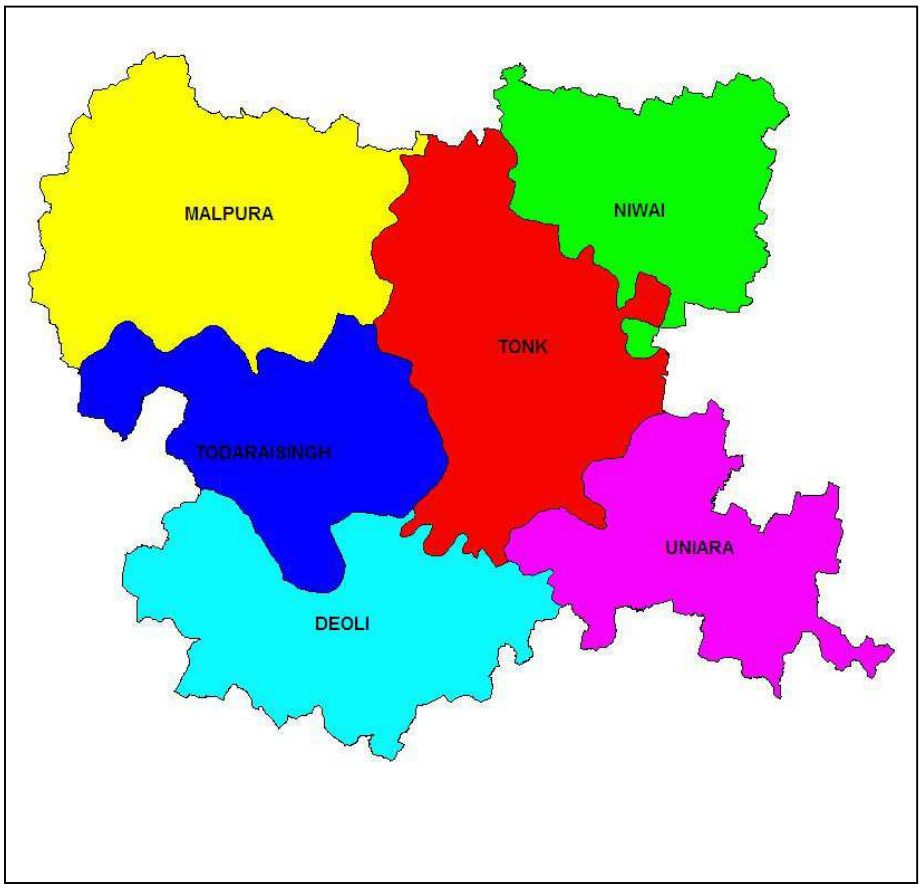
GOVERNMENT OF INDIA
MINISTRY OF WATER RESOURCES
CENTRAL GROUND WATER BOARD

GROUND WATER INFORMATION
TONK DISTRICT
RAJASTHAN



WESTERN REGION
TONK
2013

TONK DISTRICT AT A GLANCE

1. GENERAL INFORMATION

Geographical Area	:	7194 Sq. Km. (2.1% of the state)
Administrative Divisions	:	6
Villages	:	1089
Population (2011)	:	1421326
Average Annual Rainfall	:	668.3

2. GEOMORPHOLOGY

Major Physiographic unit	:	Flat to undulating small isolated ridges
Major Drainage	:	Banas River and its tributaries

3. LAND USE (2010-11)

Forest Area	:	26805 Hectare
Net Area Sown	:	484964 Hectare
Land Not Available for Cultivation	:	74946 Hectare
Other Uncultivated Land excluding Fallow Land	:	82557 Hectare
Fallow Land	:	48686 Hectare
Total Cropped Area	:	714832 Hectare
Area Sown more than once	:	229868 Hectare

4. SOIL TYPE : Sandy loam, Clayey loam

5. AREA UNDER DIFFERENT CROPS (2010-11) (ha)

Condiments & spices	:	5212
Fruits & vegetables	:	5464
Oil seeds	:	293953
Cereals	:	271091
Pulses	:	124348

6. IRRIGATION BY DIFFERENT SOURCES (2010-11)

		Net Area Irrigated (ha)	Gross Area Irrigated (ha)
Canal	:	20077	20085
Tank	:	1954	1961
Tubewells	:	6562	6686
Other wells	:	151385	154950
Other Sources	:	11148	11163
Total	:	191126	194845

7. GROUND WATER MONITORING WELLS (As on 31/03/2012)

Dugwells	:	17
Piezometers	:	12

8. GEOLOGY

Recent to Sub Recent	:	Alluvium comprising of sand, silt and clay
Archaean	:	Bhilwara Supergroup comprising of mica

schist, gneisses, phyllites and quartzites

9. HYDROGEOLOGY

Water Bearing Formation	:	Gneisses, schists/ phyllites and alluvium
Premonsoon Depth to Water Level (May-2011)	:	2.75 – 33.43 mbgl
Postmonsoon Depth to Water Level (Nov.-2011)	:	1.7 – 26.25 mbgl
Premonsoon Water Level Trend (2002-2011)	:	Rising trend - 0.0032 to 0.045 m/year Falling trend- 0.0088 to 0.078 m/year

10. GROUND WATER EXPLORATION (As on 31/3/2012)

Wells Drilled	:	19 EW, 4 OW, 8 PZ, 6 SH
Depth Range	:	18.5 – 203 m
Discharge	:	3 – 50 lpm

11. GROUND WATER QUALITY

Ranges of various constituents	:	EC - 447 to 12100 µS/cm at 25°C F – 0.175 to 20.3 mg/l Fe – 0.001 to 3.625 mg/l NO_3 – 2.58 to 254 mg/l

12. DYNAMIC GROUND WATER RESOURCES- (As on 31/03/2009)

Annually Replenishable Ground Water Resource	:	467.5235 MCM
Net Annual Ground Water Availability	:	424.8792 MCM
Annual Ground Water Draft (Irrigation+Domestic)	:	418.1517 MCM
Stage of Ground Water Development	:	98.42%

13. AWARENESS AND TRAINING ACTIVITY

A	Mass Awareness Programme	:	One
	Date	:	25.2.2009
	Place	:	Tonk
B	Water Management Training Programme	:	NIL

14. GROUND WATER CONTROL & REGULATION

Over-Exploited blocks	:	3
Semi-Critical blocks	:	3
Notified blocks	:	None

15. MAJOR GROUND WATER PROBLEMS AND ISSUES

Salinity and Fluoride

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1.0 Introduction

Tonk district is located in North- Eastern part of the state between 75° 07' to 76° 19' East longitude and 25° 41' to 26° 34' North Latitude and is covered in the Survey of India degree sheets 45 N, 45 O, 54 B and 54 C. The total geographical area of the District is 7194 sq km. The district comprises of 7 sub divisions viz. Tonk, Niwai, Deoli, Uniara, Malpura, Toda Raisingh and Piplu. It has seven tehsils viz. Tonk, Niwai, Deoli, Uniara, Malpura, Toda Raisingh and Piplu. There are six Panchayat Samities viz Tonk, Niwai, Deoli, Uniara, Malpura & Toda Raisingh. Total number of villages in the district is 1116 (2011 census). Rural & Urban population of the district is 1103603 & 317723 respectively. Decennial growth of population in the district is 17.3% since 2001. A map of the district showing block boundaries is presented as Fig. 1.

