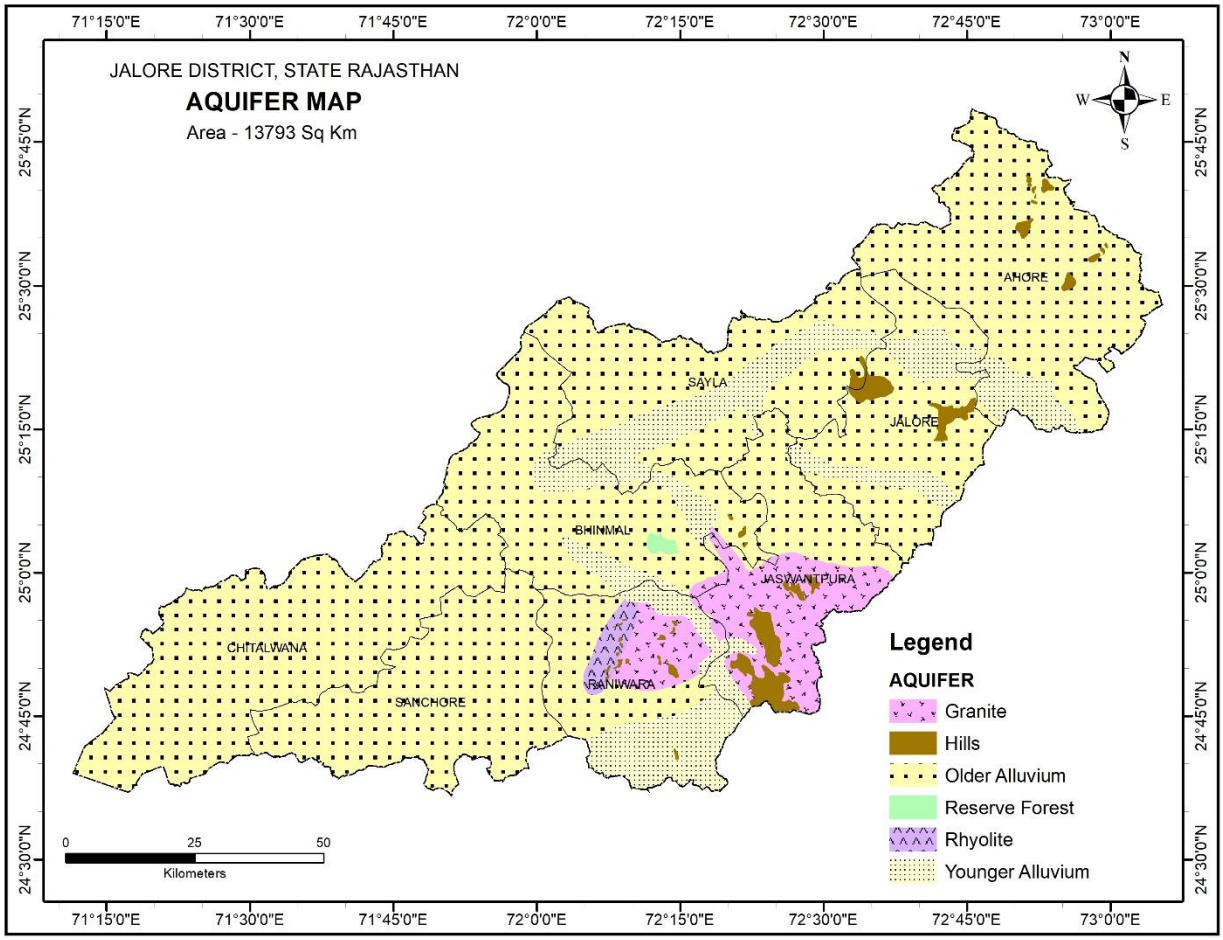
The lithology disposition shows that the Jalore district has Granite as the base with weathered and/or fractured granite overlying and at most parts of district is covered by alluvium. All the water bearing formations are separated by clay layer or somewhere silt/shale.



2 Hydrogeology:

Ground water occurs under unconfined condition in saturated zone of rock formation. Its occurrence is controlled by topography, physiography and structural features of the geological formations. The movement of the ground water in hard rock areas is governed by size, openness, interconnection and continuity of structurally weak planes while in unconsolidated rocks, ground water movement takes places through pore space between grains. Hydrogeological map of Jalore district is presented in Fig. 2.

Fig. 2: **HYDROGEOLOGICAL MAP OF JALORE DISTRICT**



Water bearing properties of different aquifers in the district are described below.

4.2.1 Ground water in Delhi Super Group

Granite: These aquifers occur predominantly in Jaswantpura tehsil. Few intrusives are also found which have low permeability. Ground water is retained in weathered zones, fractures, joints etc. Depth of open wells tapping these aquifer ranges from 20 to 50m. Yield of wells varies from 20m^3/day to 188m^3/day. The depth to water level in the area tapping this aquifer ranges from 11m to 31m.

Rhyolite : These aquifers occur predominantly towards Jaswantpura tehsil. Ground water occurs under water table condition and is mostly tapped by dug wells. Depth of wells ranges from 20m to 30m. The depth to water level ranges from 11m to 18m bgl. Yield of wells ranges from 30 to 80m^3/day.

4.2.2 Groundwater in Unconsolidated Sediments

Younger Alluvium: Alluvium occurs predominantly in the entire district. It is confined to riverbeds and riverbanks. The depth to water level is less than 10m bgl near river courses but exceeds 40 m in other areas. Yield of dug wells ranges from 60-150m^3/day and that of tubewells from 80-560 m^3/day

Deep Aquifer System: Exploratory drilling in the district reveals that Alluvium covers the maximum part of the district. Depth of tubewells ranges from 10-40m^3/day with a drawdown of 1.28-16.28 m. Transmissivity varies from 370-5696 m^2/day.

Ground Water Exploration

Hydrogeology is concerned primarily with mode of occurrence, distribution, movement and chemistry of water occurring in the subsurface in relation to the geological environment. The occurrence and movement of water in the subsurface is broadly governed by geological frameworks i.e., nature of rock formations including their porosity (primary and secondary) and permeability.

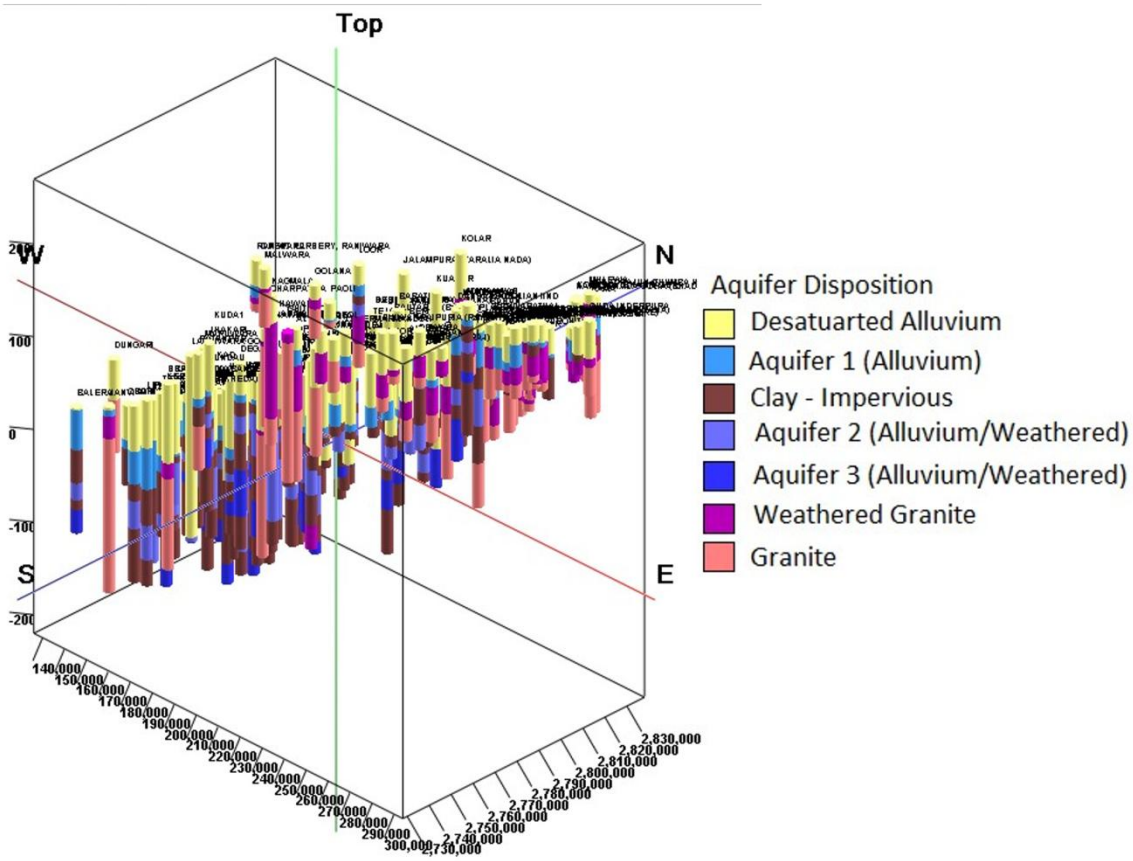
The principal aquifers in the area are Alluvium, and Granite. Occurrence and movement of ground water in Alluvial aquifer is directly proportional to the granular zones i.e., the ground water accumulation will be higher in coarser formation and the formation clear of clayey admixture or intercalation.

