

GROUND WATER POTENTIAL AND WATER QUALITY IN THE MINSAR RIVER BASIN, SAURASHTRA WESTERN INDIA

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Abstract

Gujarat has long coast line of around 1600 Kms. Most of the important ports and cities are developed along the coast. Porbandar is one such town in western parts of Gujarat. The total geographical area is 2261.95 Sq. Kms, comprising of three Talukas, Porbandar, Ranavav and Kutiyana. The climate of the district is semi arid type. The temperature ranges between 35 to 40 degrees during summer and 8 to 18 degrees during winter season. The average rainfall of the district is 613.54mm for the period of 1981 to 2007. The area is drained by Vartu, Bhadar, Kalindri and Minsar rivers. Industrial development, increased demand of water for agricultural produce and the growth in population has increased the requirement for water. The main sources of water are dams, reservoirs etc. on surface and ground water as subsurface water. Study was required to check the ground water potential of Minsar Basin and find out the difference between coast and mainland groundwater potential around Minsar Basin. Also Analysis of effect of water quality degradation due to salt water intrusion/ingression in Porbandar District with particular reference to Minsar Basin was carried out. To neutralize the impact tidal regulators on creeks, check dams on streams & channels, percolation tanks, nalabunds & spreading channels are made which resulted good impact on dilution effect.

[Keywords: Groundwater, water quality, sea water ingression]

Introduction

Gujarat has got a long coast line of about 1600 Km. Most of the important ports and cities are developed along it. Porbandar is one such town in western parts of Saurashtra. Bordering Porbandar is Arabian Sea. It is located between North Latitudes $21^{\circ} 00'$ & $22^{\circ} 20'$ and East Longitudes $71^{\circ} 22'$ & $72^{\circ} 20'$. The total geographical area is 2261.95 Sq. Km. The district comprises of three Talukas Porbandar, Ranavav and Kutiyana with geographical areas of 1170.6, 588.00, 556.35 sq. Km. respectively. The climate of the district is semi arid type. The temperature ranges between 35 to 40 degrees during summer and 8 to 18 degrees during winter season. The average rainfall of the district is 613.54mm for the period of 1981 to 2007. The area is drained by Vartu, Bhadar, Kalindri and Minsar rivers. [1], [3], [4], [13], [14].

Industrial development, increased demand of water for agricultural produce and the growth in population has lead to more and more requirement for water. The main sources of water are dams, reservoirs etc. on surface and ground water as subsurface water. The pressure on ground water has become more so with the increased demand from agriculture, industrial development and drinking water. About 70% of the total demand is met with ground water.[2], [7], [8].

Taluka	Geographical area	Av rainfall	Gross Draft	GW balance	Level of Development	Category
Kutiyana	556.35	625	43.1	24.84	62.83	Safe
Porbandar	1117.6	647	65.13	-6.88	112.33	Overexploited
Ranavav	588	670	53.51	30.34	63.36	Safe

The scenario of ground water development as per Groundwater Recharge (GRE) report 2007 of Porbandar District is as above. [2], [13], [14].

The sea water and the inland fresh ground water remain in a balanced condition. The rainfall, drainage and the artificial recharge structures enrich the ground water pushing/maintaining the status quo. The extraction of ground water within the recharge limit has no effect on sea water or wedge movement towards inland or otherwise it moves inland resulting in saline water withdrawal. [4], [6].

The movement of ground water is governed by the formation in which it flows. The sandy formation is found near coast line, thereby Miliolitic limestone, Gaj beds and hard basalt rock further inland. To study the movement of groundwater, its behavior, chemical mixing with saline water of sea and the remedial measures so far adopted and further suggestions Minsar river basin is selected. [5], [9], [11].

