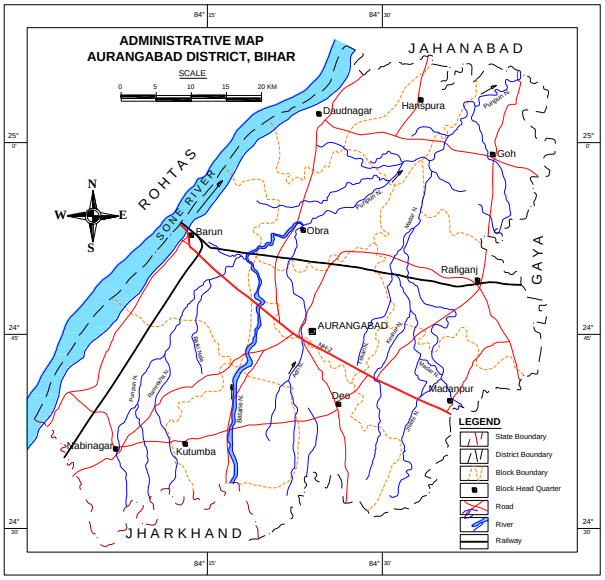
भूजल सूचना पुस्तिका

औरंगाबाद जिला, बिहार

Ground Water Information Booklet
Aurangabad District, Bihar State



केन्द्रीय भूमिजल बोर्ड
जल संसाधन मंत्रालय
(भारत सरकार)
मध्य-पूर्वी क्षेत्र
पटना

Central Ground water Board
Ministry of Water Resources
(Govt. of India)
Mid-Eastern Region
Patna

सितंबर 2013

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PREPARED BY - Sri S. Sahu Sc. C

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AURANGABAD DISTRICT

DISTRICT AT A GLANCE

Sl. No.		Statistics
1.	**GENERAL INFORMATION**	
	I. Geographical Area (Sq. Km.)	3389
	Administrative Divisions	Aurangabad Daudnagar
	II. Population (As per 2011 Census)	Total: 2,540,073 Rural: 2,303,219 Urban: 236,854
	III. Average Annual Rainfall (mm)	1106
2	**GEOMORPHOLOGY**	
	Major Physiographic Units	Quaternary alluvium, Granite-gneiss
	Major Drainages	Punpun River
3	**LAND USE**	
	a) Forest Area	111**
	b) Net Area Sown	1393 sq. km **
	c) Cultivable Area	1393 sq. km**
4	**MAJOR SOIL TYPES**	Loam, silty loam, weathered residuum
5	**AREA UNDER PRINCIPAL CROPS**	Rice-1690 km^2, wheat-643 km^2 (2007-08, Economic Survey 2011)
6	**IRRIGATION BY DIFFERENT SOURCES (Areas and Number of Structures)**	
	Dug wells	4759, 28.55 km^2 (2001 MI Census)
	Tube wells/Bore wells	11715, 117 km^2 (2001 MI Census)
	Tanks/ponds	30 km^2 *
	Canals	1150 km^2 *
	Other Sources	460 km^2 *
	Net Irrigated Area	1820 km^2 *
	Gross Irrigated Area	1940 km^2 *
7	**NUMBER OF GROUND WATER MONITERING WELLS OF CGWB (As on 31-03-2012)**	
	No. of Dug wells	9
	No. of Piezometers	Nil
8	**PREDOMINANT GEOLOGICAL FORMATIONS**	Quaternary Alluvium
9	**HYDROGEOLOGY**	
	Major water bearing formations	Sand zones in Quaternary Alluvium, weathered zone and fracture zones
	Pre-monsoon Depth to water level during 2011	2.22–12.23 m bgl
	Post-monsoon Depth to water level during 2011	0.53–9.3 m bgl
	Long term water level trend in last 10 yrs (1997 –2011) in m/yr	No Significant Decline
10	**GROUND WATER EXPLORATION BY CGWB (As on 31-03-2007)**	
	No. of well drilled (EW,OW, PZ, SH, Total)	1 EW, 2 OW
	Depth Range (m)	101-135 m bgl
	Discharge (m/s)	30-40 m^3/hr
	Storativity (s)	16-28.5
	Transmissitivity (m^2/day)	0.0111
11	**GROUND WATER QUALITY**	Fresh and potable
	Presence of Chemical constituents more than the permissible limit (e.g.EC, F, As, F)	Fluoride
	Type of Water	Na-HCO_3