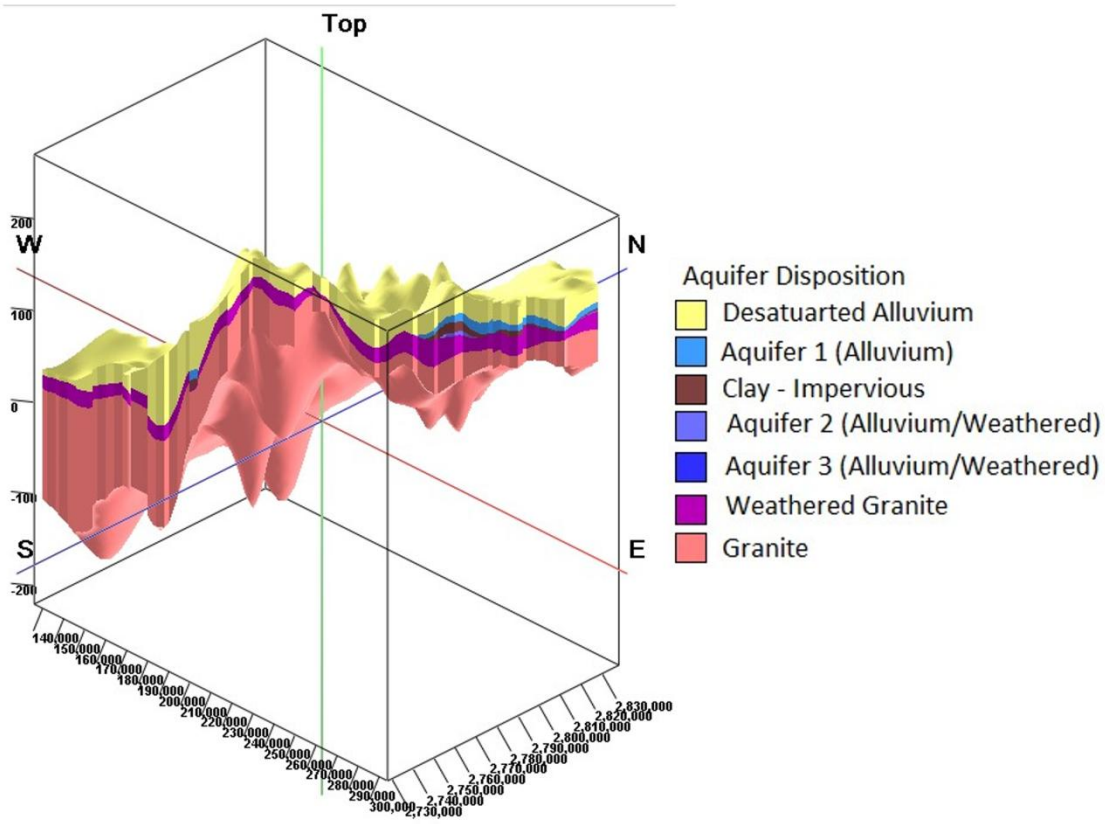
CGWB has constructed 33 Tubewells/ Piezometers/ Slim holes/Exploratory wells varying from depth of 100 to 300 m bgl in various districts of Jalore. The construction of wells, to

study the hydrogeological characteristics of district and ground water parameters was mainly carried out in blocks of Raniwara, Sanchore, Sayla and Bhinmal.

The constructed wells mainly tapped the soft rock aquifer, alluvium and weathered or/and fractured granite. Discharge varies from 50 lpm at Lakhawas, Raniwara block to 1817 lpm at Posana, Sayla block.

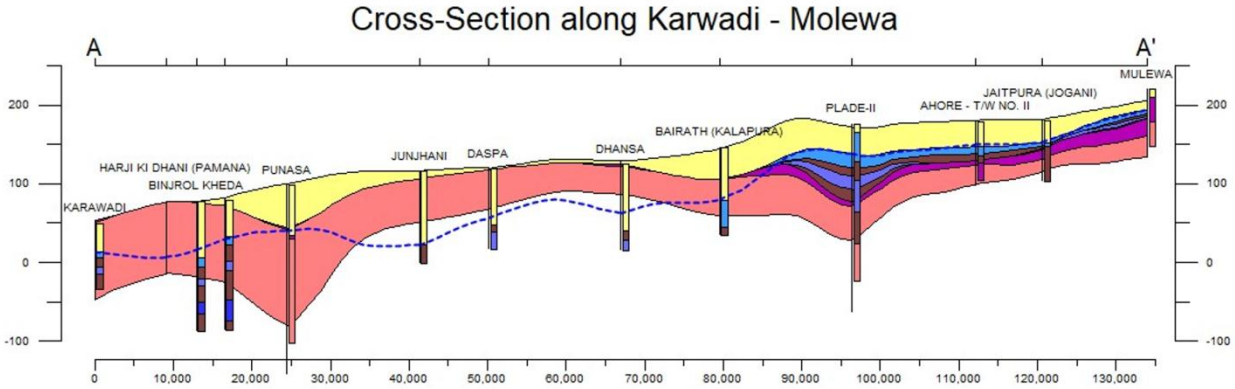
Data from 187 wells were taken to study the stratigraphy and aquifer characteristics of the district. The 187 wells are constructed wide spread in the district and represents overall aquifer disposition of the district. Out of the 187 wells, data of 16 wells from CGWB and 171 wells constructed from Ground Water Department, State of Rajasthan was taken.

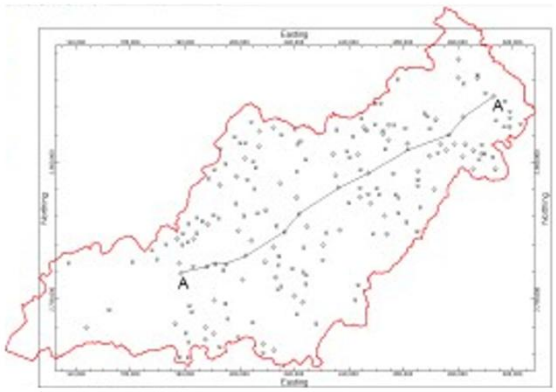




The top layer is unsaturated layer including top soil, unsaturated alluvium, weathered and fractured granite. Its depth varies from 20 m bgl to 100 m bgl. At some places of Raniwara, Bhinmal and Soyla the unsaturated layer goes beyong 120 mt depth.
The first saturated layer mostly is of alluvium but at few places is formed of fractured and weathered granite/ granitic gneiss also.

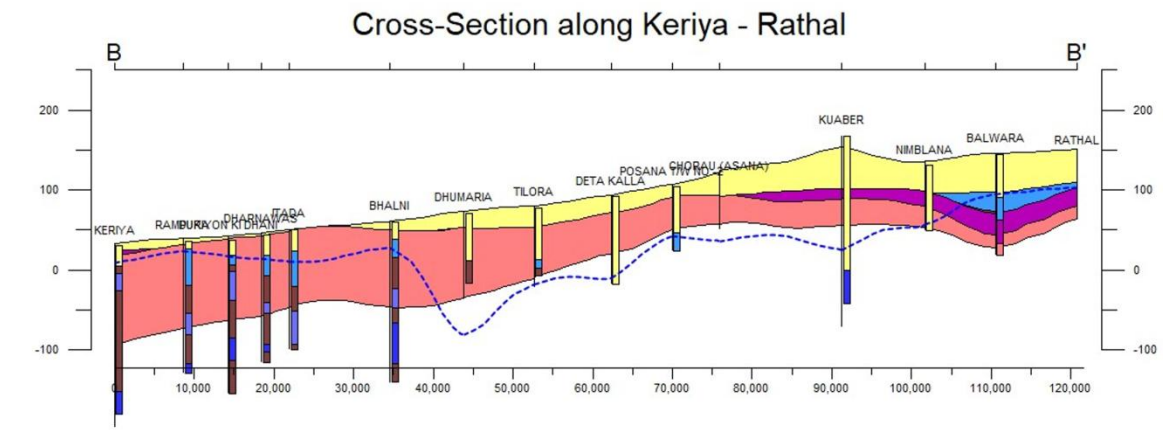
Cross Sections along the district to study the aquifer disposition along the district on the tract can be studies.
Three cross sections traversing the district along NE-SW , running along the entire district are taken while covering most of data points.

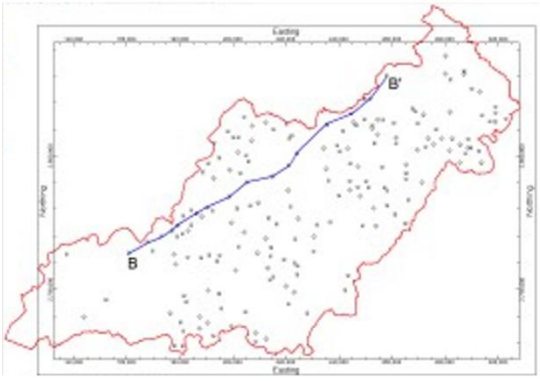




Aquifer Disposition

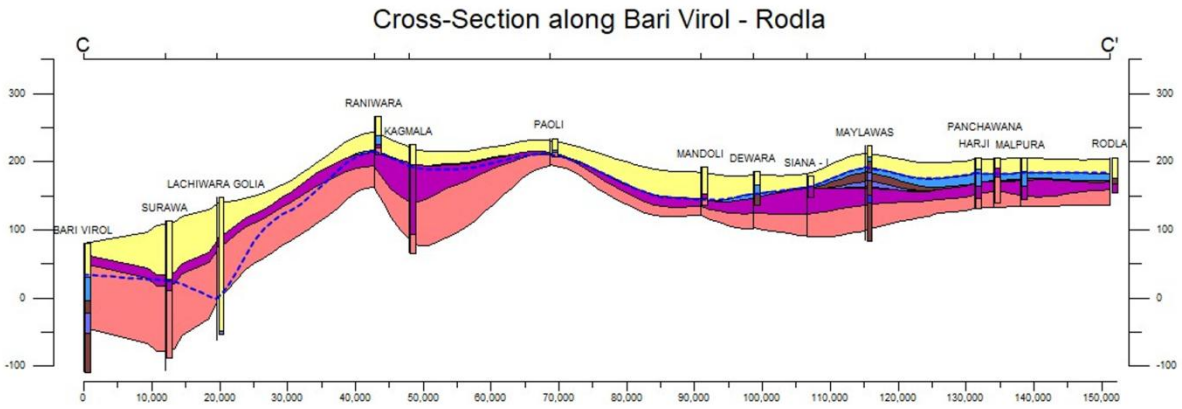
- Desatuarted Alluvium
- Aquifer 1 (Alluvium)
- Clay - Impervious
- Aquifer 2 (Alluvium/Weathered)
- Aquifer 3 (Alluvium/Weathered)
- Weathered Granite
- Granite

