जल वर्ष 2007 Water Year 2007

स्वच्छ सुरक्षित जल – सुन्दर खुशहाल कल

CONSERVE WATER - SAVE LIFE

CENTRAL GROUND WATER BOARD

Ministry of Water Resources

Government of India

GROUNDWATER SCENARIO

HANUMANGARH DISTRICT,

RAJASTHAN

Western Region

Jaipur

December, 2007

DISTRICT AT A GLANCE – HANUMANGARH, RAJASTHAN

S No	Item	Statistics	
1	**GENERAL INFORMATION**		
	(i) Geographical area (sq km)	9656.09	
	(ii) Administrative Division (As on 31.3.2007)		
	Number of Tehsils	(7)	
	Number of Blocks	(3)	
	Number of Villages	1906	
	(iii) Population (As per 2001 Census)	1517390	
	(iv) Average Annual Rainfall (1986-2005) in mm	253.70	
2	**GEOMORPHOLOGY**		
	Major Physiographic Units	Alluvial Plains, Flood Plain, Dune Complex, Inter-dunal Depression	
	Major Drainage	Ghaggar River	
3	**LAND USE (ha)**		
	(a) Forest Area	9673.00	
	(b) Net Sown Area	788200	
	(c) Cultivable Area	895982	
4	**MAJOR SOIL TYPE**	Yellow brown soil, Black, soil, Red Loam	
5	**AREA UNDER PRINCIPAL CROPS** (As on 2005)	Crops	Area in ha
		Cotton	117060
		Oil Seeds	165560
		Pulses	87128
		Wheat	178519
		Gram	232136
		Barley	9457
		Bajra	116151
6	**IRRIGATION BY DIFFERENT SOURCES**		
	Source	No of structure	Area in ha
	Dug wells	2531	32868
	Tube wells/Bore wells	17784	
	Tanks/Ponds	Nil	Nil
	Canals	-	268180
	Other Sources	-	-
	Net Irrigated Area (sq km)	301048	
	Gross Irrigated Area (sq km)	538226	
7	**NUMBER OF GROUND WATER MONITORING WELLS OF CGWB** (As on May 2007)		
	Number of Dug wells	35	
	Number of Piezometers	06	
8	**PREDOMINANT GEOLOGICAL FORMATIONS**	Alluvium. Sandstone	

9	**HYDROGEOLOGY**	
	Major Water bearing formation	Younger Alluvium
	Depth to water level (Pre-monsoon, 2006) (mbgl)	5m to 30m
	Depth to water level (Post-monsoon, 2006) (mbgl)	2m to 20m
	Long term water level trend (1997-2006) in m/yr	0.65 to 1.16 (Rise)
10	**GROUNDWATER EXPLORATION BY CGWB** (As on 31.3.2007)	
	Number of wells drilled (EW, OW, Total)	EW-24, OW-2,Total-37
	Depth Range (m)	100 - 150
	Discharge (liter per minute)	100 - 2000
	Transmissivity (m^2/day)	500 - 1500
11	**GROUND WATER QUALITY**	
	Presence of chemical constituents more than permissible limit (EC>1500 mmhos/cm at 25^0 C, F>1.5 mg/l, Nitrate>45.0mg/l)	EC - 4000 sq km F – 1730 sq km Nitrate– 1445 sq km
	Type of water	Mix Bi-Carbonate
12	**DYNAMIC GROUND WATER RESOURCES (March, 2004) in mcm**	
	Annual Replenishable Ground Water Resources	191.9700
	Net Annual Ground Water Draft	162.0140
	Projected Demand for Domestic and Industrial Uses up to 2025	11.0688
	Stage of Ground Water Development	84.40%
13	**MAJOR GROUND WATER PROBLEMS AND ISSUES**	Water Logging Salinity in ground water Pollution in ground water

GROUND WATER SCENARIO
DISTRICT -HANUMANGARH, RAJASTHAN

1.0 Introduction

Hanumangarh district is located between 28^{o} 45$^{'}$ 35" and 29^{o} 57'25" latitude and 74^{o} 17$^{'}$ 51"and 74^{o} 31$^{'}$ 04" longitude covering an area of 9659.09 sq.km. The district is part of Bikaner Division. Administratively the district is divided into 7 tehsils and 3 development blocks.

Total number of villages in the district is 1906 and 6 urban town. Rural and Urban population of the district is 12.14 lakh and 3.04 lakh respectively.

