GROUND WATER INFORMATION BOOKLET

SAGAR DISTRICT
MADHYA PRADESH

Ministry of water Resources
Central Ground Water Board
North Central Region
BHOPAL
2013

SAGAR DISTRICT AT A GLANCE

S.N.	ITEMS	STATISTIC	
1	**General Information :**		
	(i) Geological Area	10,252 Sq. Kms.	
	(ii) Administrative Division : Number of Tehsils Number of Blocks Number of villages	 11 11 2099	
	(iii) Population	2,378,295	
	(iv) Normal Annual Rainfall (mm)	1197.6 mm	
2	**Geomorphology**		
	Major Physiographic Units : The District extends over two physiographic divisions. They are :	(i) Bundelkhand massif in the north. (ii) Malwa plateau in the south.	
	Major Drainages	Two drainage basin are there	
	(i) Ganga basin	986 Sq. Km.	
	a) Ken sub basin	4507 Sq. Km.	
	b) Betwa sub basin	5562 Sq. Km.	
	(iii)Narnada basin	342 Sq. Km.	
3	**Land Use**		
	(a) Forest Area	2980 Sq. Km.	
	(b) Net area sown	5374 Sq. Km.	
	(c) Cultivable area	5374 Sq. Km.	
4	**Major Soil Types**		
		(a) Clay loam (b) Sandy clay loam (c) Sandy loam	
5	**Principal Crops**		
		Wheat, Rice, Jowar, Maize & Sugarcane	
6	**Irrigation by Different Sources**	**Nos.**	**Areas Sq km**
	Tube well/Bore wells	7087	370
	Dug wells	54202	1170
	Canala	43	82
	Tanks/Ponds	34	25.64
	Other Sources	-	763
	Net Irrigated Area	-	2410
7	**Number of Ground Water Monitoring Wells of CGWB. (As on 31.3.2013)**		
	No. of Dug Wells	29	
	No. of Piezometers	09	
8	**Predominant Geological Formations**		

	Alluvium, Laterite, Deccan traps, Lametas, Vindhyan, Bijawars, and Bundelkhand granite.	
9	**Hydrogeology**	
	Major Water Bearing Formation	Alluvium, Laterite, Intertreappean beds, Deccan traps, Vindhyans, Bijawars, Bundelkhand granites.
	Pre-Monsoon Depth to water level (2012)	2.63-36.50 mbgl
	Post-monsoon depth to water level (2012)	1.20-20.21 mbgl
	Ground Water Trend (2003 to 2012)	0.01-0.17 (Rise) 0.09-0.1 (Fall)
10	**Ground Water Exploration by CGWB (As on 31.3.2013)**	
	No. of wells drilled EW OW PZ Depth range (m) Discharge (lps)	EW-61, OW-30, Pz-26 85 – 200 Meager to 15.5
11	**Ground Water Quality**	
	Presence of chemical constituents more than permissible limit.	EC ranges: 249 to 2775 µS/cm^2 at 25 ^{0}C. F ranges: 0.12 to 0.7 mg/l NO_3 ranges: 3 to 205 mg/l
12.	**Dynamic Ground Water Resources (2009)**	
	Net Annual Ground Water Availability Existing Gross Ground Water Draft Projected Demond for Domestic and Industrial uses upto 25 years Stage of Ground Water Development	112807 ham 66079 ham 4478 ham 59%
13	**Awareness and Training Activity**	
	Mass awareness programmes organized + workshop	2
	Date	23.01.08
	Place	Karrapur (Sagar)
	No. of Participants	325
14	**Efforts of Artificial Recharge & Rainwater Harvesting**	
	Project completed by CGWB	Nil
	Project under technical guidance of CGWB	Nil
15	**Ground Water Control and Regulation**	
	No. of Over Exploited Blocks	-

	No. of Semi-Critical Blocks	Banda, Rehli and Sagar
	No. of Blocks notified	-
16	**Major Ground Water Problems and Issues**	
	1) Water depleted areas	Eastern part of Sagar block, northern part of Rahli block and southern part of Banda block had deepest water level due to heavy pumping.
	2) Scope of Artificial Recharge	At present, the stage of ground water development in Sagar district is only 59% declining trend of water levels has been observed and there is need of artificial recharge to ground water system.