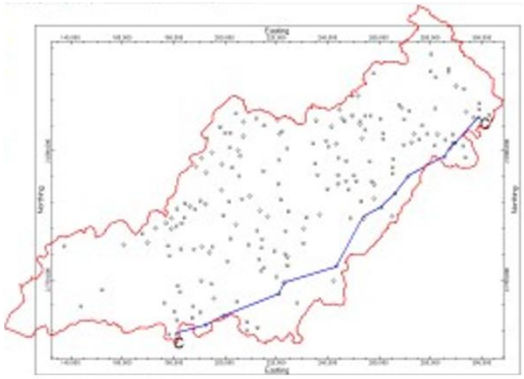




Aquifer Disposition

- Desatuarted Alluvium
- Aquifer 1 (Alluvium)
- Clay - Impervious
- Aquifer 2 (Alluvium/Weathered)
- Aquifer 3 (Alluvium/Weathered)
- Weathered Granite
- Granite





Aquifer Disposition

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Water Level Behavior

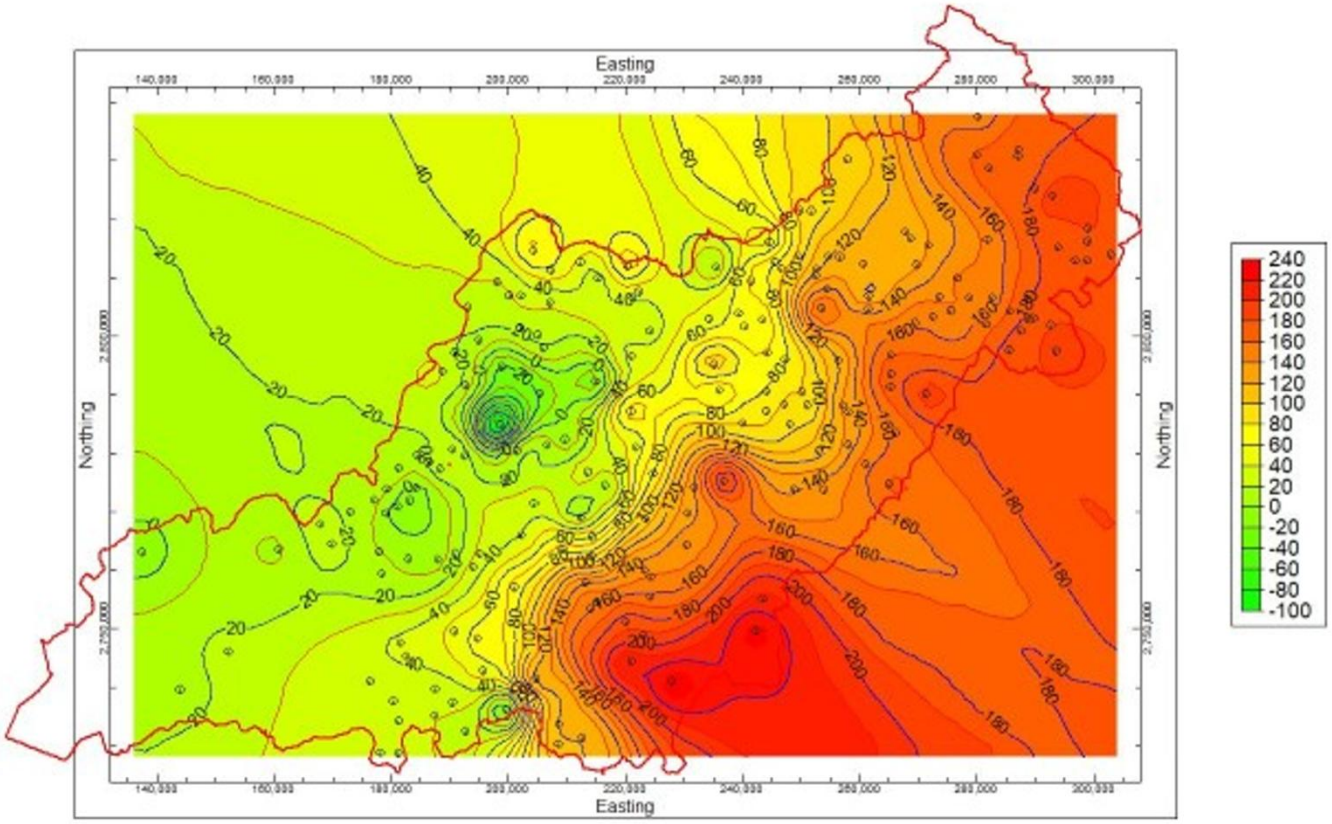
Water level behavior has been studied by taking into consideration 234 monitoring points spread across the district. The monitoring points consists of dugwells, Piezometers, Dug-cum-Bore wells and also the depth to which tubewells have been constructed and motor lowered have been taken into consideration to study the ground water level behavior in the district.

170-GWD data

24 – CGWB data

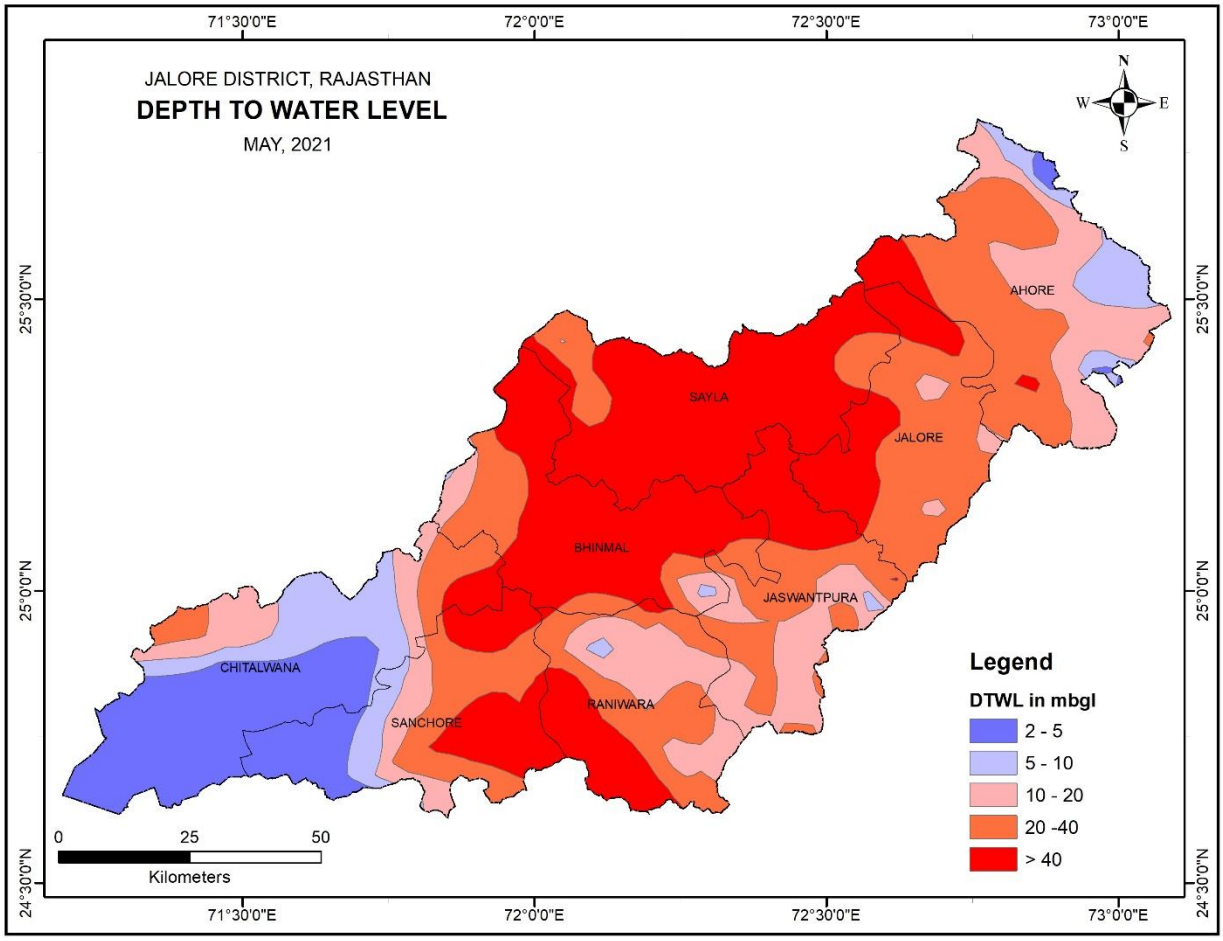
40 – key wells

Water table -Pre-monsoon 2021 (mamsl)



Pre-monsoon (May 2021)