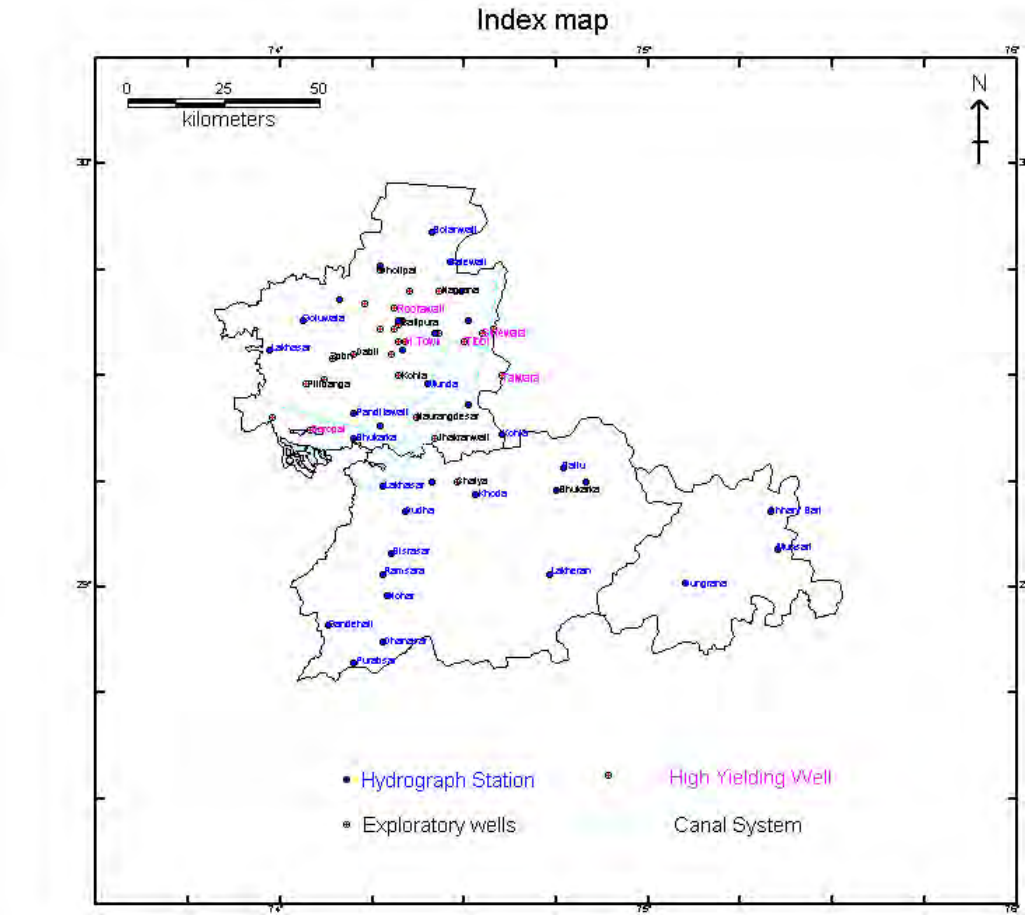
Systematic Hydrogeological survey in the district was carried out by Central Ground Water Board from 1972 to 1978. Reappraisal hydroeological survey in parts of district was carried out during 1983-84 & 2001-02. Under exploratory programme 37 exploratory boreholes have been drilled. Since 1973, monitoring of water level is being carried out four times a year from 39 National Hydrograph Network Stations.

2.0 Rainfall & Climate

Average annual rainfall (1977-06) of the district is 253.7mm. However normal rainfall for the period 1901 to 1970 is 287.8 mm. The annual rainfall gradually decreases from southern part to northern part. The maximum average rainfall is 410.9 mm at Bhadra and minimum average rainfall is 246.2 mm at Hanumangarh.

The climate of the district is semi-arid except S-W monsoon season. The cold season is from December to February and is followed by summer from March to June. From mid of September to end of November constitute post monsoon season.

The district experiences either mild or normal drought once in two years. Severe type of drought has been recorded frequently. Most severe type of drought has been experienced only once in 1969.



3.0 Geomorphology

The district is a part of Thar desert and is covered by thick layer of alluvium and wind blown sand. The sand dunes are 4 to 5m in height. The regional elevation of ground ranges from 100 to 300 m amsl. The district has a regional slope of 5m/Km. Geomorphologically the district is divided into following units

Origin	Land Forms	Occurrence in the District
Fluvial	Alluvial Plains	North of Ghaggar River
	Flood Plain	Along Ghaggar River
	Water Logged Area	Central Part of the District
Aeolian	Sandy Plain	Scattered in northern & concentrated in southern part
	Eolian plain	Scattered in central & southern part
	Dune Complex	Scattered in eastern and western margin
	Interdunal Depression	Scattered in south-east and south-west
	Interdunal Flat	Scattered in west, south-west, & southern part

Drainage:

The Ghaggar river is the only major river in the district which locally known as Nali and has northeast to southwest course and finally it enters in Pakistan. It is an ephemeral drainage, which some time gets flooded during monsoon.

The district is drained by canal of (1) Bhakra canal system and (2) Indira Gandhi Nahar Priyojana and (3) Sidmukh Canal system.

Bhakra Canal System: Bhakra canal system utilizes water of Sutlej and Beas river. Rakasthan share in Sutlej water is 2096 Mm3/yr. It provides irrigation to 372,000 ha through a total of 1,949 Km of canal network.

Indira Gandhi Nahar Priyojana: Indira Gandhi Nahar Priyojana is a multi-disciplinary irrigation project conceived to use 10.6BCM of water available from Ravi and Beas annually to cultivate 1087mha of land in Thar Desert of western rajasthan.