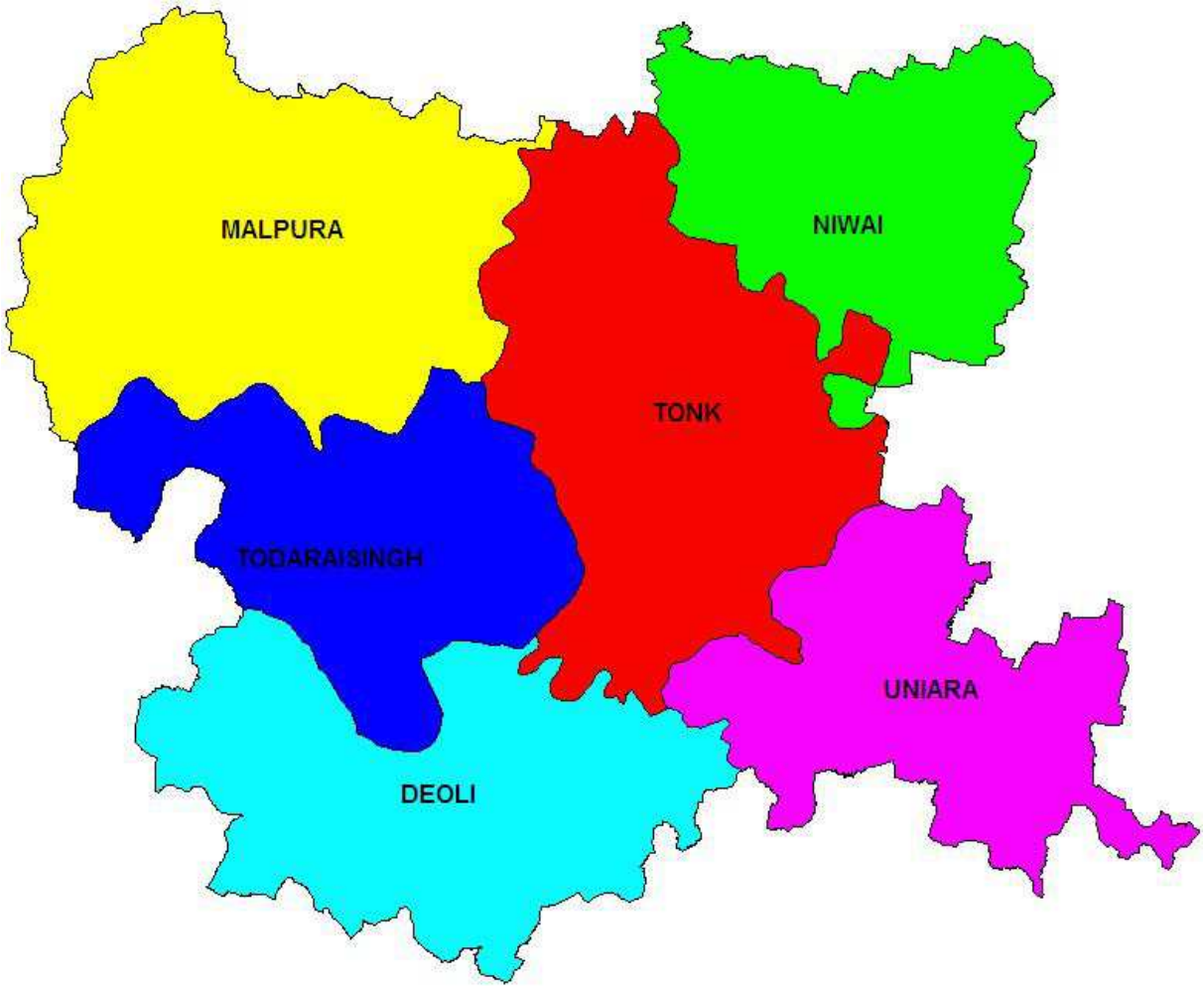

Fig. 1: Administrative map of Tonk district

Systematic hydrogeological surveys were carried out between 1964 & 1966 by the Geological Survey of India. These were continued by Central Ground Water Board during the period 1977- 79. The entire district has been covered under systematic hydrogeological surveys. During 1973-76, semi detailed survey of all the blocks was carried out by the Rajasthan Ground Water Department based on the guidelines of Agriculture Refinance Development Corporation. Reappraisal Hydrogeological

Survey of the entire district was carried out by CGWB in 2003-04.

Water levels from the National Hydrograph network stations existing in the district were monitored by the Geological Survey of India between the period 1969 to 1972 and the same are being monitored by the Central Ground Water Board since 1973. Water levels are monitored four times in a year during the months of January, May, August and November. Samples from monitoring ground water quality are collected from these network stations during the month of May. Central Ground Water Board has also been carrying out Ground Water Exploration in order to delineate potential aquifer zones and ascertain their yield characteristics. Salient features of ground water exploration in the district are given in Table 1.

Table 1: Salient features of ground water exploration.

Type of well	**No.**	**Depth drilled (m)**	**SWL (m)**	**Discharge (lpm)**	**EC (µS/cm) at 25°C**
EW	19	62.9-203	2.32 – 30. 03	50 – 1500	500 – 26000
OW	4	62.90 – 155.45	5.38 – 16.5	40 – 540	610 – 1800
PZ	8	145 – 197	2.45 – 19.9	30 – 110	800 – 7310
SH	6	18.5 – 40	10.6	40 – 100	1145 – 2480

2.0 Climate and Rainfall

The climate of the area is semiarid type. The normal annual rainfall (1901-70) of the district is 598 mm whereas the average mean annual rainfall during the period 2001 – 2010 has been 531 mm. It is evident that the rainfall in the district has significantly decreased in the recent past. The annual average rainfall has varied from 460.2 mm at Malpura to 590.04 mm at Tonk. Annual rainfall data of the district during the period 2001 – 2010 is presented in Table 2. Total annual Potential evapotranspiration computed by penman's method is 1725.0 mm. The potential evapotranspiration is the highest (255.0 mm) in the month of May and the lowest (68.0 mm) in the month of December.

Table 2: Annual rainfall data (2001-2010) (mm)

Sr. No.	BLOCK	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Average
1	JAMWA RAMGARH	800.00	270.00	620.00	597.00	533.00	369.00	500.50	937.00	281.00	562.00	546.95
2	MALPURA	443.00	181.00	520.00	450.00	540.00	272.00	452.00	629.00	294.00	821.00	460.20
3	NIWAI	477.50	167.00	756.00	584.00	548.00	313.80	388.50	693.00	583.00	515.90	502.67
4	PIPALDA	542.20	270.30	582.00	738.00	492.00	654.00	576.00	531.00	409.00	843.00	563.75
5	TODARAISINGH	586.00	236.00	655.00	978.00	646.00	369.00	484.00	678.00	200.00	600.00	543.20
6	TONK	630.60	219.65	700.20	610.50	551.90	528.50	566.30	508.00	515.50	1089.50	590.04
7	UNIARA		257.00	483.00	524.00	648.00	410.00	740.00	418.00	236.00	785.00	500.11
	Average	579.88	228.71	616.60	640.21	565.56	416.61	529.61	627.71	359.79	745.20	530.99

3.0 Geomorphology

3.1 Physiography

Physiographically, the area is characterized by general flat to undulating topography with small isolated ridges running in north- east to south-west direction between Gar and Banoli in the western part and the Aravalli hills towards Sawai Madhopur in the south-east. The general elevation of the plains ranges from 231 to 337 m above mean sea level and trends from south-west to north-east. The hills on the south-eastern side rise to a height of 518.46 m amsl. The Rajmahal and Tordi hills in the

west rise to elevation of 605.30 and 574.20 m amsl. In the central part there is a hill which runs for about 14 km between Chauth ka Barwara and Bhagwantgarh and rises to height of 150 to 180 m above the plains. Ridges of gneisses, schist and quartzite rising to height of 190 m above the plains are seen at Gaunri and Tonk. At Gaunri, these occur as isolated hills while at Tonk, they are found as clusters trending in NE-SW direction and extending up to Purtha. Small isolated hillocks are also seen at Um and Kabra. Except for these hills, the country is otherwise flat. On the bank of Banas river, there are sand dunes which rise to heights to 20 to 30 m above the plains.

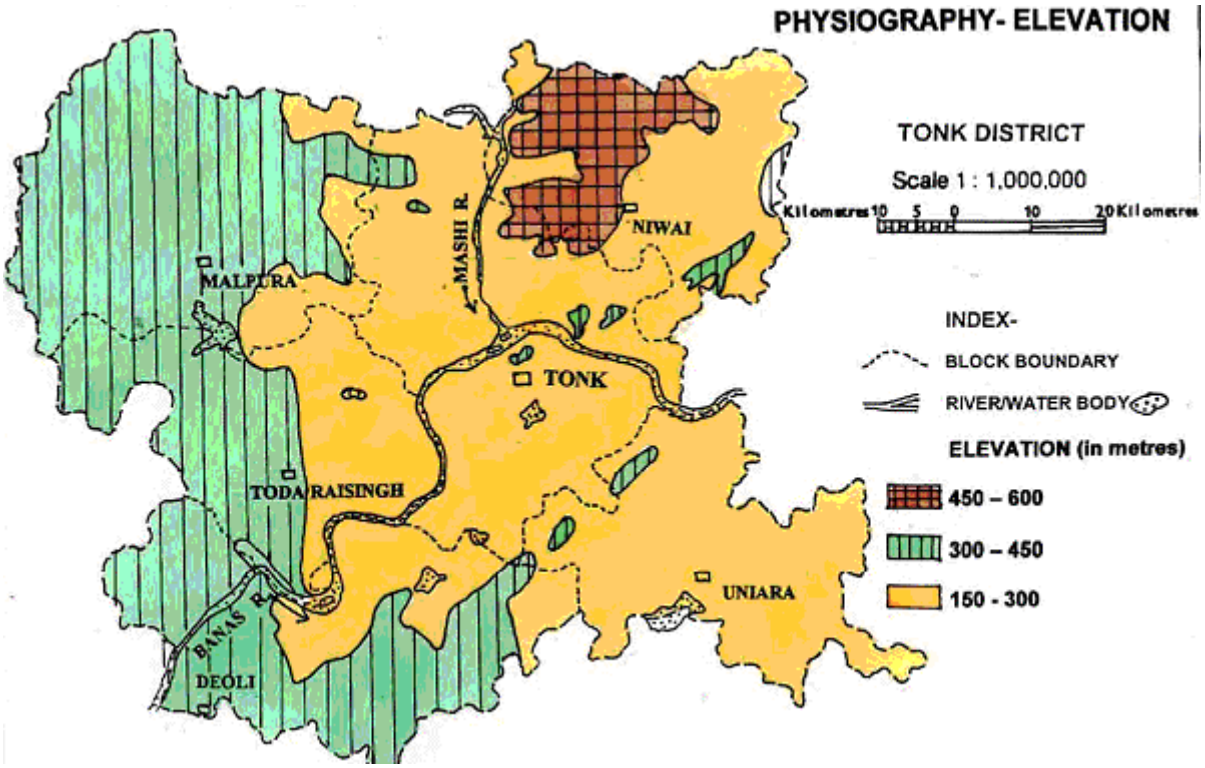

Fig. 2: Physiography and drainage map of Tonk district

3.2 Drainage

The district is drained by Banas river and its tributaries. The Banas river enters into Tonk district at Negaria in Deoli tehsil from where it takes a serpentine course dividing the district in roughly two parts; two-thirds of the area falling on its north and one-third on its south until it leaves the district at Sureli near Barawara station. It runs for roughly 135 km in the district. It is more than half a km in width and sometimes runs in 9 m deep channel. It is more or less perennial. It develops a dendritic pattern and forms a deep gorge at Rajmahal. Its left bank is stable and rocky while the right bank is covered by alluvium. The Mashi and Sohadra are the major tributaries of Banas in the district. Both are ephemeral in nature. Sohadra is considered as an important river of the district as it feeds the Tordi Sagar tank which is one of the biggest irrigation tank in Rajasthan. It joins Mashi river near village Dundia in Tonk district; thereafter it meets Banas river near Galod village. There are also 2 other minor streams in the district namely Khari & Dai, both are intermittent in nature and

4.0 Soil, Land Use & Irrigation Practices

The soil in the district varies from sandy loam to loam in Niwai block and parts of Tonk block and from clayey loam to loam in the remaining area. The National Council of Applied Economic Research regards the district as having undifferentiated soil.