12	**DYNAMIC GROUND WATER RESOURCES (2009) IN ha.m**	
	Annual Replenishible Ground Water Resources	103150
	Net Annual Ground Water Draft	21132
	Projected Demand for Domestic and Industrial Uses up to 2025	6464
	Stage of Ground Water Development	23.2 %
13	**AWARENESS AND TRAINING ACTIVITY**	
	Mass Awareness Programme Organized	Nil
	Date	Nil
	Place	Nil
	No. of Participants	Nil
14	**EFFORTS OF ARTIFICIAL RECHARGE AND RAINWATER HARVESTING**	Nil
	Projects Completed By CGWB (No. Amount Spent)	Nil
	Projects Under Technical Guidance of CGWB (Numbers)	Nil
15	**GROUND WATER CONTROL AND REGULATION**	
	No. of oE Blocks	Nil
	No. of Critical Blocks	Nil
	No. of Blocks Notified	Nil
16	**MAJOR GROUND WATER PROBLEMS AND ISSUES**	Ground water scarcity and fluoride contamination
	Note: Latest available data may be incorporated	

*Source: Directorate of Statistics and Evaluation, Bihar (1998-99) ** 2010-11

1.0 INTRODUCTION

1.1 Location, Area and Administrative Details

Aurangabad is one of the 38 districts in Bihar. It is one of the 5 districts of Magadh division. The head quarter of the district is Aurangabad. The district with a geographical area of 3389 Km^2 between the longitudes of 84^0 00'- 84^0 45' E and latitudes of 24^0 30' -25^0 15' N is located in the South Bihar Plains (SBP) and constitute a part of the marginal alluvial plains of Ganga Basin. The Sone River forms the western boundary of the district and at the southern boundary lays the Chhotanagpur Granitic Gneissic Complex (CGGC) of Jharkhnad state, which forms a part of the peninsular India (Fig 1). The district is bounded in the north and the east by the Arwal district and the Gaya district respectively.

The district has two sub-divisions namely Aurangabad and Daudnagar and 11 blocks, namely Madanpur, Kutumbba, Daudnagar, Aurangabad, Barun, Obra, Deo, Nabinagar, Haspura, Goh and Rafiganj (Table 1). There is total 224 Gram Panchayats covering 1712 villages in the district.

Table 1: *Details of administrative units.*

S.No.	Block	Panchayats	Villages	Habitations
1	Aurangabad	15	154	279
2	Barun	18	182	261
3	Daudnagar	17	56	137
4	Deo	20	118	264
5	Goh	20	163	235
6	Haspura	20	71	196
7	Kutumba	23	215	238
8	Madanpur	19	117	350
9	Nabinagar	27	284	426
10	Obra	21	144	305
11	Rafiganj	24	208	386
	Total	**224**	**1712**	**3077**