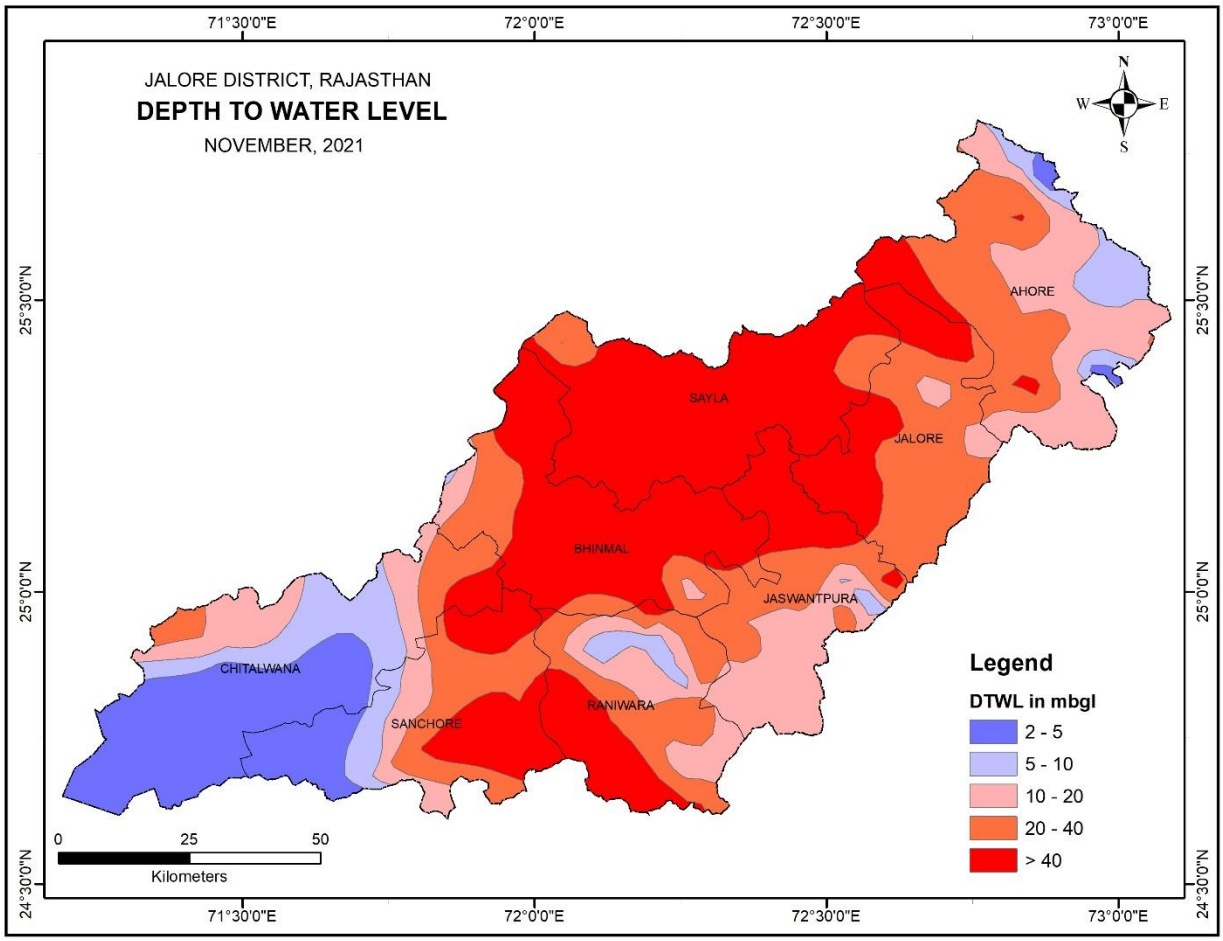
Depth to water level varied from 2.1 to 98.87 m during pre-monsoon 2021. Less than 10 m bgl depth to water level has been recorded in 23 observation wells (12% of total wells), depth to water level between 10 to 20 m has been observed in 33 observation wells covering about 17% area of the district Deeper water level i.e. more than 20 to 50 m has been recorded in 66 observation wells (34% of total wells) 62 numbers of monitoring wells have water level more than 50 meter deep, the deepest is 98.67 m bgl (Pz) while the tubewells are deeper with 150 m bgl depth.



Depth to Water Level Map of May 2021 in Jalore District.

Post monsoon (November 2021)

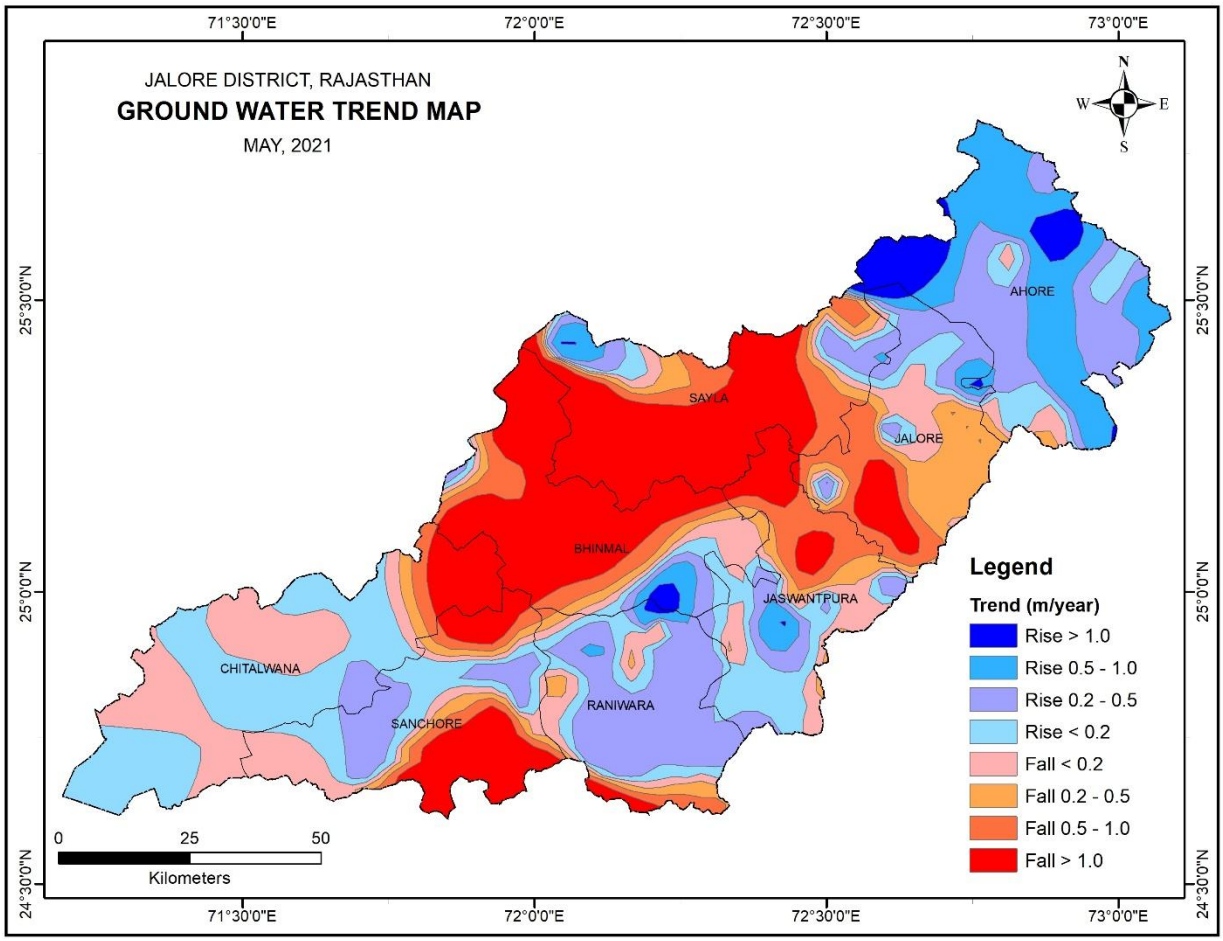
Depth to water level varied from 3.95 to 99.75 m during the Post monsoon season. Depth to water level behavior is almost same as Pre-monsoon water level between 10 to 20 m has been observed in 9 observation wells covering about 22 % area of the district Deeper water level i.e. more than 20 to 100 m has been recorded in 26 observation wells lying in the north eastern, north eastern and south western part of the district. No area in the block has water level between 0 and 2 m below ground level. In terms of area post monsoon scenario is presented in figure



Depth to Water Level Map of November 2021 in Jalore District

Ground water trend (Pre Monsoon)

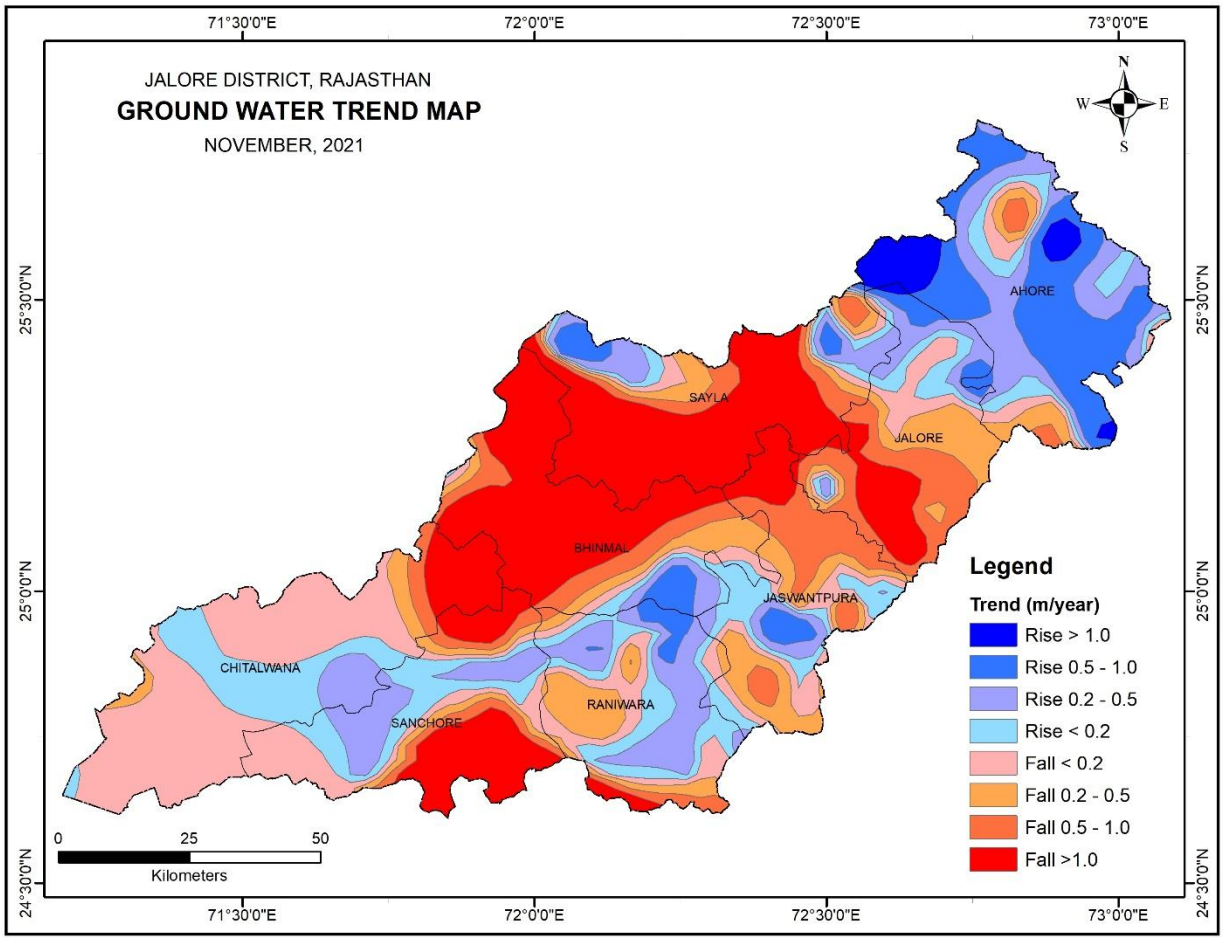
As per the ground water level data of Pre-monsoon time, the water level shows a slight rising trend in north-eastern and southern part os district mainly covering Ahore and Raniwara block with rise ranging from less than 0.2 m/year to 0.5 m/year while the central and other parts of district shows a declining trend. Mainly Sayla, Jalore and Bhinmal block and northern portion of Sanchore block shows declining trend with more than 1 m decline per year in major areas.