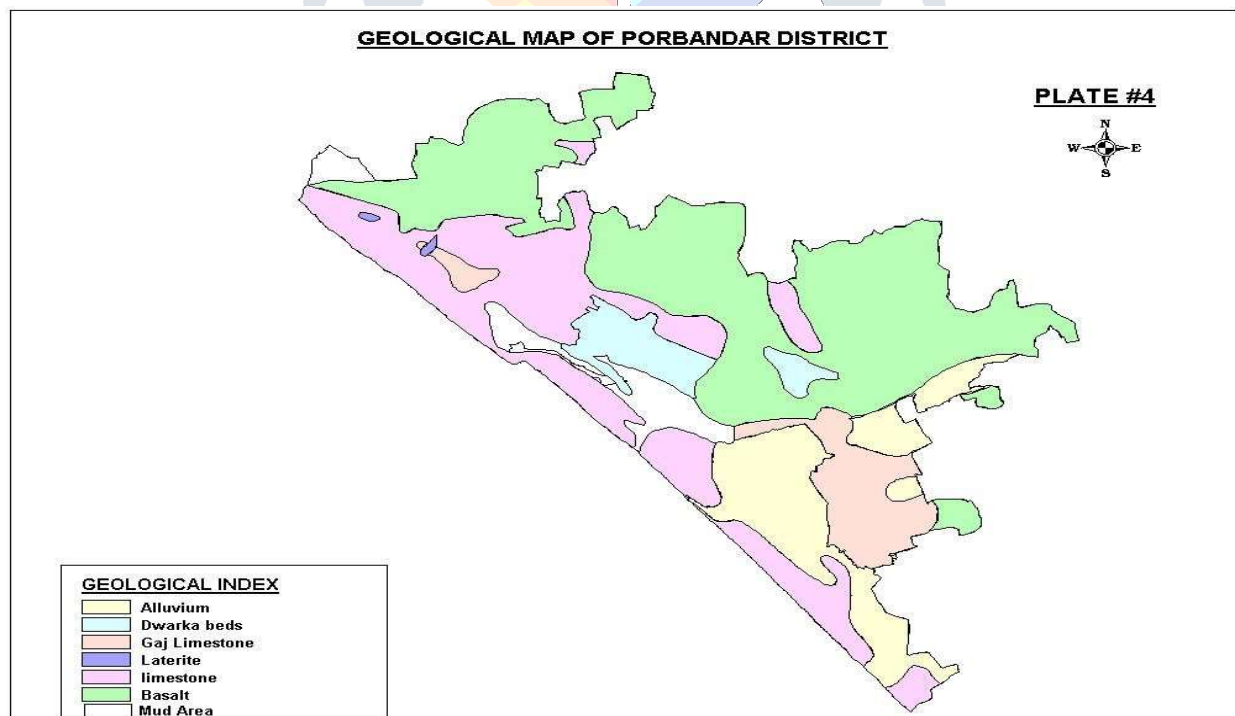
Mehodology

Literature was collection related to the Groundwater of Study Area. Drainage Map of Study Area was prepared. Water samples were taken and Chemical analysis of water sample was carried out to establish the impact of sea water ingress and its impact on water quality was established. Interpretation of Water Potential of Costal and Mainland was done for the optimum utilization of the water for various purposes.

Geology and Geomorphology of the area

The oldest rock formation found in the district is Deccan trap basalt of Cretaceous to Eocene age. This hard rocky formation is covering the upper inland part of the district. The supra trappen comprising laterite are found to occur in some scattered patches overlain by Miliolitic Limestone and Gaj clay. [1], [13], [14].

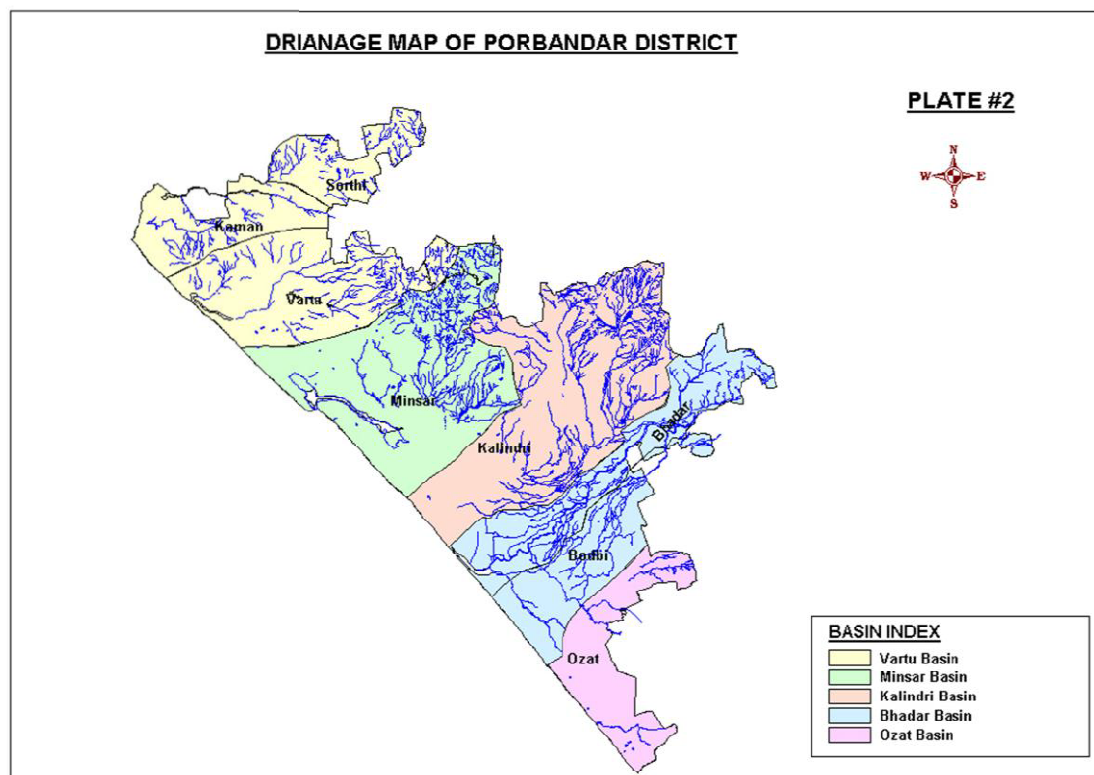
In central tract the Deccan trap is overlain by lower Miocene Gaj beds comprising limestone and clay and in time overlain by Miliolitic limestone of Pleistocene to sub-recent age. At few places sub recent to recent alluvial deposits and Dwarka beds found scattered and at the top Miliolitic limestone and clay.