Source: ddws.gov.in

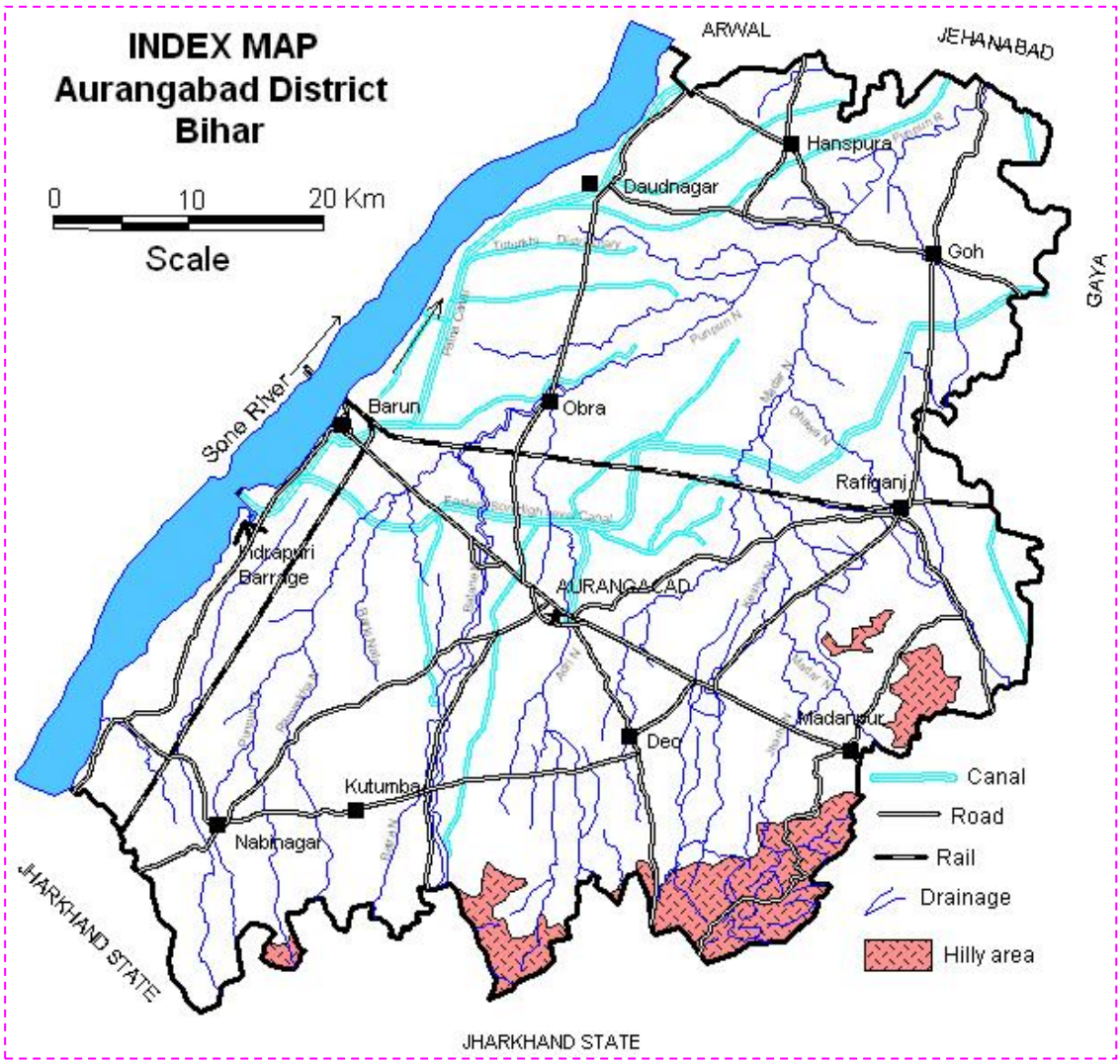


Figure 1: *The map of Aurangabad district with administrative details.*

In 2011, Aurangabad had population of 2540073 (Population Census 2011) of which male and female were 1,318,684 and 1,221,389respectively. The rural population constitutes ~90% of the total population (Table 2). There was change of 24.75 percent in the population compared to population as per 2001. The initial provisional data suggest a density of 769 in 2011 compared to 609 of 2001. Average literacy rate of Aurangabad in 2011 were 70.32. With regards to Sex Ratio in Aurangabad, it stood at 926 per 1000 male compared.

Table 2: *Statistics of population census 2001 and 2011 for Aurangabad district, Bihar.*

Description	2011	2001
Actual Population	**2.540.073**	**2.013.055**
Male	1,318,684	1,040,945
Female	1,221,389	972,110
Population Growth	**26.18%**	**30.19%**
Area Sq. Km	3,305	3,305
Density/km2	**769**	**609**
Proportion to Bihar Population	2.44%	2.43%
Sex Ratio (Per 1000)	**926**	**934**
Child Sex Ratio (0-6 Age)	944	943
Average Literacy	**70.32**	**57.03**
Male Literacy	80.11	71.13
Female Literacy	59.71	41.90
Literates	**1,466,002**	**920,766**
Male Literates	868,733	594,522
Female Literates	597,269	326,244

1.2 Basin/Sub-Basin and Drainage

The Aurangabad district falls in the Punpun River Sub-basin. The craton-origin Punpun River is a 3rd order stream, forming a souther tributary of the Ganga River. It forms the major drainage and the entire Aurangabad district falls in the watershed of the river. There are other drainages namely Batane, Batre, Adri, Ramrekha, Kasman, Madar, Dhawa etc, which merge with Punpun at different points within the district and the trunk river flows out of the district as a single thread (Fig 1). Major stretches of the river seem to follow the palaeochannels of Sone. The river in its northern stretches is highly incised and often braided. The northwestern peripheral part is drained by the river Sone, flowing from south-west to north-east. Though, the Sone and the Punpun bear little flow during non-monsoon periods, most of the other streams in the district remain almost dry during the same period.