Sidmukh Nohar canal System: It is an irrigation project planned to provide irrigation in Nohar and Bhadra tehsils by utilizing Rajasthan's share in Ravi and Beas waters.

4.0 Soils & Irrigation Practices

The northern part of the district is covered by arid soils which are characterizes by alluvial soils. These soils are loamy to sandy loam in character. Central part of the district is characterized by entisols i.e. desert soils which is loamy along Ghaggar river course. Southern part of the district is characterized by arid soils i.e. non-calcic brown desert.

Irrigation:

The principal means of irrigation in the district is through canals, though some areas are irrigated by well / tube-wells. Surface water is the main source of irrigation and is utilized through canal network. Groundwater irrigates only a small area. Details of the gross irrigated area by different sources have been given below:

(Area in Ha)

Tehsil	Well	Tanks	Canals	Other Sources	Total
Bhadra	25389	-	14538	-	39927
Hanumangarh	10584	-	133159	-	143743
Nohar	16149	-	17001		33150
Pilibanga	1742	-	92044	-	93786
Rawatsar	1616	-	58361	-	59977
Sangaria	68	-	67429	-	67497
Tibbi	6134	-	94012	-	100146

5.0 GROUNDWATER SCENARIO

Geological Framework

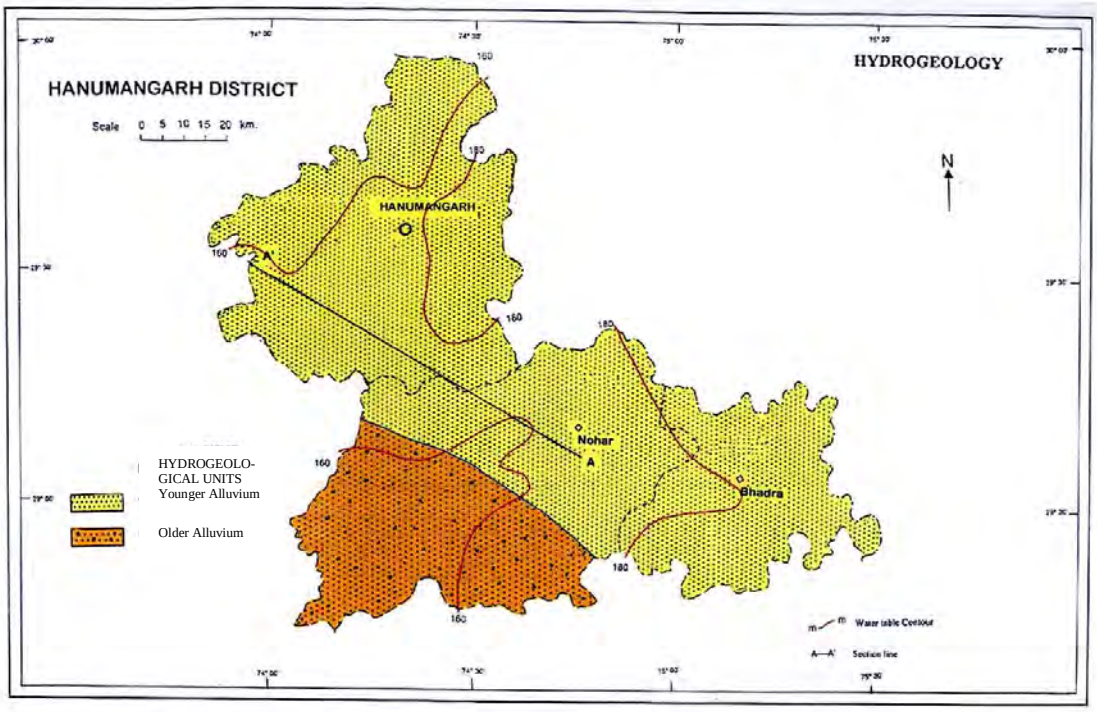
The entire Hanumangarh district is covered by quaternary alluvium overlain by thin veneer of wind blown sand. Quaternary alluvium is mostly fluvial in origin and consists of alternating sequence of sand, silt and clay. The thickness of alluvium varies from 100m in the southern part to over 400m in the northern part. The basement below alluvium consists of rocks belonging to Palana series and Nagaur group of Marwar Super group. Basement rocks consist of claystone, sand stone and basal evaporities sequence.

Hydro-geological Condition:

Hanumangarh district is divided into two units i.e. Younger Alluvium and older alluvium. Younger Alluvium covers maximum area of the district where as older alluvium is found only southern part of the district. The groundwater in the district occurs under water table condition but at few places it also occurs under semi-confined conditions due to presence of over lying impermeable clay horizons.

Younger Alluvium

It comprises of unconsolidated to loosely consolidated sediments of sand silt, clay and kankar. It forms the principle aquifer and all potential zones fall in this hydrogeological unit. Almost all tehsils have younger alluvial formation except Rawatsar.



Older Alluvium

It comprises sandy and gypseous clay with kankar. It occurs in the southern parts of the district. The older alluvium does not contain any potential zone.