Total reporting area for land utilization purpose is 717958 hectares. Net sown area of the district is 484964 hectares which is 67.84% of the total cropped area (714832 hectares). In the district, 26805 hectares area is covered under for forests, 74946 hectares land is not available for cultivation and 131243 hectares land is uncultivated including fallow land.

Wells and tube-wells are the main sources of irrigation in the district. The total net area irrigated in the district is 191126 hectares out of which 157947 hectares is irrigated by wells and tube wells. Kharif and Rabi crops are the main crops in the district. The important crops in the district in order of area coverage are rapeseed and mustard, wheat, jowar, bajra, gram and maize. Bisalpur project is one of the major projects in Rajasthan constructed on river Banas by the Irrigation Department, Govt. of Rajasthan, for water supply for domestic and irrigation purposes.

5.0 Ground Water Scenario

5.1 Geology

The district is underlain by the rocks of Bhilwara Super Group comprising mainly of mica schist, gneisses, phyllites and quartzites having small intrusive granite. These hard rocks are overlain by the alluvium of Recent to Sub-Recent age consisting mainly of clay, sand and silt. Geological map of the district is presented in Fig. 3.

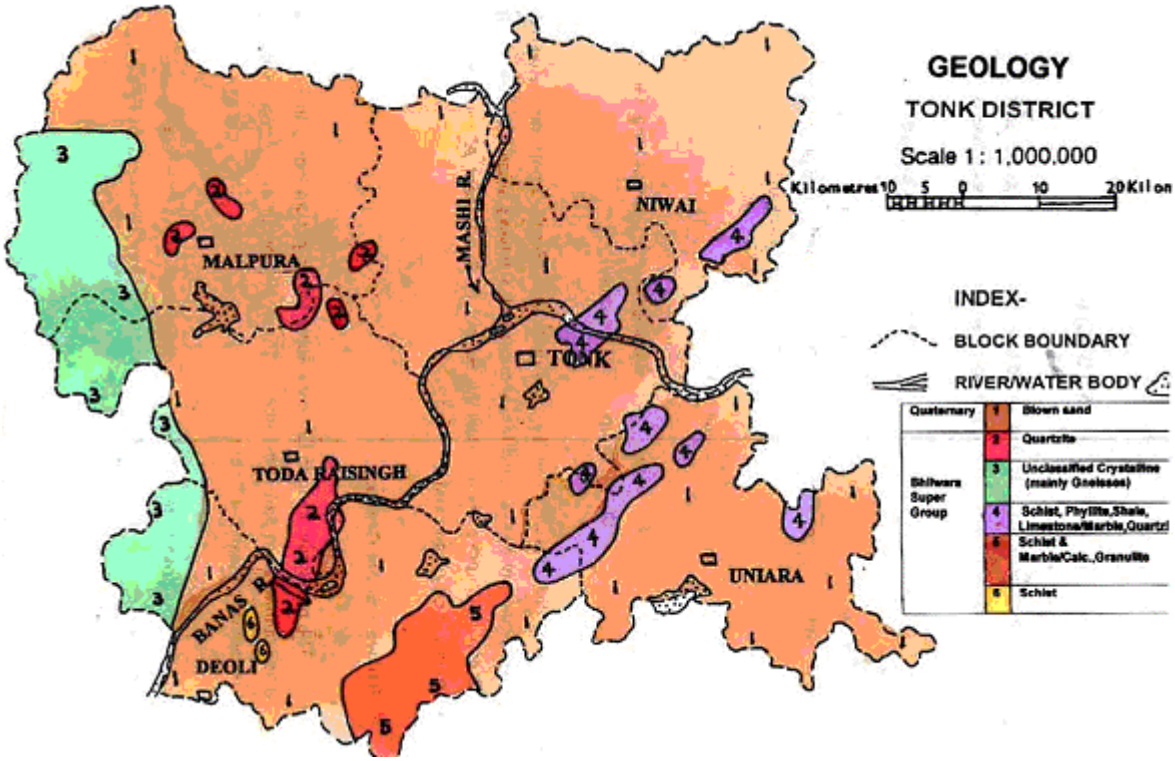

Fig. 3: Geological map of Tonk district

5.2 Hydrogeology

Ground water occurs mostly under phreatic conditions. In alluvial areas, ground water generally occurs under water table conditions where as in hard rock and crystalline rocks, it is under slight pressure. The weathered zone below the water table acts as a good storage zone. The movement of ground water is controlled by the porosity in the weathered zone and joints, fissures, fractures, bedding planes and other structurally weak zones in hard rock and grain size distribution in alluvium. The

movement is further controlled by the extent, size, openness, continuity and interconnection of fractures. Quaternary alluvium, phyllites, schists, and granitic-gneisses are the major hydrogeological formations in the district. Hydrogeological map of the district is presented in Fig. 4.

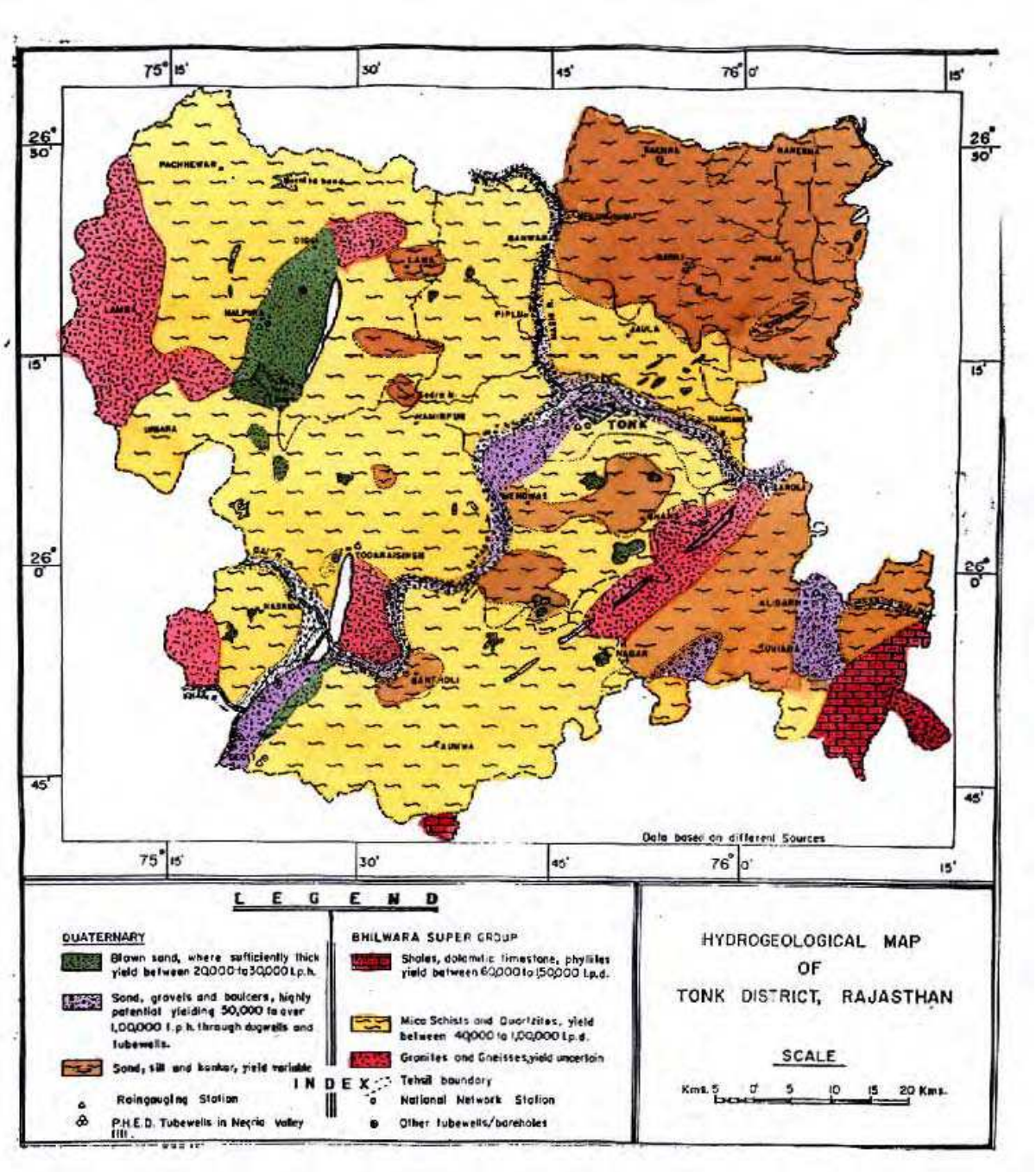

Fig.4: Hydrogeological map of Tonk district

5.2.1 Aquifer System

Alluvium and blown sand aquifers: Ground water in alluvial areas, the main ones being Negaria and Tonk valley fills, occurs under unconfined conditions. In alluvium, ground water occupies the open space between particles of sand, gravel and clay-kankar. In an area of about 75 sq. km., enclosed between Tordi-Chandsen ridge, ground water occurs mostly in aeolian sand. Locally, such as on the northern periphery of Tordi Sagar and southern periphery of Bhairon Sagar, it occurs in gravel