1.3 Water use habits

People of Aurangabad district depend on groundwater for their drinking need, except few urban areas, which get the water supply from nearby rivers, i. e. a part of the drinking need of Aurangabad town is met from the Batane River due to lack of any potential aquifer beneath the town. Earlier, people used to depend on dug wells/dug-cum-bore wells to tap groundwater. Minor Irrigation Census of 1993-94 for the state of Bihar reported 9056 of such groundwater

abstraction structures to exist in the district. However, the use of such structures is in a decline phase and the MI Census of 2001 reports only 4759 of such structures. Hand/machine driven tube wells fitted with hand pumps have been popular in the district due to shallow water level in major parts.

People depend on supply of water from the barrage on Sone River at Indrapuri for irrigation. Available surface water in streams and ponds are also used for irrigation during the dry periods.

1.4 Agriculture and Irrigation Practices

The people of the district depend on agriculture for their livelihood and sustenance. Rice and wheat are the staple crops. Besides, mustard, vegetables and dal are richly cultivated, specifically in the southern parts of the district. The northwestern parts of the district covering the blocks such as Barun, Obra, Daudnagar, Goh and Hanspura get East Sone Canal water for irrigation. Though, there is a culture of triple harvesting a year in the district, in many parts people fail to achieve this due to lack of irrigation facilities.

Plate 1: *Rich rice cultivation in Aurangabad district during the summer.*

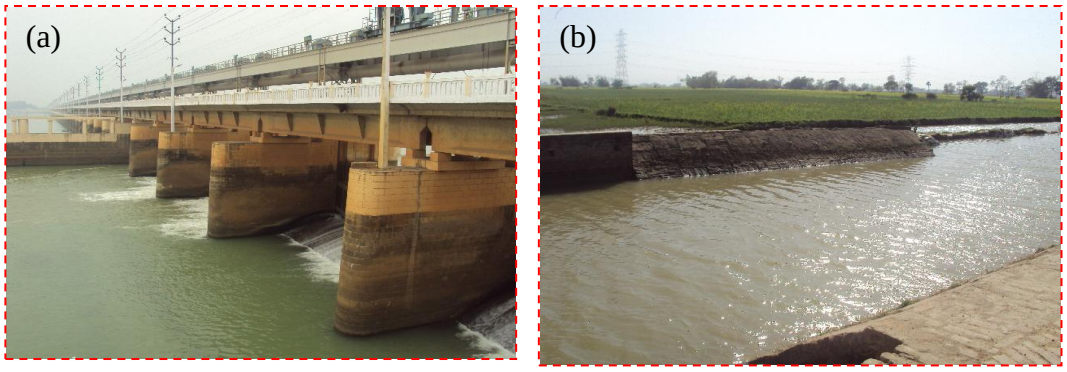


Plate 2*: (a) Photo of barrage on Sone River at Indrapuri. The Eastern Canal System from barrage provides irrigation water in parts of western South Bihar Plains. (b) Canal water in Aurangabad and irrigation for winter paddy and Dal crops.*

In the southern parts of the district, the hand driven bore wells range in depth from <10 m bgl to 30-35 m bgl. Though, these bore wells fitted with hand pumps yield sufficient water for drinking, they are not potential to meet the irrigation need. Mechanically drilled bore wells go deeper in the hard rock to tap fracture zones and often yield enough water for irrigation. For instance, a tube well of 40 m depth, constructed in the weathered/fracture zones run throughout the day with a 5 HP pump fitted in it, delivering a discharge of 5-7 liters per second (lps). The rivers such as Punpun, Barane, Adri, Ramrakha, Kasman, Dhawa and other small streams form the lifeline for the farmers, without which, large tracts of farm lands would go dry during the non-rainy days. Very often people use diesel operated pump sets to lift water from the surface water sources such as rivers/nala/ponds. Specifically, winter crops (paddy, Dal, Mustard, Jute etc) get a major help from these rivers.