Aquifer Parameters

Based on groundwater exploration transmissivity of the aquifer ranges from 100 m^2/day to 1600m^2/day. Transmissivity and permeability values are higher around Ghaggar Flood plain area and decreases away from it.

Average yield of dug wells, dug-cum bore wells and tube wells in different hydrogeological formations are summarized below:

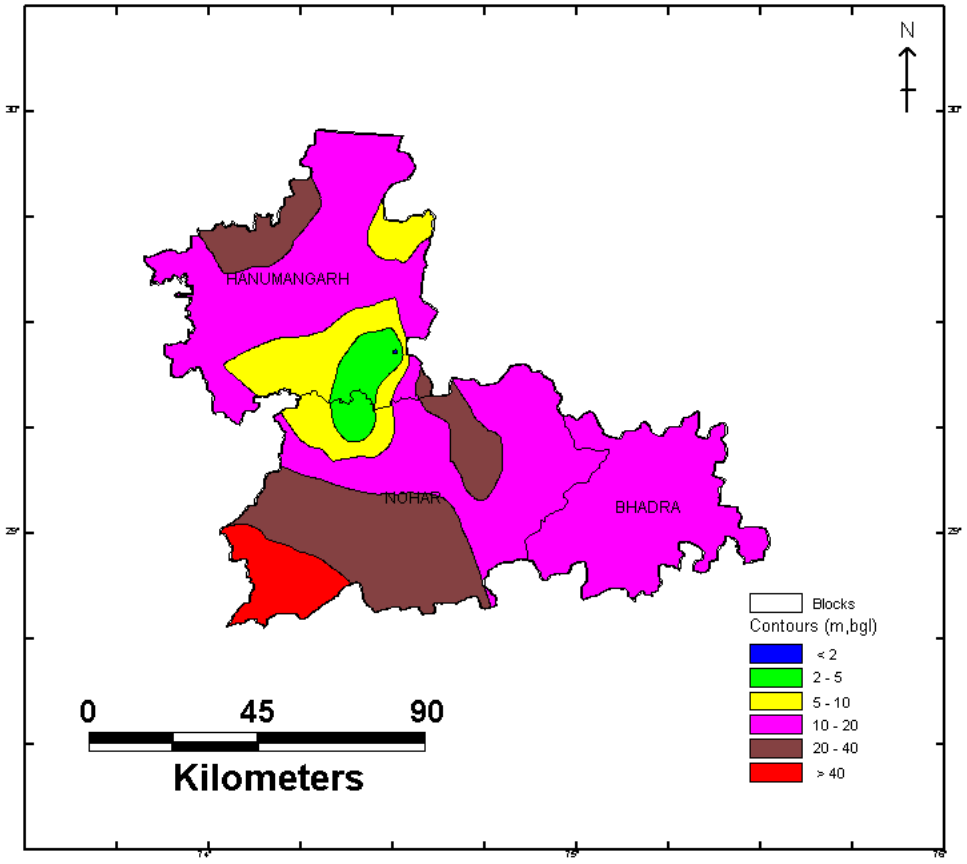
Formation	Average Yield (L/day)	
	Dug Well	DCB / TW
Younger Alluvium	20,000	3,00,000

Depth to Water Level (Pre Monsoon 2006)

The depth to water level varies widely depending upon topography, drainage, bedrock geology etc. Depth to water varies from less than 2m at Masitawali to more than 50m at Dudhal in Nohar block. Groundwater is deeper in southern part of Nohar and is generally shallower in remaining parts of the district. In general DTW varies from 5m to 30m, bgl. . Based on NHS data regional depth to water level map for May 2006 is shown below

Block	Depth to Water (m,bgl)		No / Percentage of Wells Showing Depth to water in Range of					
	Min	Max	0 – 2	2 – 5	5 – 10	10 – 20	20 – 40	>40
Bhadra	12.96	19.37	0	0	0	4 100%	0	0
Hanuman garh	1.84	24.80	1 4.76%	0	4 19.05%	12 57.14%	4 19.05	0
Nohar	2.72	48.94	0	1 7.14%	2 14.29%	2 28.57%	4 28.57	3 21.43