1.0 INTRODUCTION

Sagar district is located in the north central part of the state of Madhya Pradesh and occupies as area of 10252 sq km. The district extends between the latitude of $23^0$10' and 24^0 27' north, longitude of 78^0 04' and 79^0 21'east. The district is bound in the north by state of Uttar Pradesh, in the north east by Chhatarpur district in south and west by Raisen, in the south east by Narsimhapur district, in the northwest by Guna district and in the east by Damoh district (fig 1). The National highway No. 26 passes through Sagar town. The district falls in survey of India toposheet No. 55M, 54L and 54P.

Drainage

The southern most tip of the district is drained by the Narmada river. However the major part of the area fall in the Ganga basin. The drainage of the district is towards north and north east. The five rivers, from west to east are the Bina, the Dhasan, the Bewas, the Sonar and the Bamner. The Bina takes its course upto several Kilometer to the south of the district and enters it near village Mahura. After flowing through Rahatgarh, the river takes a north easterly course and at places forms the boundary with Vidisha district.

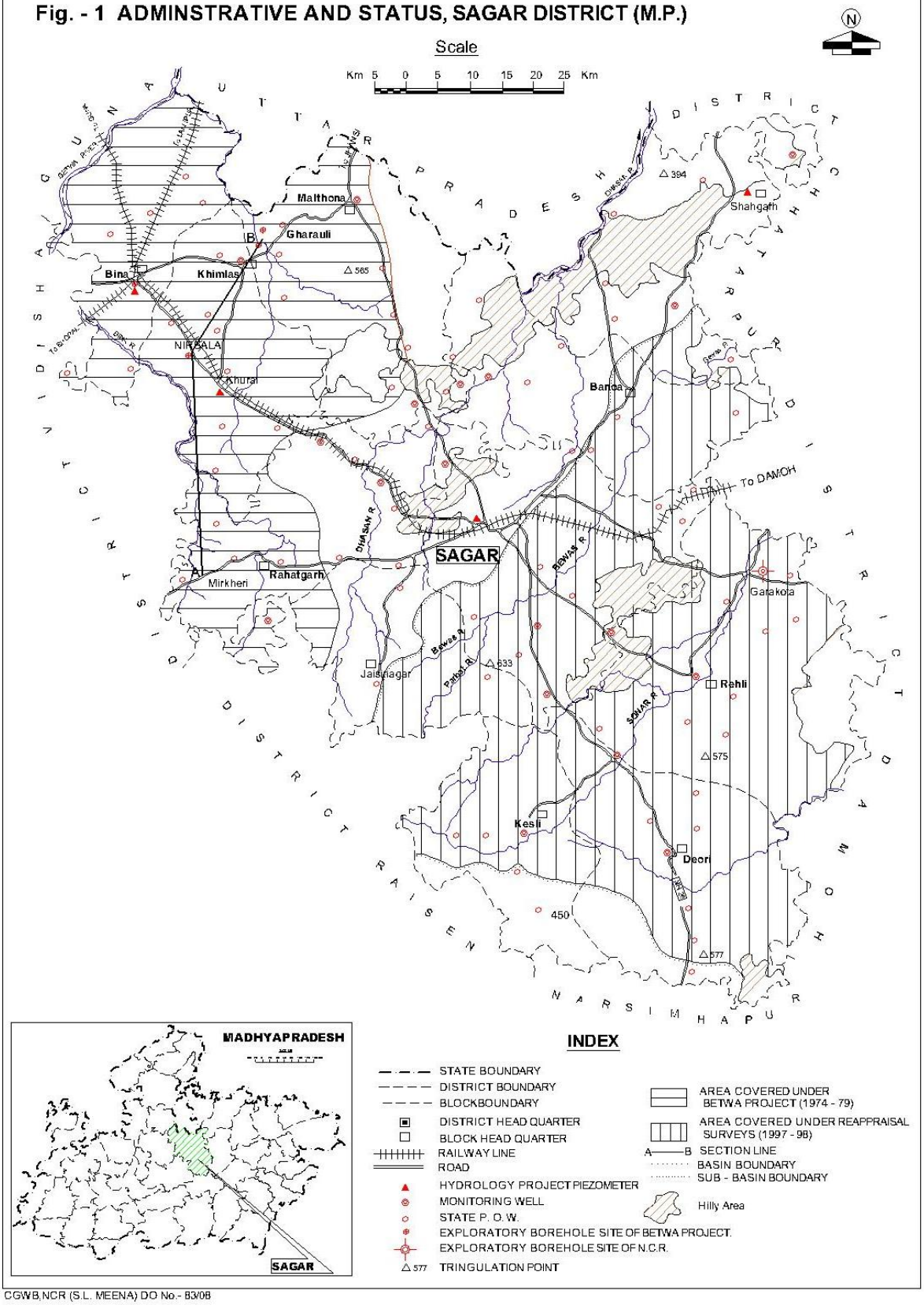
The Dhasan emerges from just south of the district and flows initially in the south and then to the north. It also forms the boundary with Jhansi district of Uttar Pradesh. The Kopra and Bewas are tributaries of the Sonar. The Sonar joins Bamber and then both river joins Ken river. The Ken is a tributary of the Yamuna river.