Plate 3: *Lift irrigation from streams/rivers in Aurangabad district.*

Plate 4: *(a) Small barrage on the river Kasma, from which a small canal (also known as Pyne) goes for irrigation (west to the photograph). (b) Check dam on the river Ramrekha on way from Amba to Deo, still makes a small reservoir in the month of February, assuring irrigation for the adjoining agricultural lands.*

Since, majority parts of the district, particularly the northern and central parts, remain under shallow water level condition (2-8 m bgl), earlier, people used to irrigate small patches of agri-fields through dug wells. *Rehat* is an old system of lifting water from the dug wells through a series of buckets attached with a rope, which remains fitted with one pulley. Such

systems are found along the rivers as mentioned above, where the dug well remain connected with the river water. Animals were used to run the pulley. However, such systems in the district have either been obsolete or abandoned due to decrease in the flow in the streams/Nalas. *Latha-kudi* is another traditional process of drawing water manually from the dug well using a single bucket. People have opted for specifically diesel pumps (3-5 HP) operating in the dug wells and bore wells.

Plate 6: *(a) Phograph showing electric operated diesel pump drawing water from the dug well. (b) Water transported to long distance for irrigation from bore well fitted with pump.*

Plate 5: *Rehat system for groundwater irrigation from dug well (at Amba) in Aurangabad district in the South Bihar Plain.*

1.5 Ahar-Pyne system of irrigation

Ahar-Pyne system is an indigenous surface water irrigation technology of South Bihar Plains (SBP), which continues to irrigate substantial areas even today in the region. High slope of land surface (~1.0 m/Km) is favourable for its success in SBP. An Ahar resembles a rectangular catchment basin with embankments on three sides. These structures serve to

Plate 7: *A small Arar in Kutumba block of Aurangabad district.*

accumulate the flood water/surface run-off during monsoon. Pynes are artificial channels constructed from rivers to divert water for irrigation. These are often connected to the Ahars for assuring supply of water to it. Ahar were sometimes built at the end of small rivulets or artificial channels called Pynes to ensure the supply of water. These structures augment artificial recharge in the region.

In the Aurangabad district, a total of 1251 Ahar and Pyne structures are operational for the purpose of irrigation. These are traditional system of surface water irrigation in the SBP.

1.6 Status of agriculture and irrigation

There are four cropping seasons in the district. Bhadai and Aghani form Kharif season, followed by Rabi and Garma (Table 3). The cropping intensity varies within 107% and 147% (Table 4).

Table 3: *Duration and crops harvested in different seasons in Aurangabad district, Bihar.*

Cropping Season	Period	Main crops grown
Bhadai	Aprill/May to August/Septemebr	Paddy, maize and millet, moong, Jute
Agahani	June to October/November	Paddy harv, Paddy general, urd, vegetables
Rabi	October/November to March	Wheat, maize, and masoor, khasari, vegetables, oilseeds,
Garma	March/April to June	Paddy, maize and millet, moong, vegetables

Table 4: *Agriculture and Irrigation status in Aurangabd district of Bihar (Area in ha).*

S. No	Blocks	Geographical Area	Net sown area	Area sown more than once	Gross area sown	Cropping intensity	Irrigation intensity	Gross area irrigated
1	Aurangab	28210	15415	1039	16454	107	85	14031
2	Barun	31036	23187	3392	26579	115	67	17695
3	Daudnaga	38521	-	-	-	-	-	-
4	Deo	27326	-	-	-	-	-	-
5	Goh	30402	19345	5865	25210	130	69	17337
6	Haspura	13869	11027	3606	14633	133	95	13942
7	Kutumba	25966	16046	7501	23547	147	72	16851
8	Madanpur	34227	15453	1411	16864	109	78	13199
9	Nabinagar	54818	-	-	-	-	-	-
10	Obra	26464	21249	9482	30730	145	90	27792
11	Rafiganj	37968	17581	4269	21850	124	72	15694
	Total	**348807**	**139302**	**36566**	**17586**	-	-	**136541**

(Source: District Statistics Department, GOB)

Irrigation plays a vital role in the agriculture in the district. Both surface and groundwater irrigation is being practiced in the district. The northern parts of the district fall in the command area of East Sone Canal System. The groundwater forms a minor irrigation source in the district with only 20% of the net irrigated area getting the source from groundwater (NIC-1998-1999, Govt. of Bihar). Canal water accounts 80% of the irrigation need in the district.