Depth to Water Level (Pre-Monsoon) 2006

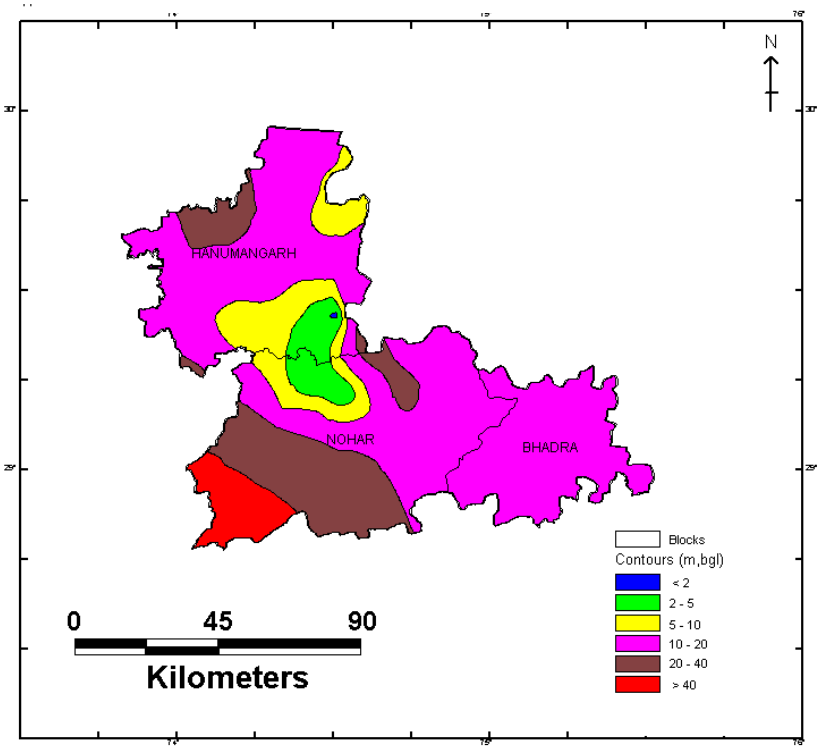


Depth to Water Level (Post Monsoon 2006)

During Nov.06 water level ranges widely from less than 2M to more than 40m bgl. Water level is shallower in central and northeastern part of the district. In general DTW varies from 10m to 20m in Bhadra block, between 5m to 50m in Nohar block and less than 2m to 30m in Hanumangarh block. Based on NHS data regional depth to water level map for Nov. 2006 is shown below:

Block	Depth to Water (m,bgl)		No / Percentage of Wells Showing Depth to water in Range of					
	Min	Max	0 – 2	2 – 5	5 – 10	10 – 20	20 – 40	>40
Bhadra	12.78	18.81	0	0	0	4 100%	0	0
Hanuman garh	1.67	25.05	1 4.76%	1 4.76%	3 14.29%	13 61.90%	3 14.29%	0
Nohar	2.11	48.60	0	2 16.67%	1 8.33%	2 16.67%	4 33.33%	3 25.00%

Depth to Water Level (Post- Monsoon) 2006



Water Level Fluctuation

Seasonal fluctuation in water level based on Pre and Post-monsoon 06' indicate that there has been rise in water level in Bhadra block and in parts of Nohar and Hanumangarh block. Decline in water level has been observed in central part of the district comprising parts of Hanumangarh and Nohar blocks.

Block	Water level fluctuation (Pre– Post), 2006			
	Rise		Fall	
	Min	Max	Max	Max
Bhadra	0.18	0.56	0.13	0.40
Hanumangarh	0.17	1.61	0.27	1.86
Nohar	0.12	7.69	0.10	3.89

Decadal (1997-06) water level trend has been worked out for Pre and Post Monsoon and has been given below. On comparing water level data majority of monitoring stations falling in Nohar and Bhadra block show rising trend ranging from 0.67m/yr to 1.159m/yr during pre-monsoon. Rising water level trend is also observed in parts of Hanumangarh block. During post-monsoon decadal trend, show rise in water level ranging from0.21m/yr to 0.48m/yr in Bhadara and Nohar block and decline of 0.086 to 0.51m/yr has been observed in parts of Hanumangarh and Nohar block. Block wise Pre and Post- monsoon decadal trend is as follows