beds. In three borings, sunk on the western half of the valley fill, bed rock was encountered within 30 m for small drawdowns. The yield of tube wells in Negaria valley fill varies from 650 to 1518 lpm for a draw downfrom 0.60 to 2.15m while yield of tube wells in Tonk valley fill, located near Tonk was recorded to be 900 lpm for a drawdown of 0.90m. The water table intercepts the land surface near the right bank of Banas river along the contact of alluvium with bed rock as evidenced by large number of springs seen for about 1.8 km between Negaria and Chhan, at Dudas 200 m NW of village in the Negaria and for about 2 km between Mendwas and Aminpura in the Tonk valley. The discharge of most of these springs is very low. However, large pools are formed all along such seepage zones.

b) Hard Rock Aquifer: Hard rock aquifer forms about 80% of the net area of the district suitable for ground water recharge. The major water bearing hard rock formations in the area are mica-schist, phyllites, banded gneissic complex and quartzites. Out of these, mica-schist occupies the largest area. Ground water occurs under water table condition in joints and foliation planes. It being susceptible to weathering, top portion is invariably covered with thin clay. Water bearing capacity of this formation is poor. The yield of open wells, having 3 to 4 m diameter, varies from 3 to 50 m^3/day. Recuperation is markedly slow. Total recuperation takes place between 12-72 hours. At places veins of pegmatites have intruded the schist. Ground water circulates through the contact between the intrusive and the country rock. The recuperation of water in wells tapping such formations is relatively faster. Depth to water in schist ranges from 4 to 19 m bgl. Specific capacity varies between 0.0751-0.2762 m^3/min/m. Ground water in phyllite occurs under water table condition in joints, fissures and fractures. This aquifer is also quite susceptible to weathering with thickness of weathered zone varying from 2 to 10 m. The depth to water ranges from less than a meter to as high as 23 m. Phyllite being compact in nature has poor water yielding capacity. The wells of 3-4 m diameter yield between 6 to 150 m^3/day. The rate of recuperation is faster in comparison to mica-schist. The specific capacity works out to be 0.034m^3/min/m. Ground water in gneisses occurs under water table conditions in joints and fractures. Depth to water ranges from 6 to 24m. Yield of the wells in gneissic complex is highly variable. It ranges from 1.5 m^3/day to 150 m^3/day. Specific capacity is computed for high yielding well is 0.05 m^3/min/m. Quartzite generally occurs intercalated with phyllites. These are brown, hard and jointed. Thickness of fractured zone varies from 2-15 m. Depth to water ranges from 3-24 m bgl. Yield of wells varies from 30-120 m^3/day.

5.2.2 Aquifer Parameters

Coefficient of permeability of wells in Nagaria valley fill ranges between 318 and 692 m/day, transmissivity varies from 1976 to 4585 m^2/day and storage coefficient ranges between 0.083 and 0.20. The coefficient of transmissivity, permeability and storage coefficient of well in Tonk valley fills were computed to be 5488 m^2/day, 518 m/day and 0.146 respectively. The results of hydrogeological tests conducted in the valley fills indicated that the aquifer material near the Banas River (Tonk wells) and in the central part of the Negaria valley fill is more permeable than further away. The high values of transitivity also indicate that aquifer material is capable of transmitting large quantities of water. The values of storage coefficient correspond to unconfined conditions. Central Ground Water Board under Ground water exploration programme during 1993-94 drilled 6 slim holes in the district. The exploratory borehole data indicate that total depth drilled varies from 22 to 40 m having discharge up to 100 lpm. Alluvium is underlain by crystalline bed rock of Bhilwara Super Group. During the year 2001-02 under accelerated exploratory programme,13 exploratory/production wells were drilled by CGWB in the consolidated formation.

The exploratory drilling data reveals that total depth drilled varies from 76 to 162 m bgl having discharge from 50 to 450 lpm with draw down from 20 to 52 m. During AAP 2008-09 six tube wells were drilled up to 112 meters and a discharge of 125 to 2000 lpm has been recorded in Peeplu ki dhani.

5.2.3 Well Design

The large diameter dug wells are the most popular ground water abstraction structures in Tonk district. The dug wells range in depth from a few metres to around 30 metres having 3 to 4 m diameter and are circular in shape with masonry linings in alluvial areas. Banas River tract is highly productive and is suitable for construction of high capacity tube wells with discharge of over 1000 to 1500 lpm for small draw down of generally less than 10 m within depth of 45 metres. Rest of the fresh water hard rock area is suitable only for medium to low capacity tube wells down to the depth of 150m.

6.0 Water Level Scenario

Central Ground Water Board periodically monitors the National Hydrograph Network Stations (NHNS) stations in the Tonk district, four times a year i.e. in January, May (Premonsoon), August and November (Postmonsoon).

6.1 Depth to Water Level during Premonsoon (May, 2011)

Depth to water level during May, 2011 varied from 2.75 mbgl to 33.43 m bgl recorded at Todaraisingh and Niwai respectively. A perusal of map (Fig. 5) reveals that deeper water levels between 20m and 40 m bgl in isolated patches exist in central and eastern parts of district in the blocks of Niwai, Unihara and Tonk. Shallow water level less than 5 m bgl have been recorded in the eastern part of the district mostly in the blocks of Malpura and Todaraisingh.

6.2 Depth to Water Level during Postmonsoon (November, 2011)

Depth to water level during November, 2011 varied from 1.17 mbgl at Jaisinghpura to 26.25 m bgl at Niwai. The depth to water level map for November, 2011 shows that water levels between 20m and 40 mbgl were observed in isolated patches in Niwai block. Shallow water level less than 5 m bgl has been recorded in parts of Malpura, Tonk, Todaraisingh and Deoli. Major part of the district has water levels between 5 and 20 mbgl.

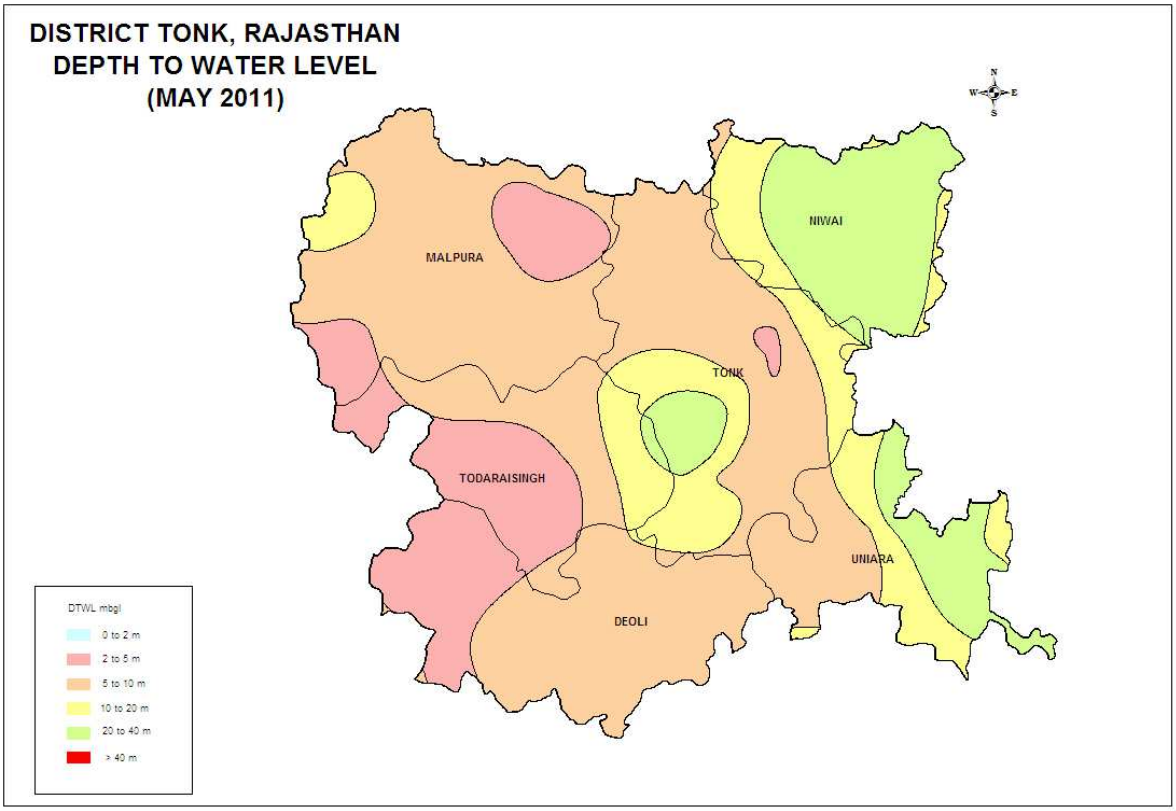

Fig. 5: Depth to water level map (May 2011)