1.7 Studies/Activities carried by CGWB

CGWB has drilled exploratory well at Deo in Aurangabad district down to a depth of 135 m. The drilling data shows that weathered formation starts from few meters below ground and goes up to 26 m bgl. The massive granite gneiss is encountered afterwards, intervened with fracture zones at depth ranges of 33-35, -53, 68-70 and 79-80 m bgl. Besides these, water samples are being collected from hand pumps (shallow tube wells) and dug wells at regular intervals in order to assess the development of arsenic in a response to the water table fluctuation. Water levels from some particular dug wells, known as Hydrograph Network Stations, are being taken four times in a year. These data reflect any change in ground water regime in the dug wells in a response to the monsoonal pattern (shallow aquifer) and are used to estimate the ground water resource available in the district for irrigation, drinking and industrial purposes.

2.0 CLIMATE AND RAINFALL

A warm and humid climate embraces the area. 175 The summer (March–June) is hot with mean maximum temperature during June (peak summer) as 36.6^{0}C. A dry and cold winter (October to February) records mean minimum temperature as 9.2^{0}C in January. Humidity varies from 24.7% to 83.45% (Govt. of Bihar 1994). The districts in the SBP fall in the South Agro-Climatic Zones of Bihar and the annual rainfall in this area varies within 990-1300 mm. 88% of this rainfall comes during the southwest monsoon (June to September). The months July and August register peak rainfall in a year (Fig 2.A). The last decade rainfall distribution indicates alternate peaks and troughs in rainfall (Fig 2.B).