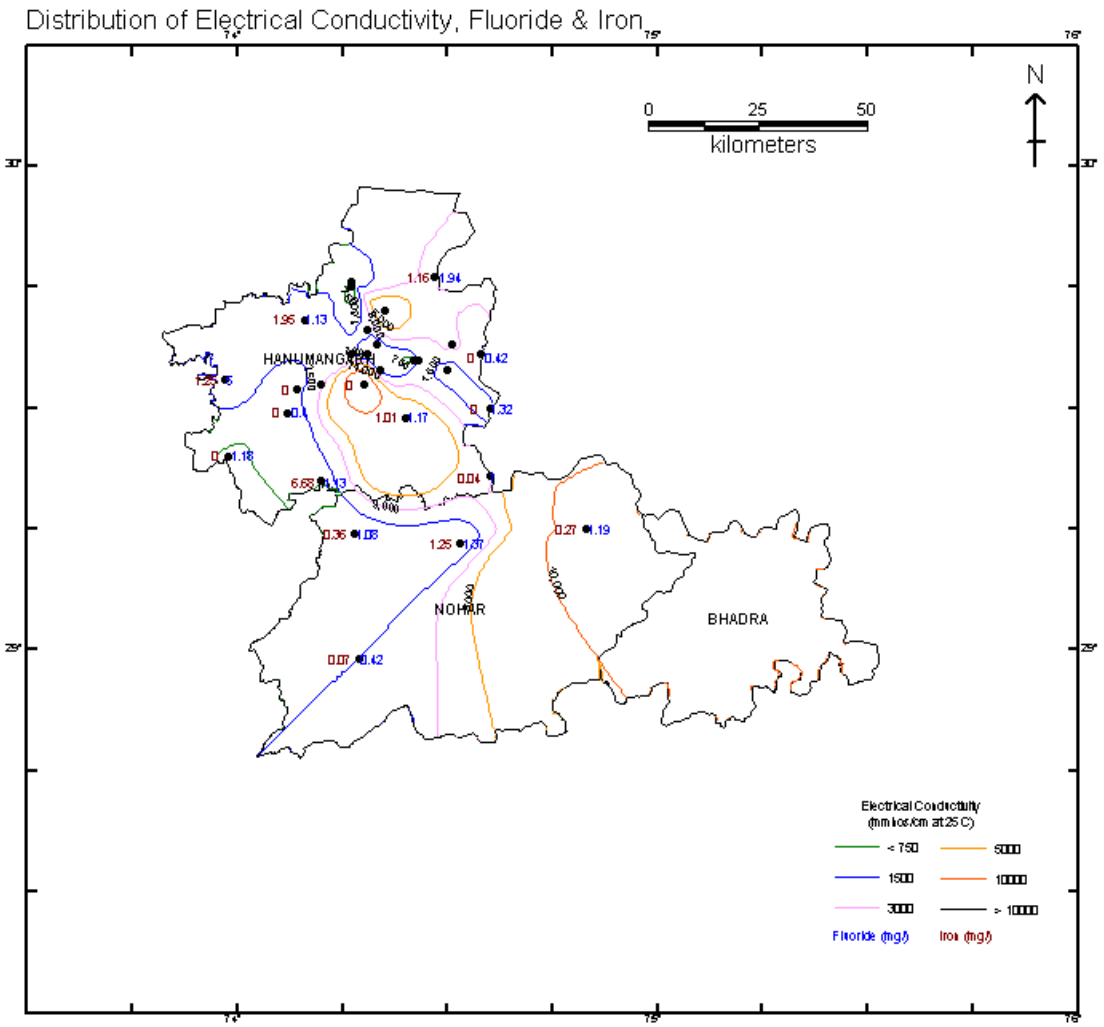
Block	Pre Monsoon Trend (m/yr)		Post Monsoon Trend (m/yr)	
	Rise	Fall	Rise	Fall
Bhadra	0.39	0.22	0.21	-
Hanumangarh	0.365	0.51	0.48	0.61
Nohar	0.49	0.02	0.39	0.086

Groundwater Quality

Water Quality in Shallow Aquifer

The native groundwater in Hanumangarh district is saline and occurs in 65% of the area. Only 18% area yields water of salinity less than 4000

mmhos/cm at 25^0C. Seepage from canals has improved the quality of pheratic aquifer.



Slightly saline groundwater (EC< 4000mmhos/cm at 25^0C) occurs from Nohar to Jhansal in the east and Pilibanga to Hanumangarh in NW. Moderately saline groundwater is found in NE and SE of Hanumangarh and NE of Nohar.

The Chloride content varies from 43 ppm to 3231ppm. High Chloride content (>250ppm) has been observed at Nohar, Masitawali, Panniwali, Rawatsar and Bisrasar. . The concentration of carbonate varies from negligible to 84ppm and bi-carbonate varies from 98 ppm to 150 ppm.

Fresh to moderately saline water is free from fluoride concentration. High fluoride content (>3.0 mg/l) are associated with saline groundwater west of hanumangarh. About 75% of the district falls under safe unit of fluoride in ground water.

The nitrate distribution in Hanumangarh block is mostly within permissible limit (<100 mg/l). Higher value of nitrate is observed in south of Nohar and SW of Bhadra. Maximum value of nitrate (840 ppm) is observed at Lakhera in Nohar block.

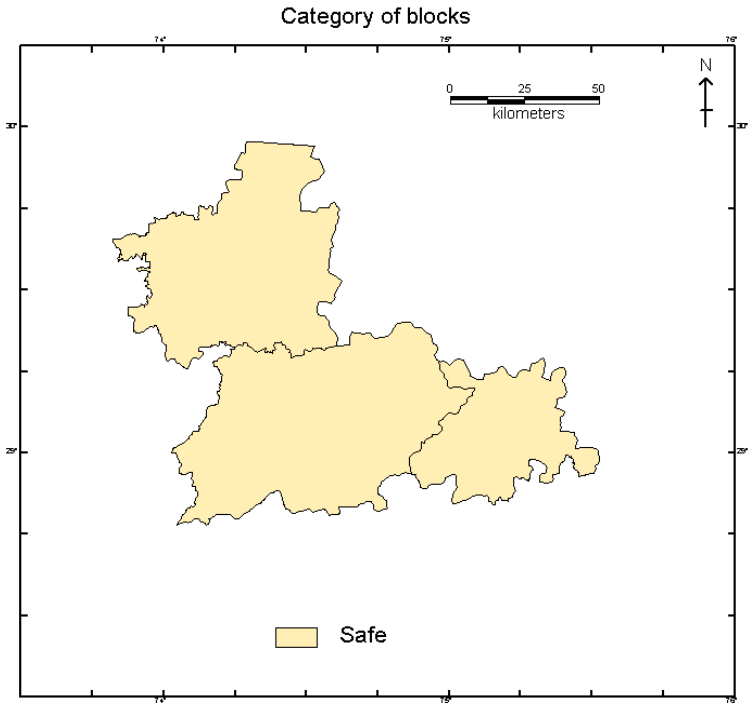
The quality of pheratic aquifer has improved along major canals and distributaries upto a depth of 60m.