The drainage pattern is of dendritic type. At a few place especially around Sagar town and near Khimlasa and Jaisinagar radial drainage pattern is also observed.

CGWB Activities

Detailed hydrogelogical studies :
CGWB (Indo-British) Betwa project – 1976-1981.
Normal exploratory drilling program – 1992-93.
Re-appraisal hydrogeological surveys – 1997-98.

Fig. - 1 ADMINSTRATIVE AND STATUS, SAGAR DISTRICT (M.P.)



CGWB,NCR (S.L. MEENA) DO No.- 83/08

2.0 RAINFALL & CLIMATE

The climate of Sagar district can be classified mainly into three season. Winter season starts from middle of November to end of February. March to May constitute summer season and the monsoon season starts from second week of June to end of September.

There are six rain gauge stations in Sagar district. Maximum rainfall occurs along the south western boundary of the district and decreases towards the north and slightly towards the east. In the southwestern parts of the district, Rehli gets a marked amount of low rainfall mainly due to its location in the valley on the leeward side of the hill range.

The normal annual rainfall of the district is 1197.6 mm. About 90% of the annual rainfall takes place during the southwest monsoon period i.e. June to September only 5.5% of annual rainfall takes place during water and about 4.5% of rainfall occurs during the summer months.

During winter season the January is the coldest months with the temperature falling as low as 11.6^0g C and max up to 24.5^0 C. During the month of May, temperature goes up to 40.7^0 C (max.).

3.0 GEOMORPHOLOGY & SOIL TYPES

Sagar district lies at the north eastern edge of the Malwa plateau, which widens in the south and south west. It lies just north of the Narmada river and is separated from tis valley by a steep escarpment towards the south. The area is by and large cropped by the deccan trap lava flows whereas at places vindhayan sandstone also crops out. The average elevation of the district is about 452 to 533 mamsl. It ranges from 353 mamsl in the Dhasan river bed in the north to 683 mamsl at Naharmau peak in the southwest.

The physical divisions of the district are represented by the basins of several rivers. The area in the north west falling under Khurai tehsil is almost a level tract with an elevation of about 411 to 427 mamsl and is drained towards north-west by Thimpa, Parasasi and Bina rivers. These rivers are tributaries of the Betwa river. The Khurai plain is separated from the rest of the district by a series of steeply rising hills. These hills attain an elevation of up to 533 mamsl and also act as a water divide.

To the east of and south-east of the above discussed hills are the five parallel valley of Dhasan, Bewas, Sonar, Kopra and Bamner rivers. These basins are separated by hills rising 91 to 153 meters above the general ground surface. The highest hill range of Tendu Dabar attains a height of 665 mamsl.

There is a very prominent lake in Sagar town around which the town has developed. As per Dr. W.D. West, the lake come into existence due to the erosion of the deccan traps and exposing the underlying Vindhyans. In Sagar district land forms have been classified on the basis of genetic factor and the geomorphic processes involved. Further the geomorphic units have been classified on the basis of different erosion of rock material, process and relief amplitude. The classified system adopted is as per ITC scheme of classification of land forms.

Three groups of landforms have been identified in the area :

1. Denudational landforms

2. Depositional landforms
3. Structural landforms.

Soil

The major part of Sagar district is covered by black cotton soil. However, clay loam soils occurs in the northern parts of Banda block, north of Malthone, west of Sagar town, Kesli and Deori blocks. Sands clay loam covers the areas falling in the southern parts Deori and Kesli blocks, east of Rehli and northern parts of Shahgarh block. Rehli block is by and large, covered by sandy loam soils.