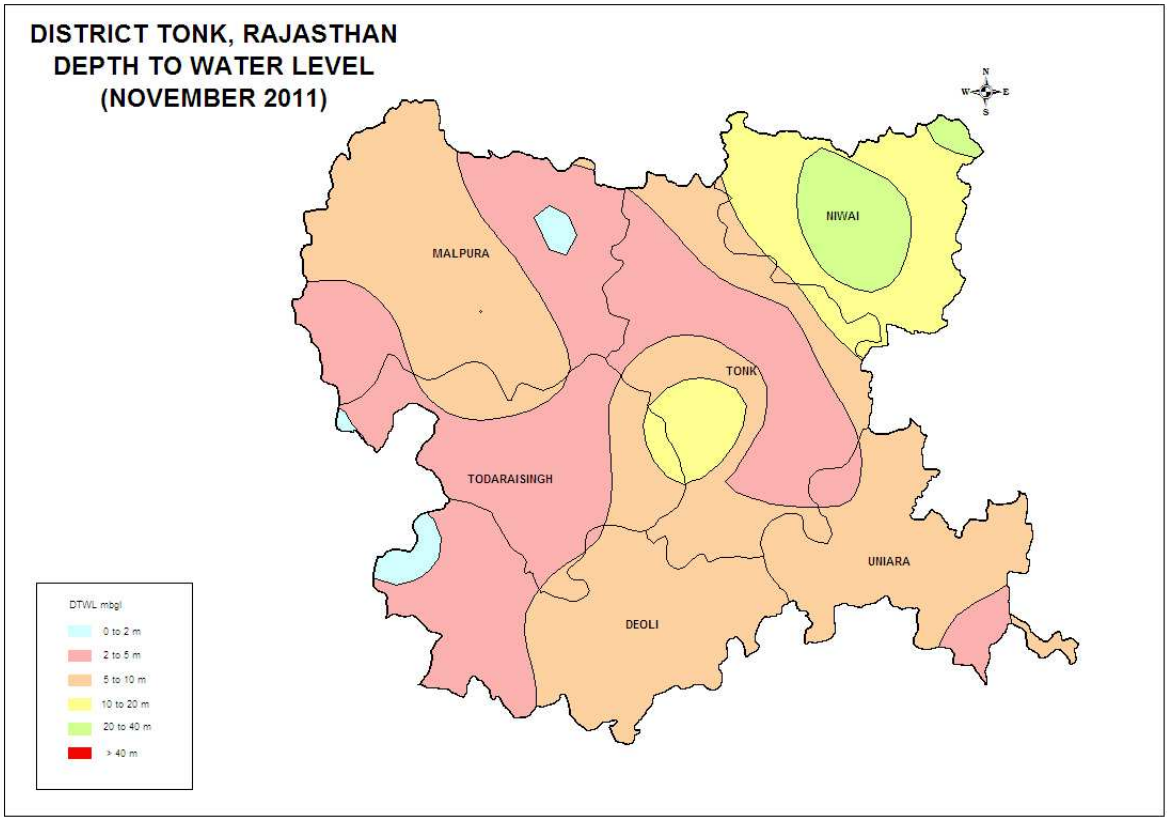

Fig. 6: Depth to water level map (November, 2011)

6.3 Seasonal Water Level Fluctuation (May-November, 2011)

Seasonal water level fluctuation map (Fig.7) shows about 88% of the monitoring stations in the state had registered rise in water level between the period May, 2011 and November, 2011. Rise of more than 4m has been observed mostly in the blocks of Niwai, Todarainsingh, Tonk and Uniara. Fall of less than 2m has been recorded in small isolated pockets in Malpura and Todaraisingh blocks. Maximum rise of 22.13 m has been recorded at Soap and maximum decline of 1.6m has been observed at Malpura.

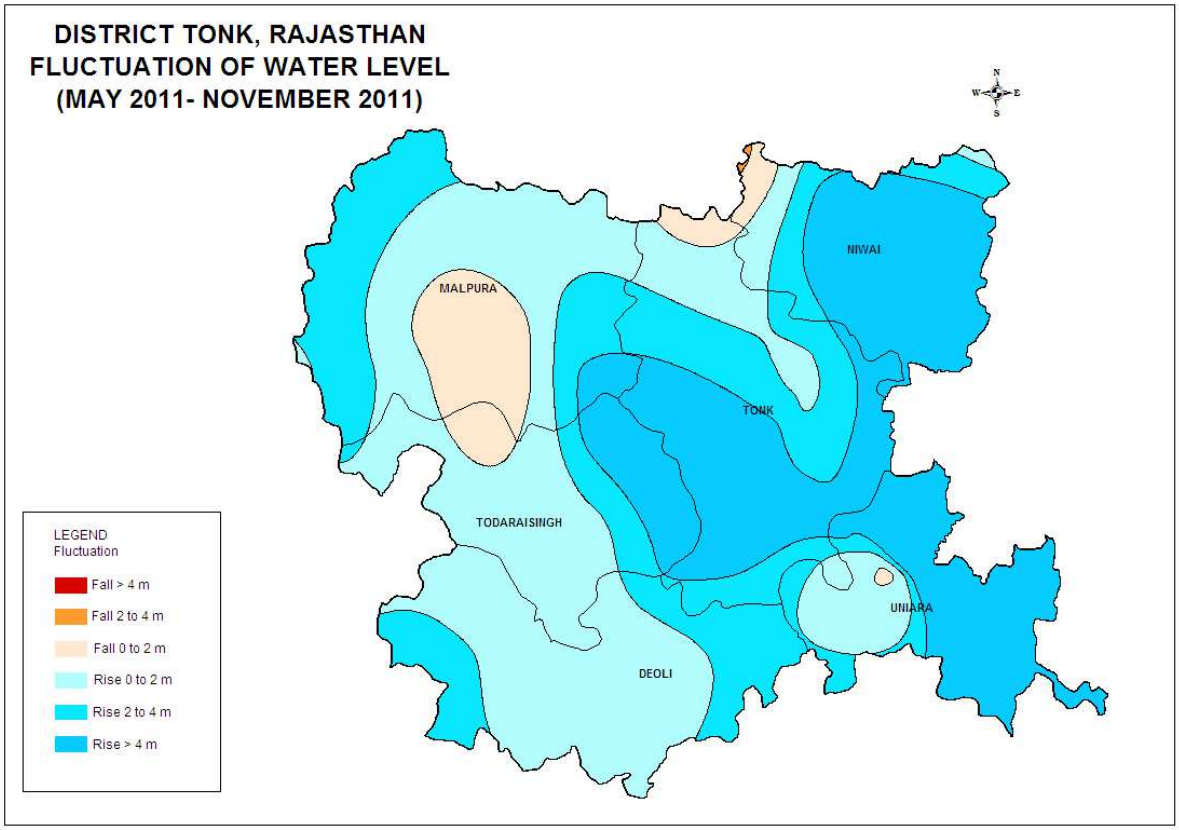

Fig. 7: Seasonal water level fluctuation map (May-November, 2011)

6.4 Water Level Trend (2002-11)

The pre-monsoon water level trend map for the period May, 2002 – May, 2011 has been prepared and the same is presented in Fig. 8. Both rising and falling trends have been observed in the district. One prominent elongated patch of falling trend in the district extending from Northwest and passing through the central part of the district to southeast direction. Southwest and northeast portion of the district experienced rising trends. Rising trends ranging from 0.0032 m/year to 0.045 m/year and falling trends ranging from 0.0088 m/year to 0.078 m/year have been observed in the district.