Ground water Trend in Pre-Monsoon time

Ground water trend (Post monsoon)

Major area in district shows declining trend with exception of Ahore block whis shows rising trend showing 0.2 to more than 1 m/year rise in ground water level. Patches in Chitalwana, Sanchore and Raniwara blocks shows rising trend from less than 0.2 to 0.5 meter/year. The remaining blocks specially Jalore, Sayla, Bhinmal shows declining trend from 0.5 m to more than 1 meter per year.



Ground water trend (Post monsoon)

Aquifer Maps and Aquifer Characteristics

GROUND WATER QUALITY

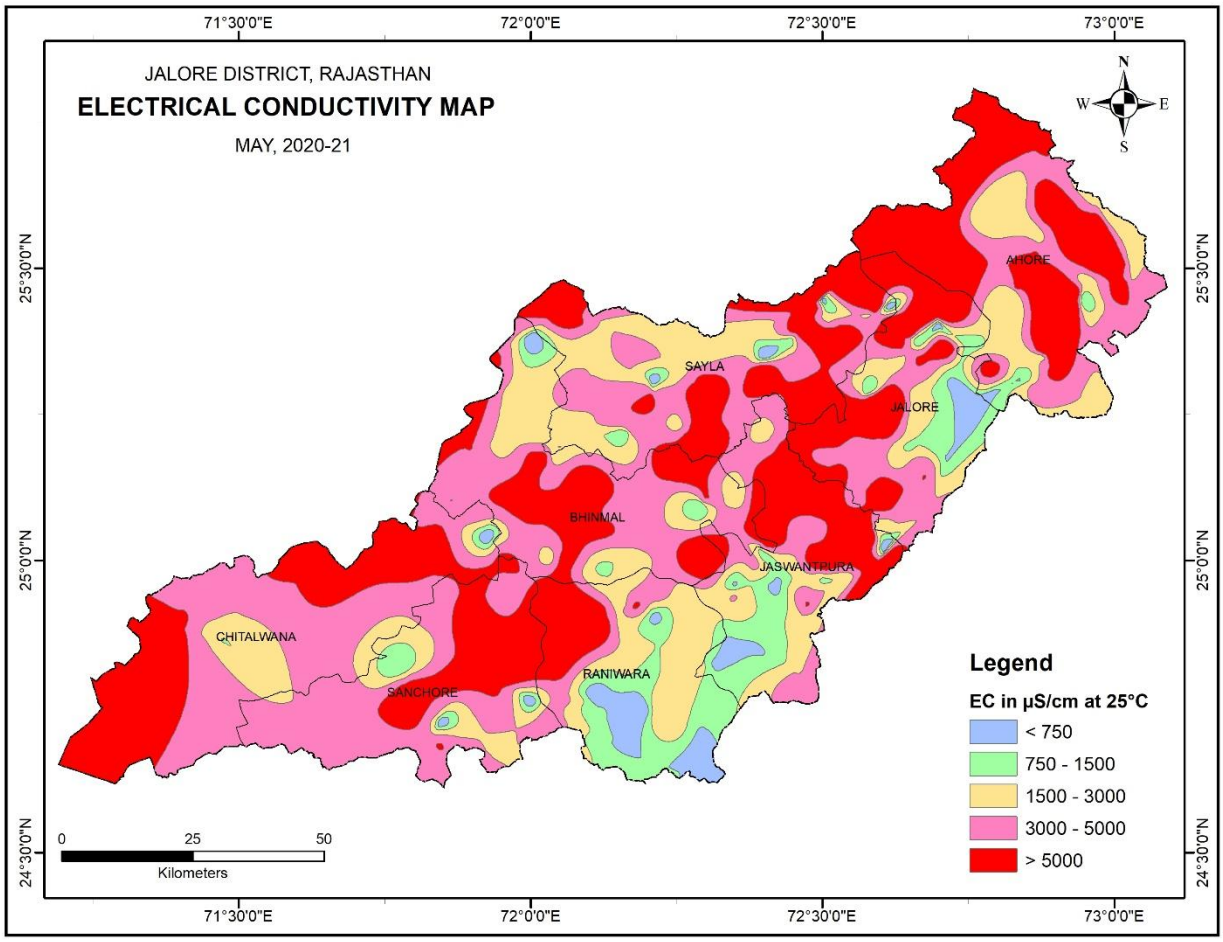
The ground water of Jalore district possesses relatively high mineral concentration, which varies considerably laterally and vertically.

Major Quality Parameters

Electrical Conductivity (EC)

Electrical conductivity is a measure of total mineral contents of dissolved solids in water. It depends upon the ionic strength of the solution. An increase in dissolved solids causes a proportional increase in electrical conductivity. The electrical conductivity value of ground

water in Jalore district found to vary from 280 (Bokra, Jalore block) to 19800 (at Sangadwa, Chitalwana block) µS/cm at 25°C. Very high concentration of 10000 to 17580 µS/cm at 25°C has been reported at Jalore, Sayla and Aahore Blocks of the district. The spatial variation of EC (175 samples from 255 gw samples) shows that in maximum area the groundwater has EC values less than 5000 µS/cm at 25°C. The entire district covering 08 blocks shows spatial distribution of EC less than 5000 µS/cm at 25°C and 47 ground water samples mainly collected from Raniwara and Jaswantpura blocks have EC less than 1000 µS/cm at 25°C.

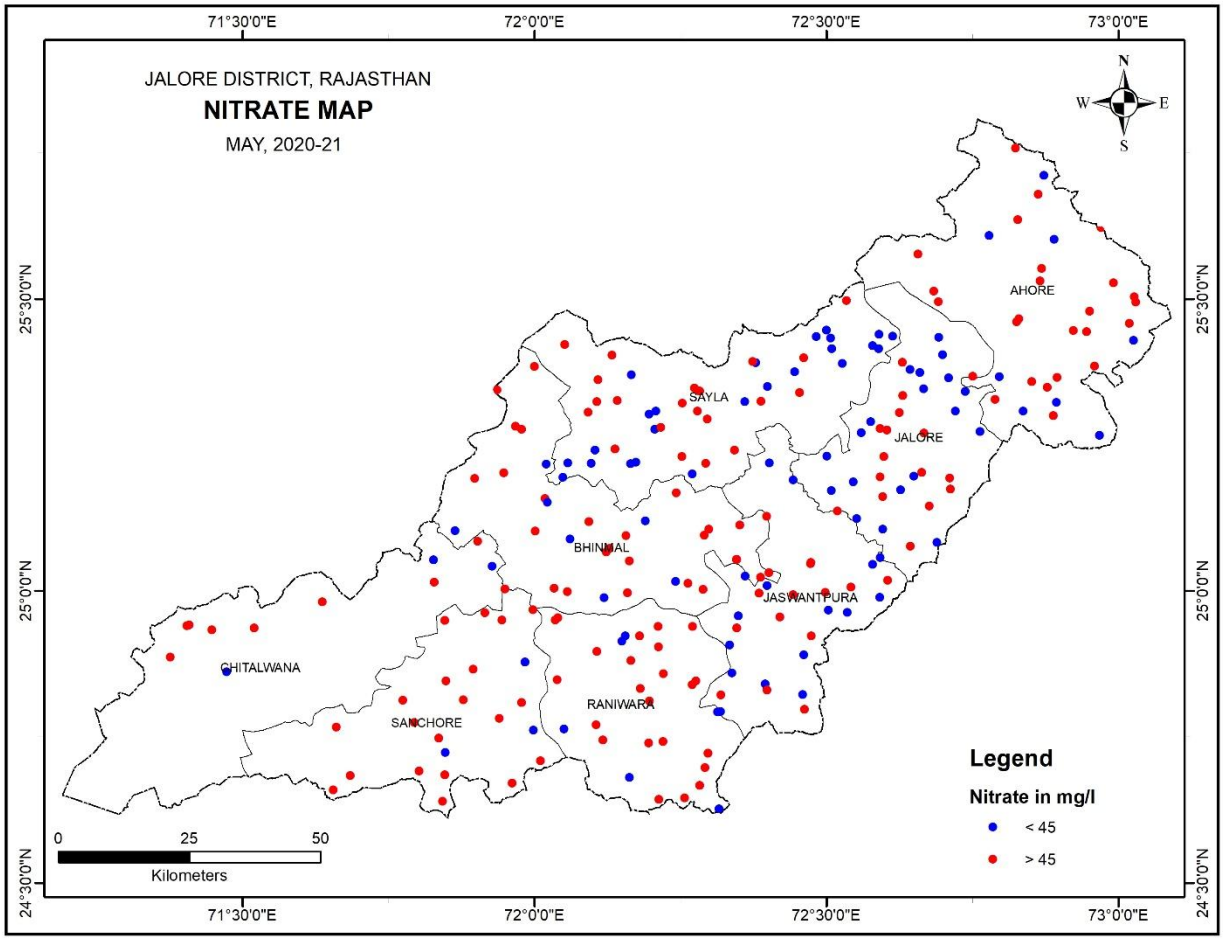


Electrical Conductivity map of Jalore District

Nitrate

Concentration of nitrate (NO_3^-) has been found to vary from < 1 mg/l to 652.86 mg/l. Nitrate concentration exceeds the maximum permissible limit of 45 mg/l in drinking water prescribed by BIS (IS-10500:2012) in around 65% (166 gw samples) of the total ground water samples. Nitrate in excess of maximum permissible limit has been reported in almost entire district even in blocks like Raniwada and Jaswantpura. Excess nitrate in drinking

water can cause methaemoglobinaemia in infants, gastric cancer, goiter, birth malformations and hypertensions



Nitrate map of Jalore District

Chloride

Concentration of chloride has been found to vary from < 250 mg/l to 5743 mg/l. Chloride concentration exceeds the maximum permissible limit of 1000 mg/l in drinking water prescribed by BIS (IS-10500:2012) in around 45 % of the total ground water samples. Chloride in excess of maximum permissible limit has been reported from almost all the blocks of Jalore district. Excess limit of chlorine in drinking water can affect the taste, corrosion, and palatability.