Water quality in Deep Aquifer

Chemical analysis of water samples collected from tubewells show that salinity increases with depth. The deep groundwater is highly saline and cannot be used for any purposes. High value of nitrate and fluoride has also affected the potability of groundwater. However groundwater with EC < 5000 mmhos/cm at 25^0C can be used for domestic purposes after blending with fresh water so that level of health affecting constituents fall within safe/ permissible limit.

6.0 Groundwater Resources

Groundwater resources have been estimated as per the norms recommended by GEC 97. While assessing the ground water resources saline and hilly areas have not been considered. Total groundwater resources based on water level fluctuation method is estimated to be 191.97mcm. Draft for



all use is 162.0140 mcm and over all stage of development is 84.40%. Summarized block wise estimate of dynamic groundwater resources is given below:

Sl. No.	Assessment Unit/District	C/ NC/ Total	Net Annual GW Availability	Gross GW Draft irrigation	Gross GW Draft for Dom& Ind	Gross Ground Water Draft for All uses	Stage of Ground Water Development
1	BHADRA	C	19.1729	10.11	0.6125	10.7225	55.93
		C (s)	50.9478	14.3694	0.035	14.4044	28.27
		NC(s)	39.8122	0	0	0	0
		Total	**113.9329**	**29.4794**	**6.6475**	**32.1269**	
2	HANUMANGARH	C	147.0983	126.2685	4.41	130.6785	88.84
		C	15.8461	13.716	0	13.716	86.56
		C(s)	416.5559	117.3006	0.119	117.4196	28.19
		Total	**579.5003**	**257.2851**	**4.529**	**261.8141**	
3	NOHAR	C	9.8527	6.897	0	6.897	70
		C (s)	134.9922	34.9704	0.049	35.0194	25.94
		NC(s)	25.175	0	0	0	0
		C (s)	11.7939	3.861	0	3.861	32.74
		NC(s)	43.6241	0	0	0	0
		Total	**225.4379**	**45.7284**	**0.049**	**45.7774**	
DISTRICT TOTAL			**918.8711**	**332.4929**	**11.2255**	**339.7184**	
Avg. of District (Including Saline Area)			**722.9011**	**170.5014**	**0.2030**	**170.7044**	**23.61**
Avg. of District (Excluding Saline Area)			**191.9700**	**156.9915**	**5.0225**	**162.0140**	**84.4**

7.0 *Status of Groundwater Development*

The principal aquifer in the district is alluvium comprising sand, silt, clay, and gravel. It thickness varies from 100m to 400m. The bed rock below alluvium consists of palana or Nagaur series of rocks, which do not outcrop anywhere in the district. Groundwater occurs both under water table and confined conditions.

Shallow Water Table Aquifer: The thickness of water table aquifer varies from few meters to about 80m. Depth to water varies from near surface to about 50m, being 20m in Ghaggar flood plain. Dug wells tapping the water table aquifer in Hanumangarh district ranges in depth from 10m to 25m with drilling to an additional 40m tapping deeper semi-confined aquifer.

Deeper Confined Aquifer: CGWB has carried out ground water in Hanumangarh district. Confined aquifer is found both in alluvium and under lying Palana and Nagaur sandstone. The first confined aquifer is encountered at depths ranging from 90 to 100m.

*Yield of Wells:*The yield of dug-cum-bore wells is reported to be between 42 to 110 m^3/hr. The yield from tube wells is about 7 to 70m^3/hr. transmissivity of aquifer varies from 100 to 600 m^2/day, reaching maximum in Ghaggar flood plain. Yield of wells in confined aquifer vary from 20m^3/hr to 120m^3/hr for a drawdown of 15m. Transmissivity varies from 100 to 3000 m^2/day.

Block	Formation	Type of Aquifer	Avg. Yield m^3 / day	
			Dug Well	DCB / TW
Hanumangarh	Alluvium	Unconfined	20	170
		Confined	-	500
		Combined	-	450
Nohar	Alluvium	Unconfined	20	180

Urban and Rural Water supply

Since the native groundwater of entire district is brackish to saline except in small pockets the urban and rural water supply schemes primarily depend upon surface water source. The daily water supply for six urban tehsil area is 21770*10 ^{3} Liters in which maximum requirement is fulfilled from surface water supply through Bhakra canal and Indira Gandhi canal system. Urban areas of

Hanumangarh and Pilibanga have water supply schemes from groundwater. Rest of urban areas i.e. Sangaria Nohar, Bhadra, and rawatsar entirely depend upon surface water source.