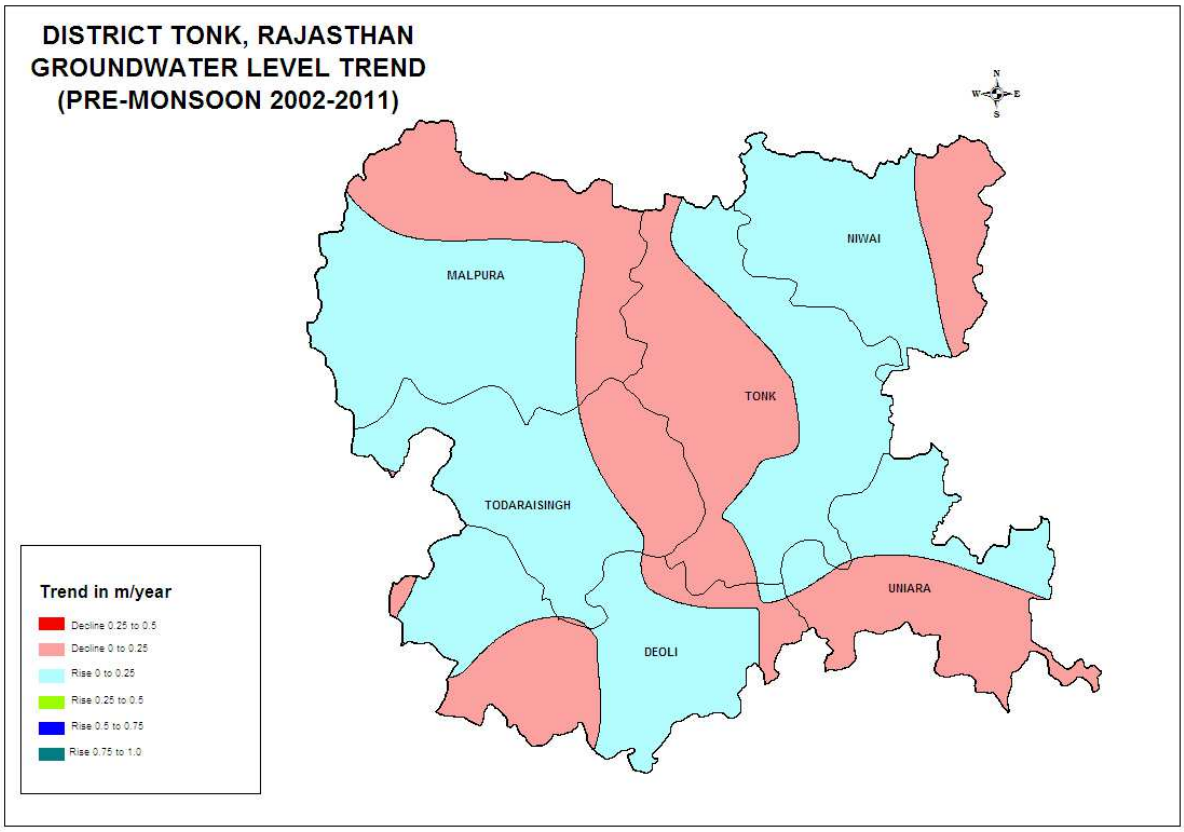

Fig. 8: Decadal pre-monsoon water level trend map (May, 2002- May,2011)

7.0 Ground Water Resources

Central Ground Water Board and Rajasthan Ground Water Department (RGWD) have jointly estimated the ground water resources of Jaipur district based on GEC-97 methodology. The same are presented in Table 3 whereas the graphical representation of the resources is shown in Fig. 9. Ground Water Resources estimation was carried out for 5308.59 sq. km. in command area and , 1217.13 sq. km in non-command area.

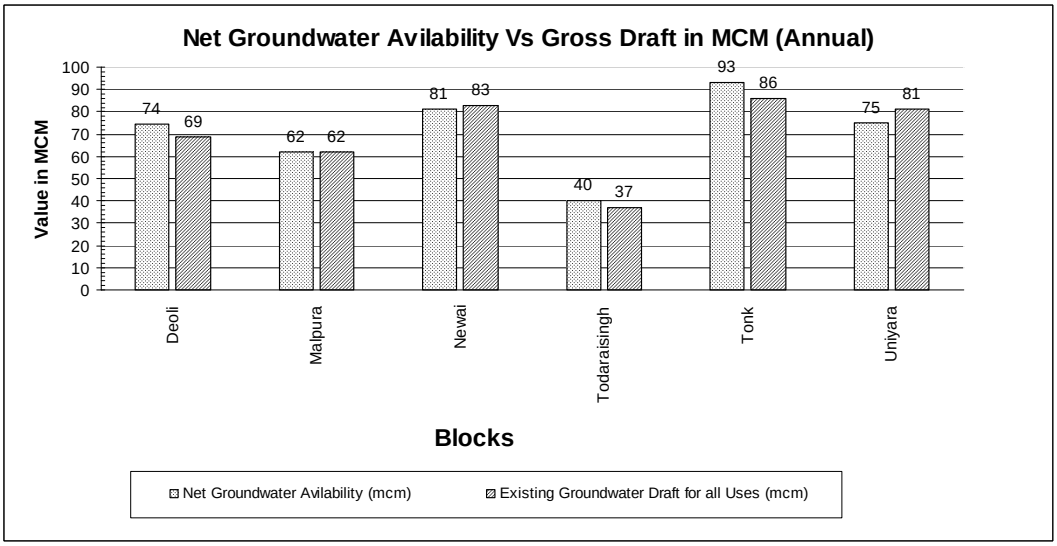

Fig. 9: Bar chart showing block wise net ground water availability Vs. gross ground water draft in Tonk district

Table 3: Block wise ground water resources of Tonk district (As on 2009)

Block	Total Annual Ground Water Recharge (MCM)	Net Annual Ground Water Availabi-lity (MCM)	Gross Ground Water Draft For Irrigation (MCM)	Gross Ground Water Draft For Dom.& Ind. Use (MCM)	Gross Ground Water Draft For All Uses (MCM)	Stage of G.W. Develop ment (%)	Category
Deoli	81.4595	74.4171	56.7291	12.1134	68.8425	92.51	Critical
Malpura	68.6347	61.7712	50.3914	11.8160	62.2074	100.71	OE
Newai	89.5309	80.5778	72.5755	10.5960	83.1715	103.22	OE
Todaraisingh	42.2407	39.8345	31.6992	5.1365	36.8357	92.47	Critical
Tonk	103.5979	93.2381	67.7868	18.3914	86.1782	92.43	Critical
Uniara	82.0598	75.0405	67.6376	13.2788	80.9164	107.83	OE
Total	467.5235	424.8792	346.8196	71.3321	418.1517	98.42	

As on March, 2009, total annually replenishable ground water resources of the district have been estimated as 467.5235 MCM and net annual ground water availability as 424.8792 MCM. Gross annual ground water draft for all uses has been estimated to be 418.1517 with stage of ground water development at 98.42%.

About 295 sq. km area is saline falling in Malpura and Tonk blocks. Saline ground water resource has been estimated separately. Total annual saline ground water recharge has been worked out to be 344.1738 MCM and net annual ground water availability as 312.2104. Total annual saline ground water withdrawal has been assessed as 320.8481 MCM with stage of development at 102.77%

7.1 Status of Ground Water Development

Rainfall in the district is the main source of ground water recharge. Due to less rainfall and increased ground water withdrawals, the groundwater levels are declining. Irrigation in the area is mainly done by ground water i.e. dug wells and tube wells. The stage of ground water development for the district as a whole has reached 98.42 % as on 31.03.2009. Out of 6 blocks, three block viz. Malpura, Newai and Uniara fall under over-exploited category and the remaining three blocks viz. Deoli, Todaraisingh and Tonk fall under over-exploited with stage of ground water development varying from 100.71% in Malpura to 107.83 % in Uniara.

8.0 Ground Water Quality

For evaluation of hydrochemistry and distribution of various chemical constituents in ground water in Tonk district, 18 water samples were collected during May 2011. Classification of ground water samples was carried out based on the desirable and maximum permissible limits as prescribed by BIS for drinking water (IS 10500:2004) for the parameters viz., TDS, TH, Ca, Mg, Cl, SO_4 and NO_3 prescribed in the standards and is given in Table 4.

Table 4: Classification of ground water

Parameters	Desirable limit	Maximum permissible limit	Samples having chemical constituent within desirable limit	Samples having chemical constituent between desirable and permissible limit	Samples having chemical constituent in excess of maximum permissible limit
TDS	0 to 500	501 to 2000	1	11	6
TH	0 to 300	301 to 600	8	5	5
Cl	0 to 250	251 to 400	10	7	3
SO4	0 to 200	201 to 400	9	5	4
NO3	0 to 45	46 to 100	12	4	2
Ca	0 to 75	76 to 200	13	2	3
Mg	0 to 30	31 to 100	6	9	3
F	0 to 1	1.01 to 1.5	5	5	8
Fe	0 to 0.30	0.31 to 1.0	14	2	2

Based on the results of chemical analyses, distribution of various constituents is discussed below.

8.1 Electrical Conductivity (EC)

Electrical Conductance is the ability of a substance to conduct an electric current. Chemically pure water in liquid form has a very low conductance. However, the presence of dissociated ions in solution renders the solution conductive. Therefore, Electrical conductivity (E.C.) of a solution gives an idea about the quantity of ions or dissolved solids present in it. Electrical conductivity in the district has been found to vary from 447 to 12100 µS/cm at 25°C. Electrical conductivity more than 3000 µS/cm at 25°C has been observed mostly in the central and southern parts of the district whereas the EC more 10,000 µS/cm at 25°C has been observed in isolated pockets in Tonk block and adjoining border of Malpura block (Fig. 10).

8.2 Fluoride (F)

Fluoride is an inherent component of igneous rocks. The main sources of fluoride in natural water are fluorite (CaF2) ,Cryolite(Na2AlF2), Fluorapatite, etc. In minerals like mica, amphiboles and topaz, fluoride ions are bound on the mineral surface. Fluoride reduces dental caries, very high concentration may cause crippling skeletal fluorosis in human body. Less than 1.0 mg/l is essential.

Fluoride concentration in ground water in Tonk district has been found to vary from 0.175 to 20.3 mg/l. Occurrence of high fluoride in the ground water of Tonk district is a matter of great concern as 44% of 18 ground water samples collected for chemical analysis show fluoride value beyond maximum permissible limit of 1.5 mg/l (Fig. 11). Around 28% each are within desirable and maximum permissible limit. The block of Malpura, Tonk, Umaria and Deoli are worst affected with fluoride contamination.