4.0 HYDROGEOLOGY

Granites

The granites and granitic gneisses in the area are quite hard and generally devoid of any primary porosity. However, due to weathering of the top mantle, jointing and fracturing secondary porosity has developed at a few places. The thickness of the weathered mantle varies from negligible near the outcrops to as much as 15 meter in the valleys and topograhpics lows. The joints and fractures close down after 35 to 30 meter. Ground water in thus formation occurs under water table condition. Tube wells in the granites are and the ground water is withdrawn. Mostly through dug wells. The tube wells sustain a maximum discharge of about two litres per second (lps) for appreciable drawdowns. The yield of open wells ranges between 20 to 100 m^3/day.

Bijawar

The Bijawars are exposed in a tiny patch in the north eastern extremity of the district. These are composed of siliceous lime stones, breacia and shales. These formations have any significant ground water occurrence.

Vindhyans

In the vindhyan sandstones, primary porosity varies from negligible to as high as 30% depending on the degree of compaction. The storage and movement of ground water in these formation is controlled mainly by the secondary porosity and permeability created due to weathering jointing and fractured. Ground water occurrence is good along the liveaments and their in trisections and occurs under water table condition. The tube wells an these formation yield up to two lps and the dug wells have yields to 100 m^3/day.

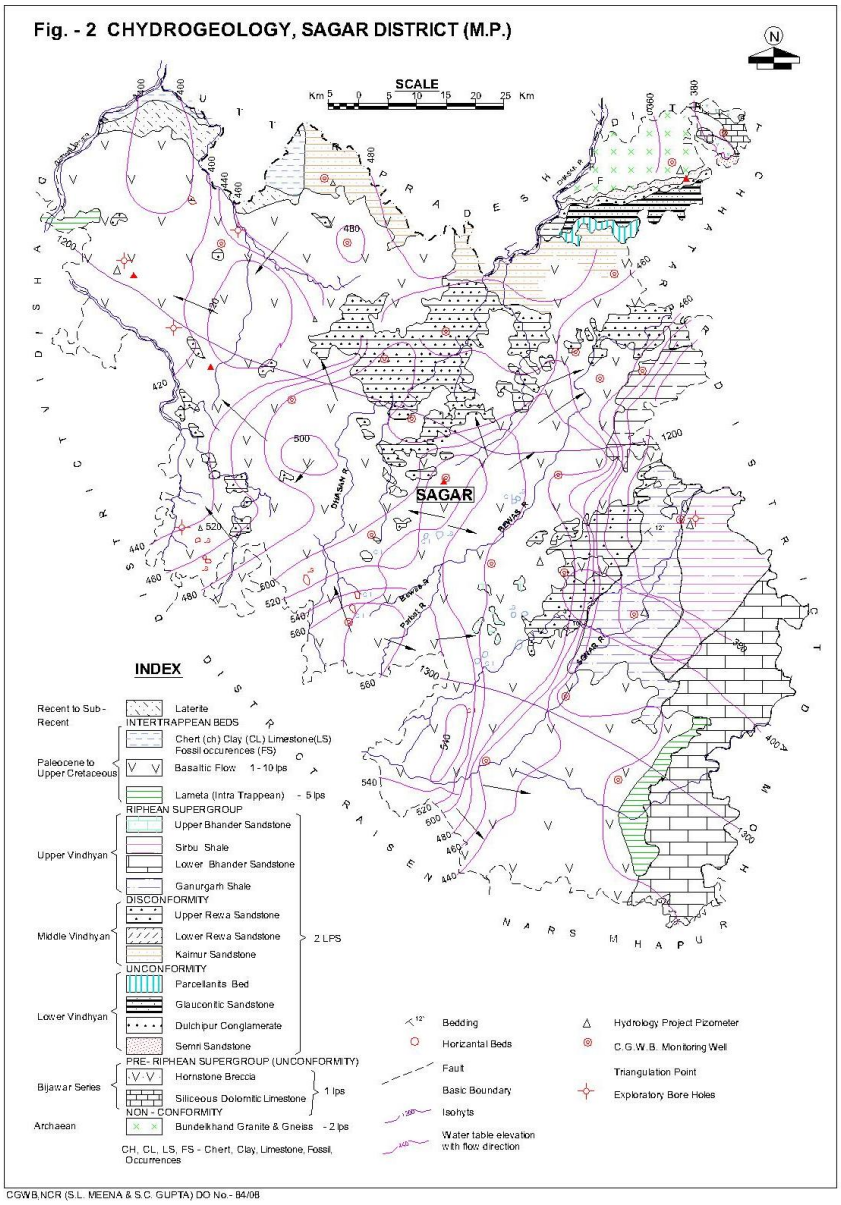
Lametas

These are intertrappean formations comprising siliceous limestone and sandstone. The lametas are fairly thick at places and attain up to 45 meter thickness east of Sagar and near Deori. The limestones of the lametas are poor quality aquifer in the district. However, sandstones are semi consolidated and have primary porosity also. These formations support dug wells having moderate to good yield in the range of 50 to 200 m^3/day.

Deccan Traps

Deccan traps are the most important formations in the district due to their large aerial extent. The weathered jointed, fractured and vesicular units of basalts form moderately potential aquifers. The zeolitic basalt in weathered form also makes good aquifer. The red bole bed, which is predominantly clay, is non productive and acts as a confining layer also. A common weathering product of the trap is a friable light greenish or yellowish green mantenlin locally called as "Murram" however.