Suitability of Ground Water for Drinking Purposes

The suitability of ground water for drinking purpose is determined keeping in view the effects of various chemical constituents in water on the biological system of human being. The standards proposed by the Bureau of Indian Standards (BIS) for drinking water (IS-m10500-91, Revised 2012) were used to decide the suitability of ground water for drinking purpose. The overall classification of ground water samples falling below desirable limit (<DL) in the range of Desirable Limit and Maximum Permissible Limit (DL-MPL) and above maximum permissible limit (MPL) for drinking purpose is presented in table

Parameters	BIS ranges for drinking		Total number of Samples	Samples< DL		Samples between DL and PL		Samples > PL	
	DL	PL		Number of Samples	%	Number of Samples	%	Number of Samples	%
pH	6.5-8.5	No relaxation	255	0	0	193	76	62	24
TDS mg/l	500	2000	255	37	14.51	86	33.73	132	56.76
TH mg/l as $CaCO_3$	200	600	255	91	35.69	100	39.22	64	25.10
Ca^{++} mg/l	75	200	255	184	72.16	56	21.96	15	5.88
Mg^{++} mg/l	30	100	255	100	39.22	101	39.61	54	21.18
Cl^{-} mg/l	250	1000	255	61	23.92	79	30.98	115	45.10
SO_4^{--} mg/l	200	400	255	190	74.51	41	16.08	24	9.41
NO_3^{-} mg/l	45	No relaxation	255	89	34.90	--	--	166	65.10
F^{-} mg/l	1	1.5	255	93	36.47	37	14.51	125	49.02

DL Desirable Limit MPL Maximum Permissible Limit

Total Hardness (TH)

Classification of ground water samples based on Total Hardness (TH) is given in Table. TH has been found to vary between 20 mg/l and 3450 mg/l, indicating soft to very hard type of ground water. High hardness may cause precipitation of calcium carbonate and encrustation on water supply distribution systems. Long term consumption of extremely hard water might lead to an increased incidence of urolithiasis, anencephaly, parental mortality and cardio-vascular disorders. In Jalore, Total Hardness exceeds the recommended maximum permissible limit of 600 mg/l (IS-10500: 2012) in 64.40% of total analysed ground water samples. Total hardness in excess of the maximum permissible limit has been reported from parts of Jalore, Ahore, Bhinmal and parts of Jaswantpura Blocks of the district.

Hardness Classification of water

Hardness (mg/l)	Water Class	No. of Samples	% Sample
0 – 75	Soft	18	7.06
75 – 150	Moderately Hard	46	18.04
150 – 300	Hard	69	27.06
>300	Very Hard	122	47.84

Total Dissolved Solids (TDS)

Total Dissolved Solids (TDS) in water include all dissolved materials in solution, whether ionized or not. It is numerical sum of all mineral constituents dissolved in water and is expressed in mg/l. The TDS contents of ground water are controlled by the mineral dissolution rate, chemical character of ground water and ionic saturation status of solution. The concentration of total dissolved solids in the ground water has been found to vary generally between 160 mg/l to 11880 mg/l. TDS of 69% (176 numbers) of analyzed water samples falls in the category of fresh water, while 30% (76 numbers) samples have TDS in the range of 3000 - 10,000 mg/l and fall in brackish water category.

Classification of water based on Total Dissolved Solids

Block	Fresh % Samples	Brackish % Samples	Saline % Samples	Brine % Samples
	0-3000 mg/l	3000-10000 mg/l	>10000 mg/l	>35000 mg/l
Ahore	56	42	2	0.00
Bhinmal	61	39	0	0.00
Chitalwana	69	23	8	0.00
Jalore	76	21	3	0.00
Jaswantpura	72	28	0	0.00
Raniwara	84	16	0	0.00
Sayla	74	26	0	0.00
Sanchore	58	42	0	0.00

Suitability of Ground Water for Irrigation Purposes

The ground water used for irrigation is an important factor in productivity of crop, its yield and quality of irrigated crops. The quality of irrigation water depends primarily on the presence of dissolved salts and their concentrations. The Electrical Conductivity (EC), Sodium Absorption Ratio (SAR) and Residual Sodium Carbonate (RSC) are the most important quality criteria,

which influence the water quality and its suitability for irrigation. The quality of groundwater based on EC and SAR is discussed in tables

Classification of Ground Water Samples based on EC

	Electrical Conductivity µS/cm at 25° C			**Classification of water**	**Activity required**
Type of Water	**Range**	**No. of Samples**	**% of Samples**		
Low Saline	>250	0	0	Excellent	• Good for all crops • little likelihood of development of salinity
Medium Saline	250-750	35	13.72	Good	• Plants with moderate salt tolerance • No special practices for salinity control required. • Moderate amount of leaching occurs.
Highly Saline	750-2250	51	20.0	Doubtful	• Cannot be used on soils with restricted drainage. • Even with adequate drainage, special management for salinity control may be required • Plants with good salt tolerance should be selected.
Very Highly saline	> 2250	169	66.27	Unsuitable	• Not suitable for irrigation under ordinary condition. • soils must be permeable, drainage must be adequate, irrigation water must be applied in excess to provide considerable leaching • very salt tolerant crops should be selected
		255	100		

High saline water cannot be used on soils with restricted drainage and requires special management for salinity control. Plants with good salt tolerance should be selected for such areas. Very high saline water is not suitable for irrigation under ordinary conditions but may be used occasionally under very special circumstances. The soil must be permeable, drainage must

be adequate, irrigation water must be applied in excess to provide considerable leaching and salt tolerance crops/plants should be selected.

Classification of Ground Water Samples based on SAR

Type of Water	Sodium Adsorption Ratio			Classification of water
	Range	No. of samples	% of Samples	
Low Sodium Water	< 10	88	43.56	Excellent
Medium Sodium Water	10 to 18	40	19.80	Good
High Sodium Water	18 to 26	53	26.24	Doubtful
Very High Sodium Water	>26	21	10.40	Unsuitable
		202	100	

Classification of Ground Water Samples based on Na%

Water Class	Na%		
	Range	No. of samples	%
Excellent	< 20	03	1.49
Good	20 - 40	23	11.39
Medium	40 - 60	39	19.31
Bad	60 - 80	62	30.69
Very Bad	> 80	75	37.13

Low sodium (alkali) water can be used for irrigation on almost all soils with little danger of the development of harmful levels of exchangeable sodium. Medium sodium water will present an appreciable sodium hazard in fine textured soils having high cation exchange capacity especially under low leaching conditions. This water can be used on coarse textured or organic soils with good permeability.

Ground Water Resources

The ground water resource assessment as on March 2020 has been carried out and the salient features of the resources are given in Table

As per table- out of the total 10640 sq km area, recharge worthy areas is 10251.53 sq km and area identified for artificial recharge is 1297.23 sq km.

Table : Area for Resource assessment (as on March 2020) in Jalore District

S.No	Blocks/ Assessment Units	Total Geographical Area (ha)	Hilly Area (ha)	Potential Area (ha)	Command Area (ha)	Non Command Area (ha)
1.	Ahore	1613.77	72.53	535.24	0	1541.24
2.	Bhinmal	1365.61	7.24	1322.75	0	1358.37
3.	Chitalwana	1817.85	0	1075.60	1692.85	125
4.	Jalore	1049.05	67.12	834.37	0	981.93
5.	Jaswantpura	1058.42	126.05	932.37	0	932.37
6.	Raniwara	1009.75	91.13	918.62	0	918.62
7.	Sanchore	1237.12	0.22	1236.90	949.4	287.5
8.	Sayla	1488.43	24.18	1372.25	0	1464.25
	Total	**10640**	**388.47**	**8228.1**	**2642.25**	**7609.28**

Recharge Component

During the monsoon season, the rainfall recharge is the main recharge parameter, which is estimated as the sum total of the change in storage and gross draft. The change in storage is computed by multiplying groundwater level fluctuation between pre and post monsoon periods with the area of assessment and specific yield. Monsoon recharge can be expressed as:-

$R = h \times Sy \times A + DG$

Where h = rise in water level in the monsoon season, Sy = specific yield

A = area for computation of recharge, DG = gross ground water draft

The monsoon ground water recharge has two components- rainfall recharge and recharge from other sources. The other sources of groundwater recharge during monsoon season include seepage from canals, surface water irrigation, tanks and ponds, ground water irrigation, and water conservation structures.

During the non-monsoon season, rainfall recharge is computed by using Rainfall Infiltration Factor (RIF) method. Recharge from other sources is then added to get total non-monsoon recharge.

The season wise and block-wise wise assessment of recharge from various components such as rainfall and other sources for various units was done and presented in table. The recharge from rainfall contributes maximum component (424.8921 mcm) during monsoon season and recharge from other sources (15.7622 mcm during monsoon season and 118.8922 mcm during non monsoon season). The total annual ground water recharge is 559.5465 mcm and net ground water availability after natural discharge is 505.6122 mcm.