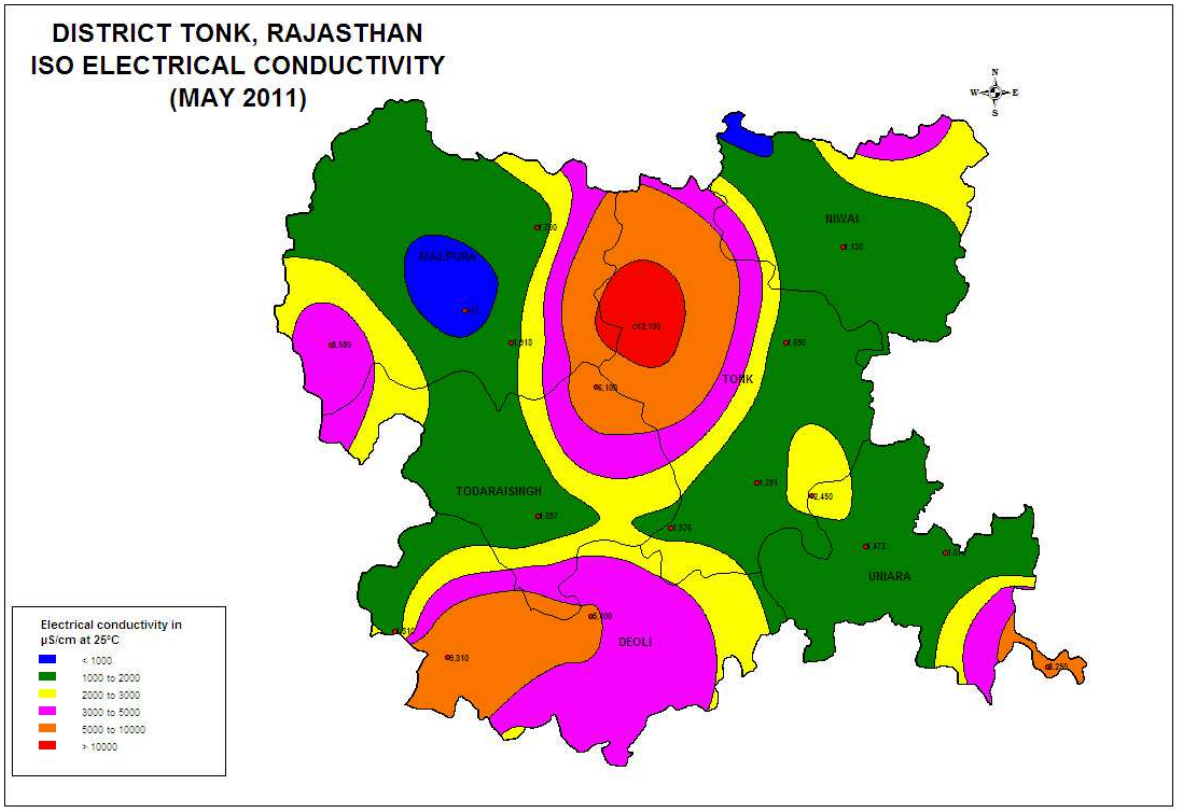

Fig. 10: Iso electrical conductivity map of Tonk district (May, 2011)

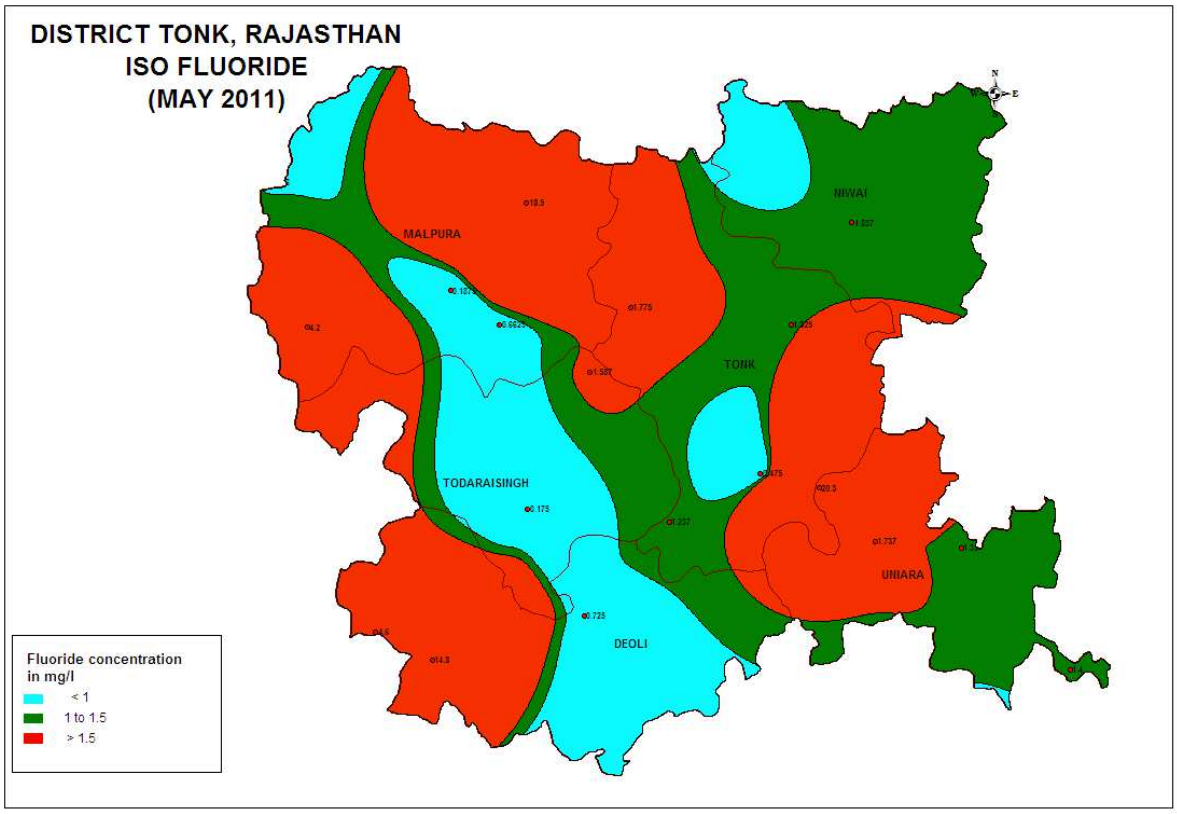

Fig. 11 : Iso fluoride map of Tonk district (May, 2011)

8.3 Iron (Fe)

Common ores of iron are Hematite, Magnetite, Limonite, Siderite and Pyrite. Leaching of iron salts (acid mine drainage) & iron products from industrial wastes may also be a source of pollution. Iron is an essential element in human nutrition. Excess of iron may cause bitter sweet astringent taste to water.

Iron concentration in the district has been found to vary from 0.001 to 3.625 mg/l. Out of 18 water samples analysed, 11% of samples have iron value beyond the permissible limit of 1.0 mg/l. Iron content in about 78% samples was reported to be within the desirable limit of 0.3 mg/l and in the rest 11% it was within the maximum permissible limit (0.31to 1.0 mg/l). Adjoining area of Deoli, Todaraisingh and Tonk blocks and some parts of Niwai have recorded high iron concentration in ground water (Fig. 12).

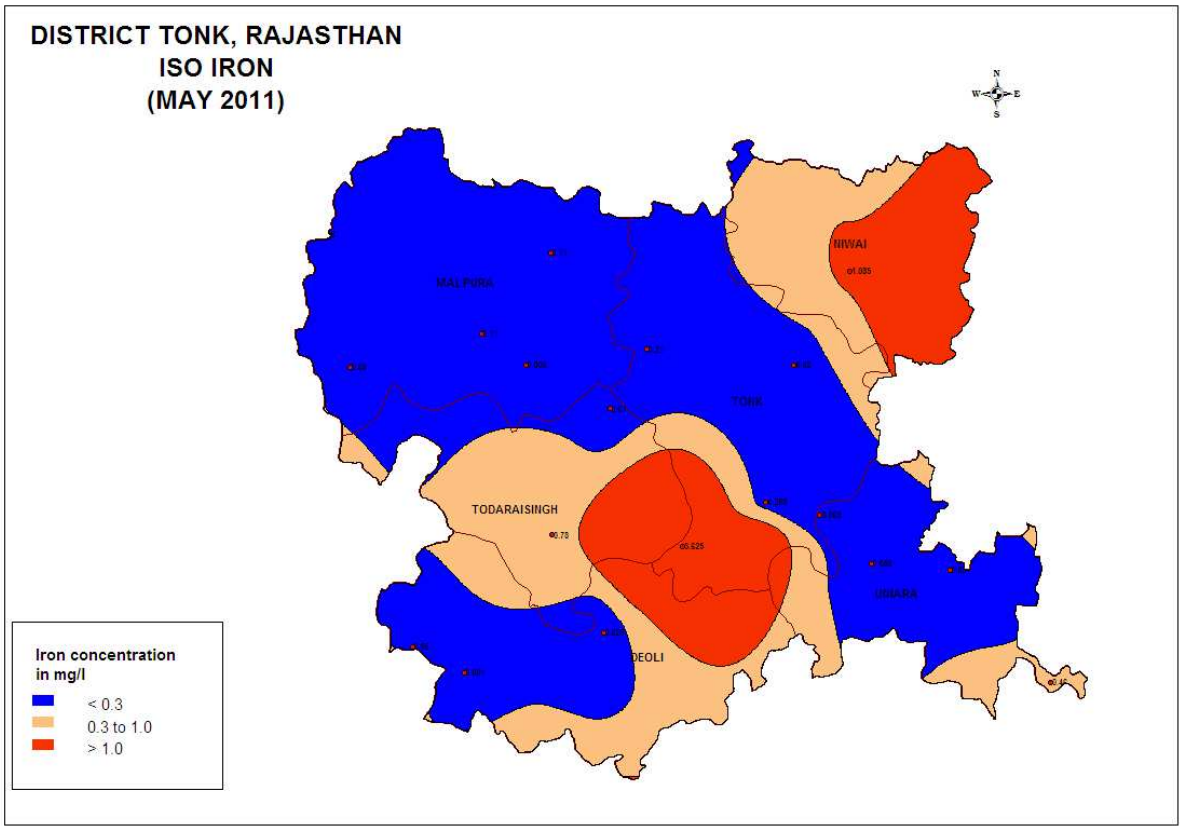

Fig. 12: Iso iron map of Tonk district (May, 2011)