Murram does not occurs everywhere the trap zones bearing "Murram" forms potential aquifers. Basalt vindhyan contact is not a promising zone. However wherever thick vesicular and fractured/jointed zone is encountered in the basalts. It can sustain tube wells of moderate to good discharges. The discharge in the depth range of 38 to 40 and 47 m at Mirkheri was about 16 lps. The dug wells in these formations can sustain yield of up to 750 m^3/day.



Laterites

Laterite, a by product of weathering of basalt (at some places). In found only to the west of Sagar town. This formation has not attained significant thickness in the area.

Alluvium

The alluvial deposits are confined mostly to the area along the river courses and in the eastern parts of the district. It is composed of five to medium sand, silt, clay and kankar. The alluvium supports tube wells and dug wells wherever thick and can sustain tube wells with discharge up to 10 lps.

4.1 Aquifer Parameter

During exploratory drilling in vindhyan limestone (upper Bhander limestone) are also not promising as in village Garhakota, a 58.3 meter thick zone of Bhander limestone was encountered in the depth range of 18.7 to 77.0 mbgl. This was underlain by 107.70 meter thick Ganurgarh shales followed by Rewa sandstone up to the drilled depth of 185 mbgl.

There were several shale bands in the depth range of 30 and 52 mbgl in the limestone. The limestone also contained solution cavities in the depth range of 18-22 mbgl. A well assembly tapping the zone between 53 and 69 mbgl was lowered in the bore hole. During PYT, the discharge obtained was only 0.7 lps for a draw down of 28.21 meters after 100 minutes.

Four exploratory bore holes in deccan trap country were drilled under the Betwa project. The bore hole at Mirkheri which was 171.33 m deep, encountered nine flows. The five zones in basalts were encountered in the depth range of 16-17 mbgl, 27.9-31.00 mbgl, 37.7-40.1 mbgl at 47 mbgl and between 58-59 mbgl.

All the zones were in jointed/amydaloidal basalt. The yield of the first and second zones tested together was only 3.2 lps. The tranmissivity was 36.3 m^2/day. The yield of the second and third zones tested together was 16.3 lps and the transmissivity was 43^2/day.

The borehole at Nirtala was drilled down to 88.68 mbgl and the vindhyan sandstone were struck at 52 mbgl. water was struck at two depths, between 42-42.5 mbgl in jointed basalt and at the basalt vindhyan contact at 52-52.5 mbgl. these zones tested together yielded 0.64 lps of water and the transmissivity value was only 0.3 m^2/day. Similarly at Sabda the depth drilled was 85-94 mbgl. the vindhyan basement was struk at 54.2 mbgl. the water bearing zones were at 48.0 -57.3 mbgl in jointed basalt and at 54.2-54.7 mbal at the basalt vindhyan contact.