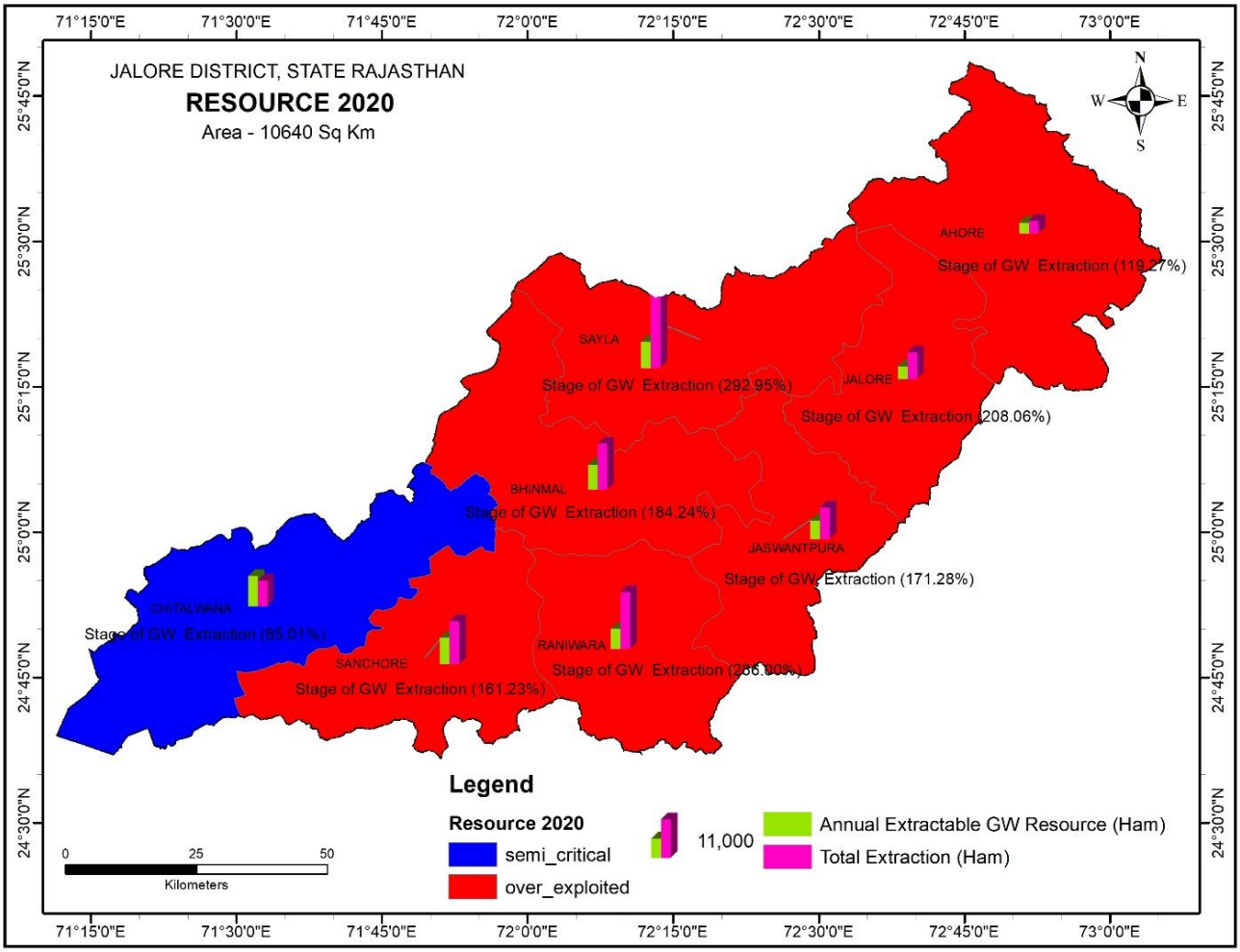
Recharge Components evaluated for Resource Estimation

Blocks/ Assessment Units	**Recharge from Rainfall-Monsoon Season**	**Recharge from Other Sources-Monsoon Season**	**Recharge from Rainfall-Non Monsoon Season**	**Recharge from Other Sources-Non Monsoon Season**	**Total Annual Ground Water Recharge**	**Total Natural Discharges**	**Annual Extractable Ground Water Resource**
	(mcm)	**(mcm)**	**(mcm)**	**(mcm)**	**(mcm)**	**(mcm)**	**(mcm)**
AHORE	27.5013	0	0	7.3962	34.8975	3.4897	31.4078
BHINMAL	76.0236	1.60.4	0	4.8515	82.4815	8.2482	74.2333
CHITALWANA	37.8268	3.9842	0	58.2797	100.0907	10.0091	9.00.16
JALORE	36.6895	0.9301	0	2.791	40.4106	2.0206	38.39
JASWANTPURA	49.4237	2.8959	0	8.6922	61.0118	6.1012	54.9106
RANIWARA	57.6646	2.0403	0	6.122	65.8269	6.5827	59.2442
SANCHORE	64.0549	1.5352	0	22.434	88.0241	8.8024	79.2217
SAYLA	75.7077	2.7701	0	8.3256	86.8034	8.6804	78.123
DISTRICT	424.8921	15.7622	0	118.8922	559.5465	53.9343	505.6122

The annual gross draft for all uses is estimated at **950.7629 mcm** with irrigation sector being the major consumer having a draft of **908.9021 mcm**. The annual draft for domestic and industrial uses was 41.8608 mcm. The allocation for domestic requirement supply up to next 25 years is about 42.2928 mcm.

Block wise GW Resources of Jalore (March 2020) (in mcm)

Block	Potential Zone	Annual Extractable Ground Water Recharge	Existing Gross Ground Water Draft for Irrigation	Existing Gross Ground Water Industrial Uses	Existing Gross Ground Water Domestic Uses	Existing Gross Ground Water Draft for all uses	Stage of Ground Water Extraction %	Category
AHORE	535.24	31.4078	32.3204	0	5.1408	37.4612	119.2736	OE
BHINMAL	1322.75	74.2333	129.1578	0	7.6104	136.7682	184.241	OE
CHITALWANA	1075.60	90.0816	75.88944	0	0.6912	76.58064	85.01252	Semi Critical
JALORE	834.37	38.39	74.42337	0	5.4492	79.87257	208.0557	OE
JASWANTPURA	932.37	54.9106	89.13903	0	4.914	94.05303	171.2839	OE
RANIWARA	918.62	59.2442	163.245	0	6.1956	169.4406	286.0036	OE
SANCHORE	1236.90	79.2217	122.8128	0	4.9152	127.728	161.2286	OE
SAYLA	1372.25	78.123	221.9143	0	6.9444	228.8587	292.9466	OE
		505.6122	908.9021	0	41.8608	950.7629	188.0419	


JALORE DISTRICT, STATE RAJASTHAN
RESOURCE 2020
Area - 10640 Sq Km
N
W
E
S
AHORE
Stage of GW Extraction (119.27%)
SAYLA
Stage of GW Extraction (292.95%)
JALORE
Stage of GW Extraction (208.06%)
BHINMAL
Stage of GW Extraction (184.24%)
JASWANTPURA
Stage of GW Extraction (171.28%)
CHITALWANA
Stage of GW Extraction (85.01%)
SANCHORE
Stage of GW Extraction (161.23%)
RANIWARA
Stage of GW Extraction (286.00%)
71°15'0"E
71°30'0"E
71°45'0"E
72°0'0"E
72°15'0"E
72°30'0"E
72°45'0"E
73°0'0"E
25°45'0"N
25°30'0"N
25°15'0"N
25°0'0"N
24°45'0"N
24°30'0"N
Legend
Resource 2020
semi_critical
over_exploited
11,000
Annual Extractable GW Resource (Ham)
Total Extraction (Ham)
0
25
50
Kilometers

In-storage Resources

Ground water resource assessment of the zone below water level fluctuation is carried out is presented in table.

Table: Block wise In-storage Resources of Jalore District

Block	Water Bearing Formation	Potential Area (sq km)	Sp Yield	Average DTW (m) formation-wise	Thickness of unsaturated zone 3 m below ground level (m)	Volume of sub surface storage space available for artificial recharge (MCM)	Volume of Unsaturated Zone (MCM)
Ahore	Alluvium	535.24	0.060	17.49	14.49	465.21	7753.49
Ahore	Alluvium (Saline)	1006	0.077	17.49	14.49	1124.51	14576.94
Bhinmal	Alluvium	1322.75	0.060	37.89	34.89	2768.93	46148.76
Bhinmal	Alluvium (Saline)	35.62	0.080	37.89	34.89	99.42	1242.73
Jalore	Alluvium	556.25	0.073	27.94	24.94	1017.19	13870.71
Jalore	Alluvium (Saline)	425.68	0.080	27.94	24.94	849.18	10614.80
Jaswantpura	Alluvium	500	0.015	33.16	30.16	226.17	15077.80
Jaswantpura	Granite	432.37	0.080	15.48	12.48	431.68	5395.98
Raniwara	Alluvium	699.87	0.015	20.32	17.32	181.83	12122.31
Raniwara	Granite	218.75	0.060	12.98	9.98	131.03	2183.85
Sanchore	Alluvium	1236.9	0.060	32.67	29.67	2201.80	36696.60
Chitalwana	Alluvium	1075.6	0.060	12.64	9.64	621.87	10364.48
Chitalwana	Alluvium (Saline)	742.25	0.070	12.64	9.64	500.66	7152.32
Sayla	Alluvium	1372.25	0.060	62.10	59.10	4865.92	81098.60
Sayla	Alluvium (Saline)	92	0.020	62.10	59.10	108.74	5437.20

The total in-storage resources of the district, comes to mcm. The block-wise sustainability period of aquifers, if the present ground water draft for all uses continues to be same, is

calculated after considering both dynamic resources and in-storage resources and presented in table

Block wise Sustainability of Aquifer in Jalore

Block	Dynamic Resource (mcm)	In-Storage Resources (mcm)	Current annual gross ground water extraction for 'All Uses' (mcm)	Sustainability period of Aquifer (years)
AHORE	31.4078	42.64	37.4612	13.8
BHINMAL	74..2333	178.39	136.7682	20.29
CHITALWANA	90.0816	51.32	76.58064	3.495
JALORE	38.39	237.30	79.87257	12.76
JASWANTPURA	54.9106	267.53	94.05303	10.28
RANIWARA	59.2442	717.97	169.4406	118.3
SANCHORE	79.2217	292.12	127.728	35.05
SAYLA	78.123	14.09	228.8587	22.03
Total	505.6122	3157.63	950.7629	12.44

Aquifer Management Plan

8.1 Ground Water Related Issues

Over Exploitation of Groundwater

The ground water draft is more than net ground water availability in all the blocks The Stage of Ground Water is also increasing. This is due to over-exploitation of ground water for irrigation purposes. The groundwater resource estimation was done for all blocks of the district, stage of ground water development has increased over the period of time from 2017 to 2020 in almost all blocks of the Jalore District.

Inland Salinity

Almost 80% of the district has poor ground water quality with EC higher than 3000 µS/cm at 25°C wherein entire area of Bhinmal and Sayla blocks and almost 80% area of

Jaswantpura, Chitalwana and Ahore blocks have EC higher than 3000 µS/cm. More than 25% of district has EC higher than 5000 µS/cm**.** The ground water in these areas is neither suitable for drinking nor for irrigation purposes.