8.4 Nitrate (NO_3)

Sources of Nitrate are mineral deposits (sodium and potassium nitrates), soils, sea water and atmosphere. Nitrate is used as a fertilizer, as a food preservative and as an oxidizing agent in the chemical industries. Higher concentrations are expected where fertilizers are used, in decayed animals and vegetable matter, in leachates from sludge and refuge disposal and in industrial discharges.

Higher concentration of nitrate causes methamoglobinaemia disease in bottle fed infants (3 months old). It may also lead to gastrointestinal disorders adversely affect central nervous and cardio vascular systems.

Nitrate concentration in ground water in the district ranges from 2.58 to 254 mg/l. Deoli and Uniara blocks have recorded nitrate values beyond permissible limit (Fig. 13). Around 79% of samples have nitrate value within the permissible limit of 45 mg/l.

Remaining 11% samples have nitrate value beyond permissible limit.

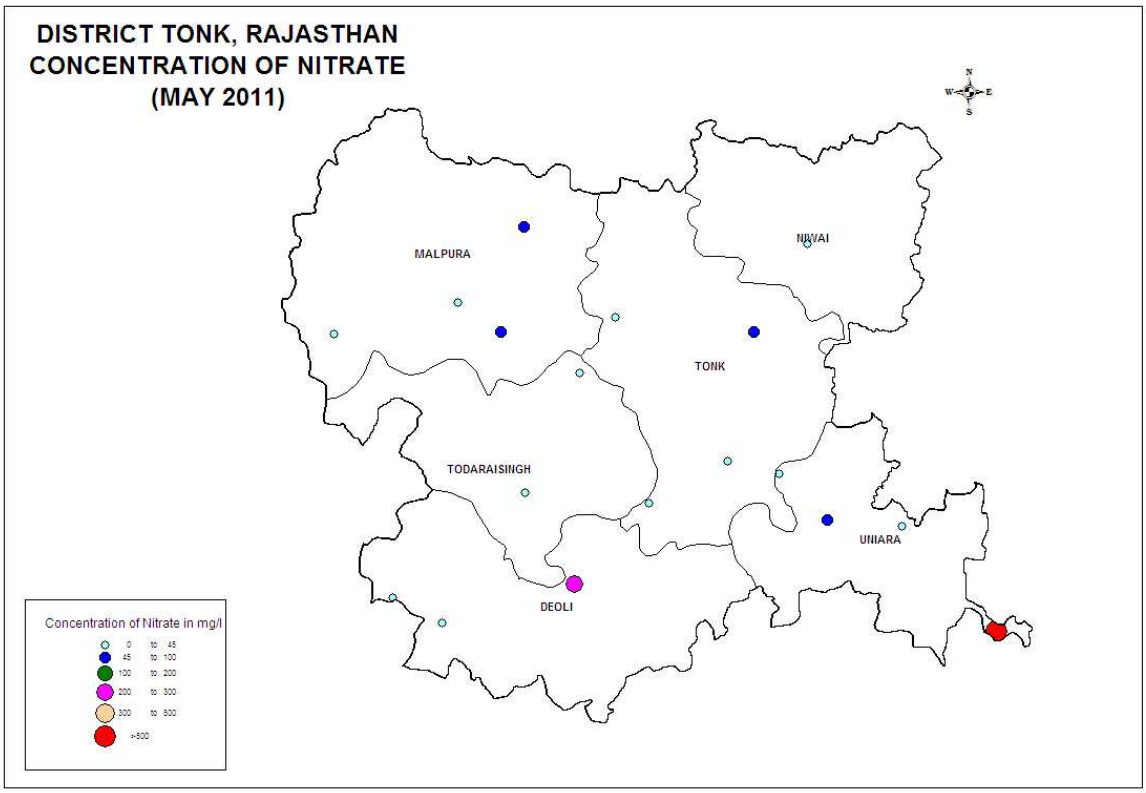

Fig. 13: Nitrate distribution map of Tonk district (May, 2011)

9.0 Ground Water Related Issues & Problems

Out of six blocks in the district, three are over-exploited, where stage of ground water development has exceeded 100 % leaving no further scope for ground water development. The remaining three blocks fall under critical category, which also require judicious development of ground water resources. Ground water levels have registered declining trend during the last decade in some parts of the district.

Salinity and Fluoride are the major water quality problems in the district.

10.0 Ground Water Management Strategy

Due to pressure of population and improvement in the standard of living, the demand of fresh water for both agriculture and domestic use has substantially increased. This has led to a sharp increase in ground water withdrawal. The top layer of fresh ground water is also reducing every year. Artificial recharge serves as a means for restoring the depleted ground water storage, slow down the quality deterioration and put back into operation many groundwater abstraction structures.

10.1 Ground Water Development

Stage of ground water development in three out of six blocks in the district has exceeded 100%, which indicates that the scope of ground water development is already exhausted in these blocks and the blocks have been categorized as “Over-exploited”. There is no scope for further development of ground water in the district for irrigation or industrial use. However, exploratory drilling can be taken up in unexplored area for estimation of aquifer parameters. There is need to control and regulate ground water development in all the over-exploited blocks in the district. In

the remaining three blocks, which fall under “Critical” category, caution needs to be exercised so as not to further deplete the resource. Further, there is need to check over-exploitation of ground water resources in the district.

10.2 Water Conservation and Artificial Recharge

Precious Groundwater resources have to be conserved for sustainable availability. There is need to reduce/ avoid wastage of water in various uses. Ground water should be used judiciously taking into account modern agriculture water management techniques by cultivating crops needing less watering and use of sprinkler system & drip irrigation should be encouraged.

There is a plenty of scope for artificial recharge at suitable sites along Banas River and its tributaries by construction of small check-dam & subsurface barriers across the courses of flow to arrest surface runoff during the rainy period and subsurface ground water runoff during the lean period. This in the long span of time will help in augmenting recharge to the aquifers in the area. Tonk district is covered by alluvium which forms the potential aquifer along the Banas river and schist and granite form scattered rocky terrain. Hydrogeologically, alluvial formation has good water storage and transmission capacity in comparison to hard rocks. Therefore, different techniques of artificial recharge of ground water resources can be adopted such as rain water harvesting and construction of subsurface barriers/ check dams/ percolation tanks etc. in the district.

After detailed scientific studies, massive programme needs to be taken up for artificial recharge to groundwater using suitable techniques like harvesting roof top rainwater urban storm rainwater runoff, village storm water runoff, dug well recharge in farms, constructing sub surface barriers across streams/rivers and nallas along with watershed development projects in hard rock terrains. Awareness creation along with financial incentives is the need of the hour for promoting construction of recharge structures. Techniques of ground water recharge should percolate down to common man through numerous Training Programmes

10.3 Mass Awareness and Training Activities

Central Ground Water Board has been organizing Mass Awareness Programmes in different parts of the state to educate local people about the existing ground water situation and need for water conservation and rain water harvesting. One Mass Awareness Programme was organized in Tonk during 2008-09.

11.0 Recommendations

- Only very restricted and planned ground water development can be taken up in Critical areas to avoid becoming overexploited.
- Ground water should be used judiciously taking into account modern agriculture water management techniques by cultivating crops that need less watering such as Wheat (Raj 911), Barley (RD 2508), Makka-Mahi kanchan, Jowar (CSH 1, 6 &14), Bajra (HHB 67260), Moong (K 581), Soyabeen (Pusa 16), Til (RT 46), Groundnuts (RG 141), Mustard (Pusa Bold) etc.
- Use of sprinkler system & drip irrigation should be encouraged.
- Small farmers in the area should be encouraged to use common ground water structures for optimum use of ground water resources for irrigation purposes.

- Cultivators should also be made aware and encouraged to adopt suitable cropping pattern using modern techniques by extension services for getting maximum agriculture production through minimum withdrawal.
- Suitable artificial recharge structures like subsurface barriers across the river beds should be constructed so that the ground water runoff can be arrested and impounded in the subsurface reservoir for meeting various sectoral demands.
- There is need for regulation of ground water development in overexploited areas.
- The district should be notified for ground water control and regulation in the district & all the ground water abstraction structures should be registered.
- Awareness about the consequences in the near future caused by the impact of sharply declining water levels and need and ways of judicious use of water and rain water harvesting and artificial recharge needs to be created among the users.