5.0 GROUND WATER SCENARIO

Water Level

CGWB is monitoring ground water levels four times a year. There are 29 national hydrograph stations (NHS) and 9 piezometers. The behavior of ground water regime for the premonsoon and post monsoon period of 2012 is discussed hereunder:

Pre monsoon (May 2012)

The Premonsoon depth to water level (DTW) map is presented as fig. 3. The DTW ranged between 2.63 mbgl to 36.50 mbgl. However, in major part the DTW ranged between 4 to 16 mbgl. Deeper water levels of more than 20 mbgl are observed in isolated patches in western part.

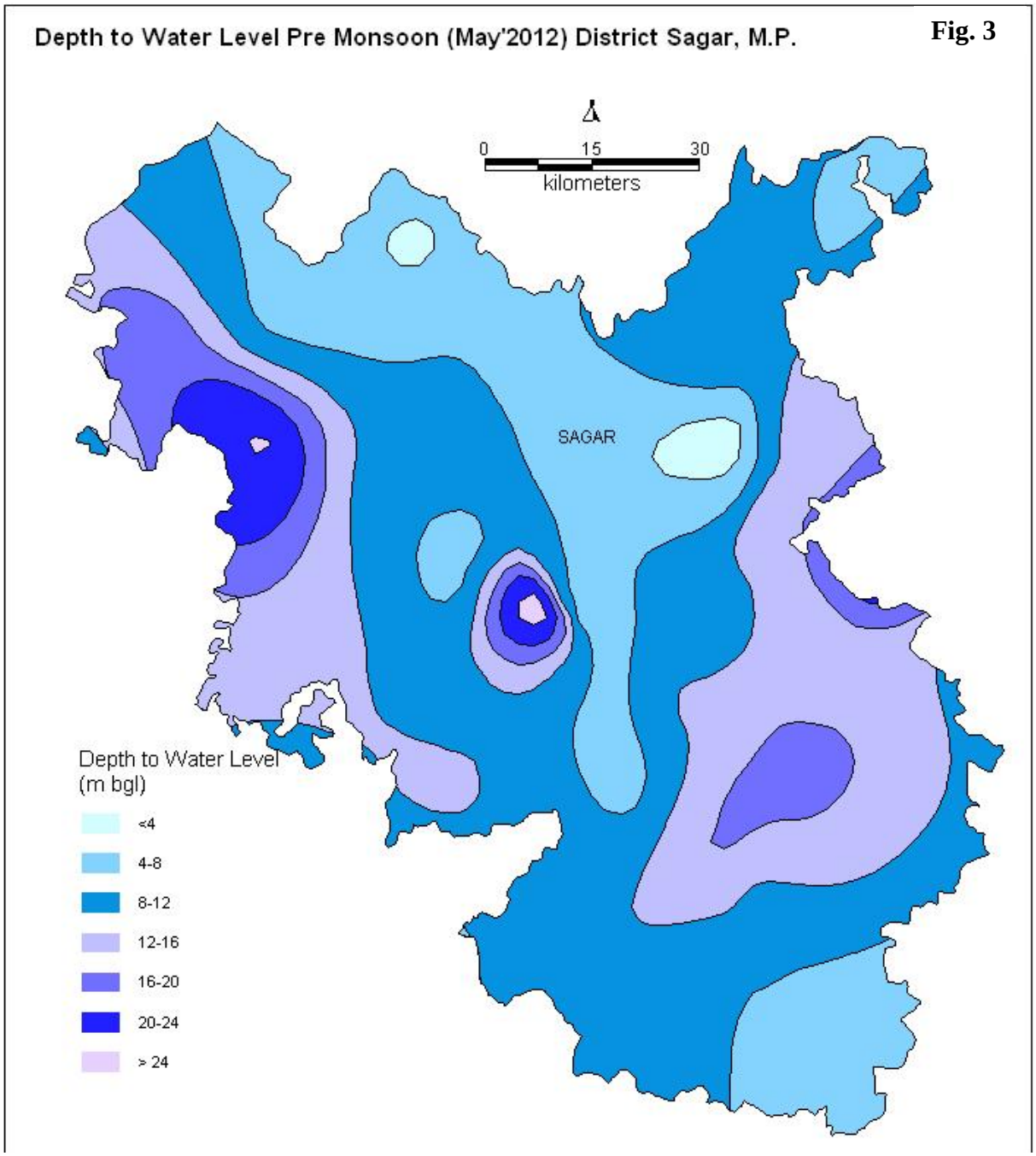
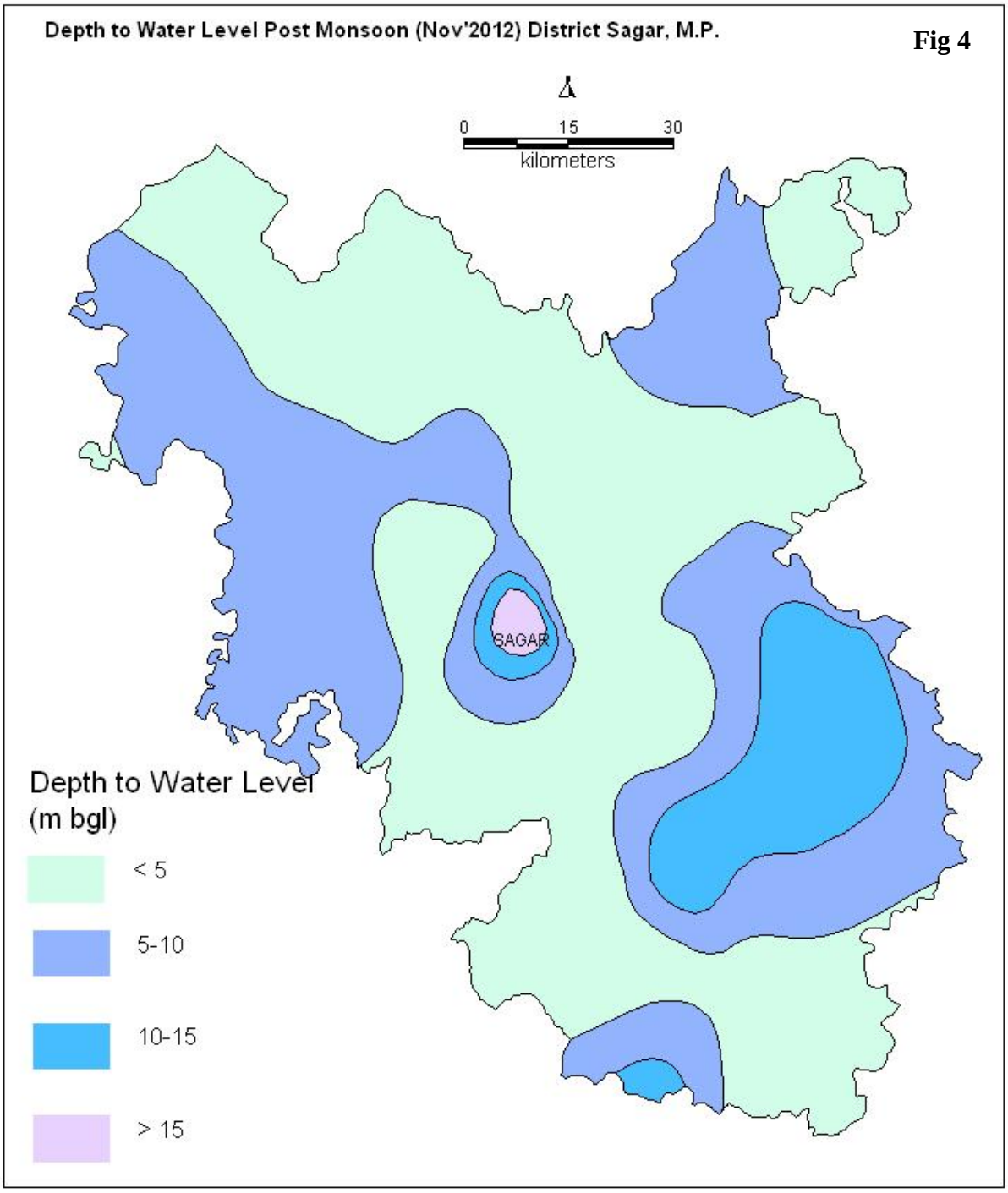