Ground Water Management Plan

The management plan has been proposed to manage the ground water resources and to arrest further decline in water levels and improve the Stage of Ground Water Development in the district which is 188.04 % for the district and falls in Over-Exploited category. The management plan comprises two components namely supply-side management and demand side management. The management plan proposed in all the 8 blocks of Jalore District is discussed below

Supply Side Management

The supply side management of ground water is done through constructing water conservation/ harvesting structures to utilize the available surplus runoff/ surface water. Based on this many Artificial Recharge structures/ Water harvesting structures have been constructed in the district under MJSA.

The details are as follows:

Structures	Chitalwana	Ahore	Bhinmal	Jalore	Jaswant- pura	SAnchore	Sayla	Raniwada	total
Farm Pond / Khet Talai	0	2	2	4	13	3	2	2	28
Earthen Check Dam	115	78	13	152	21	424	13	243	1059
Mini Percolation Tank	12	128	19	66	110	19	19	50	423
Khadin	0	68	0	15	2	2	0	1	88
Surface Storage Barrier	0	14	9	23	23	4	9	44	126
Water Harvesting Structure	0	0	0	1	3	2	0	3	9
Anicut	0	2	1	2	13	0	1	1	20
total	127	292	44	263	185	454	44	344	1753

Overall 1753 structures have been constructed under various phases of MJSA including surface water conservation/ storage structures like Earthen Check Dam/ Mini Percolation tanks etc and also artificial recharge structures like water harvesting structures.

However, 7.70 mcm surplus surface water is still available during rainy season for which various artificial recharge and water conservation/ storage structures are proposed in district to catch the surplus water. The details are as follows

Block-wise Proposal of Water Conservation Structures in Jalore District

Block	**Total Geographical Area (sq.km)**	**Potential area (sq.km)**	**Type of aquifer**	**Area suitable for artificial recharge**	**Volume of sub surface space available for artificial recharge (mcm)**	**Surplus surface water available in (MCM)**
Ahore	1613.77	535.24	Soft Rock	535.24	465.21	1.16
Bhinmal	1365.61	1322.75	Soft Rock	1322.75	2768.93	0.98
Chitalwana	1817.85	1075.60	Soft Rock	1075.60	621.87	1.20
Jalore	1049.05	834.37	Soft Rock	834.37	1017.19	0.76
Jaswant-pura	1058.42	932.37	Soft Rock	932.37	657.85	0.75
Raniwada	1009.75	918.62	Soft Rock	918.62	312.87	0.82
SAnchore	1237.12	1236.90	Soft Rock	1236.90	2201.80	0.98
Sayla	1488.43	1372.25	Soft Rock	1372.25	4865.92	1.04
	10640	8228.1		8228.1	12911.61158	7.70

Block	Catchment area for treatment	Mini Percolation Tank	Percolation Tank	Pacca Check dam	Anicut	Mini Storage Tank	Total Surplus water utilized (mcm)	Total Cost estimate (Crore)
Ahore	2070	535	88	45	31	0	1.08	36.04
Bhinmal	1921	409	74	43	7	0	0.77	29.15
Chitalwana	2394	585	101	40	15	0	1.06	47.46
Jalore	1409	330	53	27	12	1	0.63	22.90
Jaswant-pura	1631	320	56	27	21	0	0.67	25.96
Raniwada	1280	335	95	32	8	0	0.71	22.12
SAnchore	1630	371	71	41	25	0	0.86	28.35
Sayla	1993	435	84	48	15	0	0.95	31.93
	14328	3320	622	303	134	1	6.74	243.91

In total, 6.74 mcm of surplus surface water could be recharged/conserved/stored and which in return would increase the total available ground water resources.

In addition to this with construction of household tankas in the district could decrease the dependency on ground water for domestic use and thus save ground water. If in general, tankas are constructed in field or at household it may save upto 0.1 mcm of water in each block and thus saving 0.8 mcm of ground water.

So, in addition to surplus surface water that could be recharged/conserved/stored the amount by constructing tankas at household could bring 7.54 mcm of additional water in flow to supply side.

Demand Side Management

The Demand Side Management is proposed in all the blocks as the Stage of Ground Water Development is 188.04. All the blocks other than Chitalwana block falls in over exploited Category, while Chitalwana block falls in Semi-Critical category. Even though after implementation of supply side management options in the current scenario, the water saving is still less to compensate the withdrawal. So, there is a need to adopt micro-irrigation techniques more adhesively and with shift to hybrid seeds or to less water intensive crop or both are required to save water.

The micro-irrigation techniques viz. sprinkler or drip irrigation, is already in widespread use in the district. Looking at the less amount of available ground water the farmers have mostly shifted to micro irrigation techniques but the chance to improve the situation is still available. If it is used more extensively then about 10% of water used for agriculture could be saved in addition to already saved ground water.

The sown crops during Kharif are already less water consuming crops like Bajra, Mung etc. Wheat and Raida is sown in winters and may be replaced by gram or less water consuming hybrid crop of wheat and other rabi crops. May save some amount of ground water during rabi time

Block-wise proposal for adopting Micro-Irrigation in Jalore District

Blocks	Net Irrigated Area through Ground Water (ha)				Water Saving through Micro Irrigation (mcm)
	Canals	TW	DW	Total	
Ahore	18	10378	5765	16187	4.0
Bhinmal	0	3097	67736	70833	13
Chitalwana	41120	30927	11192	83239	7
Jalore	0	7289	17345	24634	8
Jaswant- pura	0	24496	3237	27733	9
Raniwada	0	12500	30233	42733	15
SAnchore	41634	10116	30590	82340	10
Sayla	0	16840	44865	61705	20
Total	**82772**	**115643**	**210963**	**409404**	**86**

Block-wise proposal for Crop Change and Water Saving in Jalore District

Blocks	Water Saving through Change in Crop (mcm)
Ahore	0.5
Bhinmal	2
Chitalwana	1
Jalore	2
Jaswant- pura	2
Raniwada	5
Sanchore	5
Sayla	2
Total	**19.5**

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

After implementation of interventions the total Stage of Groundwater Extraction will improve from 188.04% to 164.72%.

Table : Ground Water Availability & Stage After Interventions in Jalore District

Block	Net G.W. Availability (mcm)	Additional Recharge from RWH & conservation (mcm)	Total Net G.W. Availability after intervention (mcm)	Existing G.W Draft for all purpose (mcm)	Saving of Ground water through projects (mcm)	Net GW draft after interventions (mcm)	Present stage of G.W. development (%)	Projected stage of G.W. Dev. (in %)
Ahore	31.4078	1.18	32.5878	37.4612	4.5	32.9612	119.2736	101.145828
Bhinmal	74.2333	0.87	75.1033	136.7682	15	121.7682	184.241	162.134287
Chitalwana	90.0816	1.16	91.2416	76.58064	8	68.58064	85.01252	75.1637849
Jalore	38.39	0.73	39.12	79.87257	10	69.87257	208.0557	178.610864
Jaswant-pura	54.9106	0.77	55.6806	94.05303	11	83.05303	171.2839	149.159725
Raniwada	59.2442	0.81	60.0542	169.4406	20	149.4406	286.0036	248.842879
Sanchore	79.2217	0.96	80.1817	127.728	15	112.728	161.2286	140.590683
Sayla	78.123	1.05	79.173	228.8587	22	206.8587	292.9466	261.274298
Total	505.6122	7.54	513.1522	950.7629	105.5	845.2629	188.0419	164.719726

Conclusions

The study was carried out based on data gap analysis, data generated in-house; data acquired from State Govt. departments and GIS maps prepared for various themes. All the available data was brought on GIS platform and an integrated approach was adopted for preparation of block wise aquifer maps and aquifer management plans of Jalore District.

Jalore district covering an area of 10640 sq.km. Geologically, the area is occupied by Quaternary alluvium and various igneous and meta-sedimentary rocks. Vast area is covered by Quaternary alluvium and wind blown sand. The stage of ground water development is 188.04 %. The area witnessed Inland Salinity, Declining water level, Over-exploitation and low yield potential aquifers, being the major issues in the district.

Managing ground water is a grand challenging problem in its severity, pervasiveness and importance. To increase the water use efficiency, source sustainability plans of rain water harvesting and artificial recharge have been envisaged in the district.

The management plan has been proposed for all 08 blocks namely 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.

As a part of Supply side Management, a total of 4380 artificial recharge/water conservation/storage structures have been proposed along with catchment treatment of 14328 sq km area. After which an amount of 7.54 mcm surface water conserved.

As a part of **Demand side Management**, **micro-irrigation techniques are to be adopted thereby saving a total of 86 mcm water. Change in cropping pattern is proposed will save 19.5 mcm water** in the district and in turn bring down the Stage of Ground Water Development to **164.72 %.**

The total of 27 mcm water will be saved/recharged through the management, this 27 mcm water can be utilized for drinking and irrigation purposes. Looking at the increasing demand of drinking water 25% of the saved/recharged water resources, 6.75 mcm can be used for drinking water supply and 20.25 mcm can be used for supplying for irrigation purposes.

Recommendations

Awareness program to educate about conservation of precious ground water resources and training on rainwater harvesting will be beneficial to check decline in water level and justified use.

Ground water development in over-exploited, critical and semi-critical area should not be encouraged.

Use of water saving devices like sprinklers and close field distribution channels etc should be promoted.

Modern agricultural management techniques have to be adopted for effective and optimum utilization of the water resources. This can be achieved by maintaining irrigation through minimum pumping hours as per minimum requirement of water by the crop and also selecting most suitable cost effective crop pattern.

High water requirement crops to be discouraged. Proper agriculture extension services should be provided to the farmers so that they can go for alternate low water requirement economical crops.

Salt resistant crops can be sown in the area having brackish ground water.

Traditional rainwater harvesting structures like tankas, roof top rain water storage should be encouraged for meeting day to day requirements which will reduce ground water withdrawal.

Large-scale recharge potentials exist in depleted aquifers. Implementation of artificial recharge in such areas through outside surface water sources like lift canal from IGNP system or floodwater during excess rainy years be promoted.

Conjunctive use of ground water and surface water should be encouraged in canal command areas to prevent further water logging in the CCA. Anti water logging measures have to be adopted in the canal command areas.