Drainage of the area

The Sub main basins (Rivers) persists in this districts are Vartu (Vartu, Sorthi and Kaman), Bhadar (Bhadar and Bodbi), Ozat , Kalindri and Minsar.

<u>Sr.No</u>	<u>DRAINAGE BASINS</u>	<u>AREA- Square Kilometers</u>
<u>1</u>	<u>Sorthi</u>	<u>118.10</u>
<u>2</u>	<u>Kaman</u>	<u>156.6</u>
<u>3</u>	<u>Vartu</u>	<u>328.90</u>
<u>4</u>	<u>Minsar</u>	<u>499.20</u>
<u>5</u>	<u>Kalindri</u>	<u>568.70</u>
<u>6</u>	<u>Bhadar</u>	<u>266.60</u>
<u>7</u>	<u>Bodatri</u>	<u>196.60</u>
<u>8</u>	<u>Ozat</u>	<u>187.00</u>
	<u>Total</u>	<u>2321.70</u>



Water Sample data

The study area is monitored for ground water quality changes through active observation wells located along the geophysical profiles fixed since 1980 onwards by GWRDC. In Porbandar district groundwater occurs 1.25 m to 35.0 m from below ground level in the wells having a depth range of 4.80 m to 40.00 m. Discharge from the dug wells ranges between 100 m to 350 m. [9], [11], [12].

ISO TDS CONTOUR PRE MONSOON 2007

Details of observation well in Minsar river basin area								
Sr no	Well no	Village	taluka	Swl{m}	Td{m}	Tds{ppm}	Lithology	Depthto {m}
1	Jnd-016	Adityana	Ranavav	8.30	40.00	770	limestone	40.00
2	Jnd- 019	Bhod	Ranavav	8.65	30.50	1120	Topsoil Limestone fractured basalt	1.20 28.00 30.50
3	Jnd- 022	Devada	Kutiyana	14.10	29.60	1130	Topsoil Limestone limestone	1.70 15.70 29.60
4	Mp-39	Pipaliya	Ranavav	3.30	10.25	590	basalt	1.07
5	k-001	Kuchadi	Porbandar	3.00	3.70	4050	Limestone hard	3.70
6	k-005	Degam	Porbandar	10.90	16.30	3810	limestone	17.40
7	k-010	Kantela	Porbandar	3.00	5.30	2970	limestone	5.50
8	Mp-42	Ratanpar	Porbandar	3.50	5.20	4020	m.l.st	5.70
9	Mp-44	Chaya	Porbandar	2.10	2.65	4240	m.l.st.	2.85
10	Jnd-010	Tukda	Porbandar	1.70	5.40	7060	Lst	5.40

Conclusion

The area receives good rainfall form last three years due to western disturbances. The tidal regulators on creeks, Check dams on streams & channels, percolation tanks, nalabunds & spreading channels have resulted good impact on both water table & ground water quality (Dilution effect). The rainfall & recharge structures, have progressively reduced & controlled the Sea water ingression.

One of the most effective ways of combating saltwater intrusion is to regulate pumping activities. Generally speaking, the amount of groundwater extraction should not exceed that of natural replenishment. Optimization of pumping patterns to maximize the yield and minimize the extent of intrusion is a high-priority management issue. Recharge of natural surface water or reclaimed wastewater into aquifers can increase the freshwater outflow rate to push back the saltwater wedge. A recharge near the coast can build a local freshwater mound that forms a barrier to protect the water table depression inland. Extraction of saltwater in an invaded saltwater wedge can also protect the freshwater behind, if a proper way can be found to dispose of the extracted saltwater.

A similar method involving pumping simultaneously in the upper freshwater zone and the lower saltwater zone to prevent upconing, known as double pumping, has been attempted. Using collector wells (horizontal wells) to skim the thin layer of freshwater floating on top of the saltwater wedge has been effectively used in countries such as Israel which can also be implemented up here. Land reclamation has the added effect of pushing saltwater to the sea. Finally, in places

where large freshwater springs flowing to the sea can be identified, physical barriers, such as solid walls or slurry curtains, can be used to intercept freshwater.

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