URBA AREA	Present population (in lac)	Water Supply (Lts/ day)	Demand (Lts/ day)	SOURCE	
				Surface (lits/day)	Sub Surface (lits/day)
Hanumangarh	1.2	$8500*10^3$	$9140*10^3$	$3500*10^3$	$2000*10^3$
Sangaria	0.34	$2500*10^3$	$2780*10^3$	Total from surface water (Bhakra canal system)	
Pilibanga	0.33	$1920*10^3$	$3200*10^3$	$1800*10^3$	$120*10^3$
Nohar	0.42	$4000*10^3$	$3300*10^3$	Total from surface water (IGNP& Bhakra canal system	
Bhadara	0.35	$3600*10^3$	$2900*10^3$	Total from surface water (Bhakra canal system	
Rawatsar	0.28	$1250*10^3$	$2200*10^3$	Total from surface water (IGNP canal system	

8.0 Ground Water Development Strategy

Ground Water Development

Groundwater estimation reveals that in Bhadara, Nohar and Hanumangarh blocks falls under safe category. The balance groundwater potential available can be developed through 112 wells/ tube wells at 100% stage of ground water development. Irrigation wells are required to be constructed in Ghaggar Plain area where groundwater is suitable for irrigation.

Well Design

The district is under lain by unconsolidated to semi-consolidated formations where direct rotary drilling is used for construction of wells. Tube wells of screened assembly with gravel pack are recommended in the area. The thickness of gravel pack may be 13 to 20 cms.

9.0 GROUND WATER RELATED ISSUES & PROBLEMS

Water Logging Hazard

Nineteen natural inter-dunal depressions are located in east of Hnumangarh district. These depressions are used to store excess floodwaters of Ghaggar river. As the depression is filled with water the area around depression experienced a sudden rise in ground water level causing wide spreed waterlogging condition. The specific areas affected by water logging are west of &SW of Baropal, SE & SW of Manaktheri, SE of Rangmahal, SW of Kalanwali Dhani.

Cause of Water Logging

Impoundment of Ghaggar floodwater in natural depression is the main cause of water logging. The physiographic situation of these villages is such that villages in this belt are located at lower altitude than the depression, which creates a steep gradient and sand dunes being pervious, causes heavy seepage which result in water logging conditions in surrounding areas.

Studies Carried Out by CGWB

Conjunctive use of surface and groundwater were under taken by CGWB during 92-95. The following recommendations were made

- To mitigate the problem of water logging ground water development should be 18% of canal water release at the head.
- A total of 10.023 shallow tube well be constructed in the command area.
- In areas where water level is shallow (< 10m,bgl) skimming wells are recommend.

Water Quality Hazard

There is a wide variation in the quality of ground water. The salinity varies from low (<1500 mmhos/cm) to very high (> 8000 mmhos/cm). Patches of very high EC are observed north of Hanumangarh town and SE of Suratgarh. The region comprising Ghaggar flood plain EC ranges from 300 to 3000 mmhos/cm indicating medium to low salinity of groundwater. EC of confined aquifer varies from 3000 to 3500 mmhos/cm. In the entire district the confined aquifer is saline except locally.

10.0 Recommendations

1. Agricultural potential in Hanumangarh block and NE of Bhadra block is high with respect ground water quality. Water having EC< 4000 mmhos occurs in 18.11% area which can be used for growing semi tolerant to salt tolerant crop. Saline ground water available in the district can be used for agriculture by blending with canal water or using in lean period.
2. In some areas fresh water cushions have been developed due to seepage of canal water accumulated over impervious formation. Therefore attempt has to be made to locate those points where maximum thickness can be ascertained and exploit ground water judiciously.
3. Anti water logging measures should be taken to avoid further water logging in the area east and south east of Suratgarh around natural depression.
4. It is strongly advocated that a massive ground water development may be launched especially in the Ghaggar flood plain area where the quality of ground water is suitable for irrigation.
5. Detailed geophysical survey may be conducted for demarcation of aquifer of fresh / saline water interface in the aquifer.
6. Rajasthan's share in River Yamuna amounts to 1,119Mm3 / yr. It is proposed to utilize 70% in Banganga basin. According to Tahal Consultants (1998) the amount of water transported to Banganga River basin should be restricted to 229Mm3 / yr and remaining 890 Mm3/yr to be utilized in Churu and Hanumangarh districts.
7. Modern agricultural management techniques have to be adopted for effective and optimum utilization of the water resources. Maintaining irrigation through minimum pumping hours as per minimum requirement of water by the crop and also selecting most suitable cost effective cropping pattern can achieve this.
8. 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.

9. Sewage reclamation should be an important part of the development of irrigation sector. It is required to avoid contamination of water resources. This source of irrigation water is highly reliable, albeit only for non-edible crops. The approx. area which can be irrigated with reclaimed sewage from town and cities are given below:-

City / Town	2005		2015		2045	
	Sewage water (10^3 m^3)	Area ha	Sewage water (10^3 m^3)	Area ha	Sewage water (10^3 m^3)	Area ha
Sangaria	1352	135	3373	337	12005	1200
Pilibanga	635	64	1567	156	5466	545
Rawatsar	544	54	1354	135	4796	480
Nohar	422	42	1054	105	3749	375
Bhadra	735	74	1815	181	6370	637
Hanumangarh	665	66	1648	165	5809	581

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