Fig. 3

Post-Monsoon (Nov-2012)

The Postmonsoon depth to water level (DTW) map is presented as fig. 4. The DTW varied from 1.20-20.21 mbgl. In major part the DTW was less than 10 mbgl. Deeper water levels of more than 15 mbgl are observed in an isolated patches in central part.



Water Level Trend (May 2003-12).

The Water level trend for the 10 years (2003-2012) shows that both rise and fall is observed. The rise is observed in the range of 0.01 to 0.17 m/ year. The decline in the range of 0.09 to 0.1 m/year is also observed.

4.3 Ground Water Resources (2009)

Sagar district is underlain by Basaltic lava flows of Deccan trap Vindhyan Sandstone and Alluvium. Dynamic ground water resources of the district have been estimated for base year -2008/09 on block-wise basis (table). There are eleven assessment units (block) in the district which fall under non-command (99 %) and command (1 % Deori, Shahgarh) sub units. Banda, Rehli and Sagar blocks of the district are categorized. as semi critical and rest of the blocks are safe. The highest stage of ground water development is computed as 74 % in Banda block. The net ground water availability in the district 1,12,807 ham and ground water draft for all uses is 66,079ham, making stage of ground water development 59 % as a whole for district. After making allocation for future domestic and industrial supply for next 25 years, balance available ground water for future irrigation would be 44,859 ham.

DYNAMIC GROUND WATER RESOURCES (As on March, 2009)

S. No.	Assessment Unit	Sub-unit Command/ Non-Command/	Net Annual Ground water Availability (ham)	Existing Gross Ground water Draft for Irrigation (ham)	Existing Gross Ground water Draft for Domestic & Industrial water Supply (ham)	Existing Gross Ground water Draft for All uses (ham)	Provision for domestic, and industrial requirement supply to next 25 year (2033) (ham)	Net Ground water Availability for future irrigation d development (ham)	Stage of Ground water Development (%)	Category
1	Banda	Command								
		Non-Command	8862	6335	250	6585	428	2099	74	Semi Critical
		Block Total	**8862**	**6335**	**250**	**6585**	**428**	**2099**	**74**	Semi Critical
2	Bina	Command								
		Non-Command	11828	7082	175	7256	364	4382	61	Safe
		Block Total	**11828**	**7082**	175	**7256**	**364**	**4382**	**61**	Safe
3	Deori	Command	395	142	8	150	21	232	38	Safe
		Non-Command	10839	4889	154	5043	321	5629	47	Safe
		Block Total	**11235**	**5031**	**162**	**5193**	**321**	**5883**	46	Safe
4	Jaisinagar	Command								
		Non-Command	12709	7535	185	7720	357	4818	61	Safe
		Block Total	**12709**	**7535**	**185**	**7720**	**357**	**4818**	**61**	Safe
5	Kesli	Command								
		Non-Command	9505	4005	159	4164	311	5189	44	Safe
		Block Total	**9505**	**4005**	**159**	**4164**	**311**	**5189**	**44**	Safe
6	Khurai	Command								
		Non-Command	13907	8139	318	8457	484	5284	61	Safe
		Block Total	**13907**	**8139**	**318**	**8457**	**484**	**5284**	**61**	Safe

		Command								
7	Malthone	Non-Command	9250	4053	301	4354	405	4792	47	Safe
		Block Total	**9250**	**4053**	**301**	**4354**	**405**	**4792**	**47**	Safe
8	Rahatgarh	Command								
		Non-Command	9862	5470	361	5831	499	3893	59	Safe
		Block Total	**9862**	**5470**	**361**	**5831**	**499**	**3893**	**59**	Safe
9	Rehli	Command								
		Non-Command	8686	5898	249	6147	420	**2368**	71	Semi Critical
		Block Total	**8686**	**5898**	**249**	**6147**	**420**	**2368**	**71**	Semi Critical
10	Sagar	Command								
		Non-Command	9837	6989	284	7274	474	2374	74	Semi Critical
		Block Total	**9837**	**6989**	**284**	**7274**	**474**	**2374**	**74**	Semi Critical
11	Shahgarh	Command	1920	88	16	104	37	1795	5	Safe
		Non-Command	5208	2846	148	2994	379	1982	58	Safe
		Block Total	**7127**	**2934**	**165**	**3099**	**417**	**3777**	**43**	Safe
		District Total	**112807**	**63470**	**2609**	**66079**	**4478**	**44859**	**59**	

4.4 Ground Water Quality

The electrical conductivity (EC) is a measure of salinity. EC ranges from 249 to 2775 $\mu S/cm^2$ at 25 ^{0}C. The nitrate concentration in Sagar district ranges from 3 to 205 mg/l. The fluoride concentration in the district is within permissible limits, it ranges between 0.12 to 0.7 mg/l.