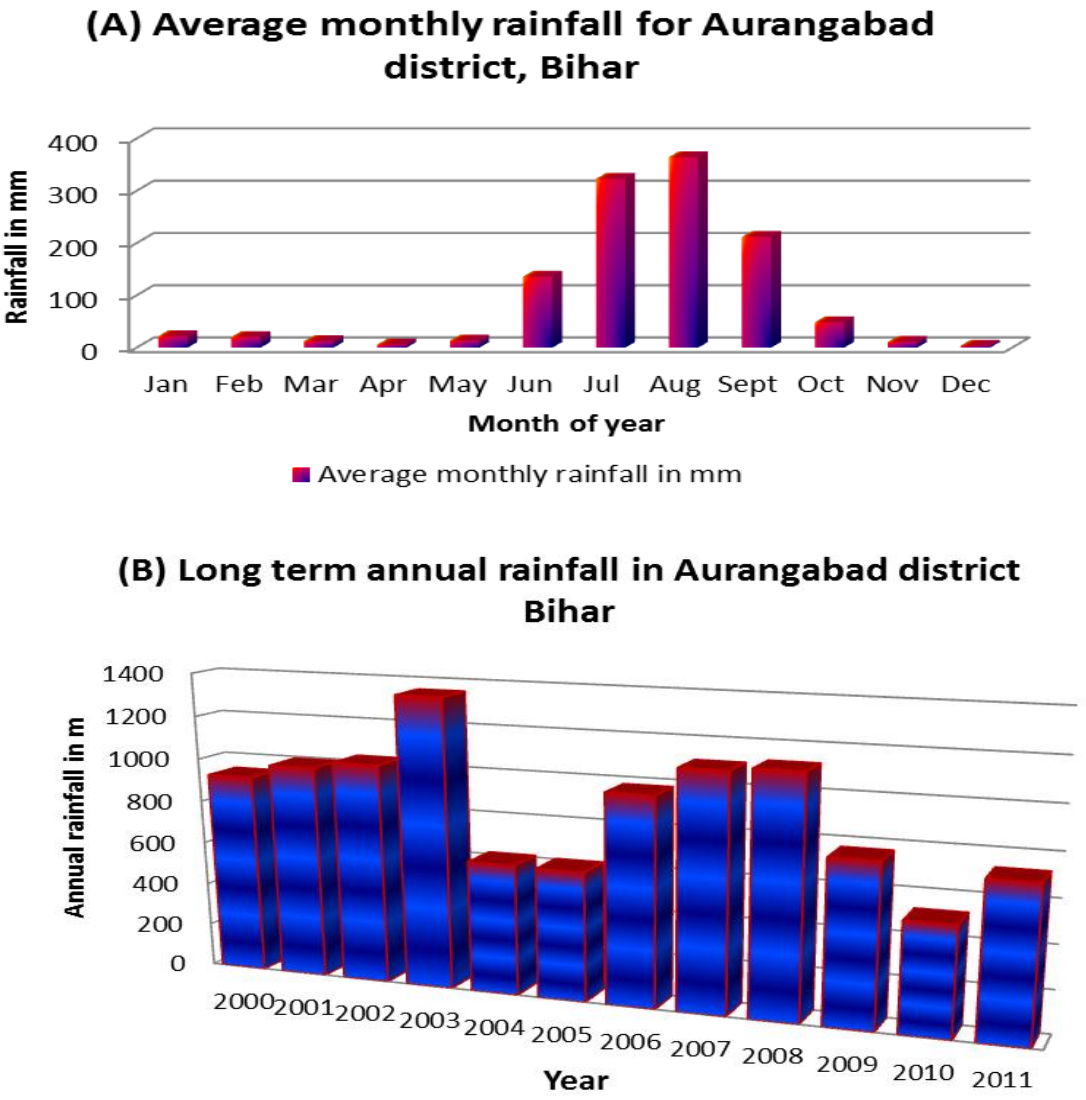


Figure 2: ***(A)*** *Average monthly rainfall in mm for Aurangabad district.* ***(B)*** *Trend in annual rainfall distribution observed during last 10 years (2000-2011) in the district.*

3.0 GEOMORPHOLOGY

3.1 Physiography

The southern hilly ranges and the northern Gangetic Plains form two physiographic units of the Aurangabad district. The southern hilly unit is undulating in character, occupied by high mountain ranges and low valleys covering parts of Kutumba, Nabinagar, Deo and Madanpur blocks. The constituting rocks of the hills dip northward and form the basement of the northern lying Gangetic Plain. At the transition parts from hard rock to alluvial plain, the hard rocks are exposed (linearly) at places as inliers. The northern alluvial plain slopes NNE.

The maximum elevation is attained to heights of 411.48 m above mean sea level by the hills located south of Deo. The minimum elevation of ~80 m amsl runs at the northeastern parts around Goh (Fig 3).

Plate 8: *Granitic gneiss exposures near Amba. Artificial pond near the mound holding water during the month of November 2011.*

Figure 3: *Surface elevation contour map of Aurangabad district. Mostly, the district is covered in the elevation range of 80-140 m amsl.*

3.2 Soil

Three types of soil are mainly observed in the district: (1) Younger Alluvial soils, (2) Older Alluvial soils, and (3) Foot hill soils.

These soils have been formed as a narrow belt along the western periphery of the district following the Sone River. These are generally yellowish white to reddish yellow in colour, sandy to loamy sand in texture.

Major parts of the district are occupied by the Older Alluvial soils. These soils are composed of very fine to fine sand and clay. These are gray to grayish yellow in colour and moderate to heavy in texture. They develop wide polygonal cracks during the dry season. Layers of calcium carbonate concretions are also common in some places.

The foot hill soils occur at the southern parts of the district in the blocks of Kutumba, Deo, Madanpur and Rafiganj. These soils are mainly derived from the crystalline rocks. These soils form a very thin veneer over the bed-rocks. These are generally light textured, stony and gravelly, moderately acidic in nature. Most of these soils support the forests.

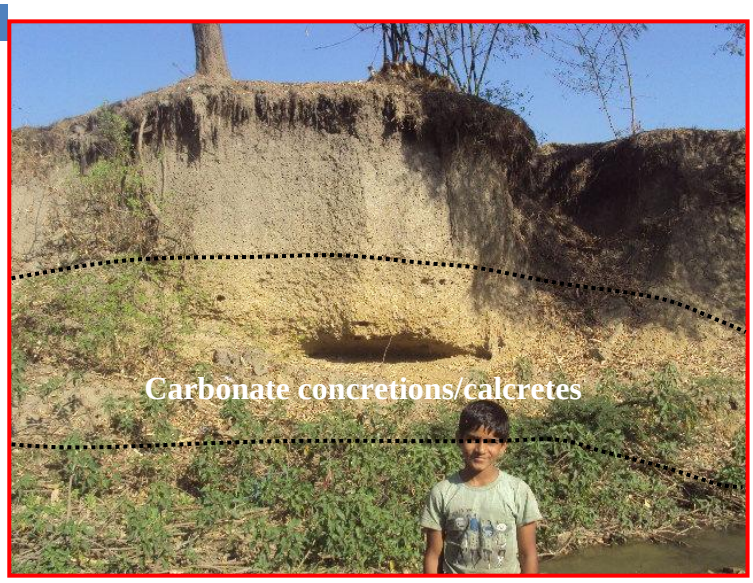
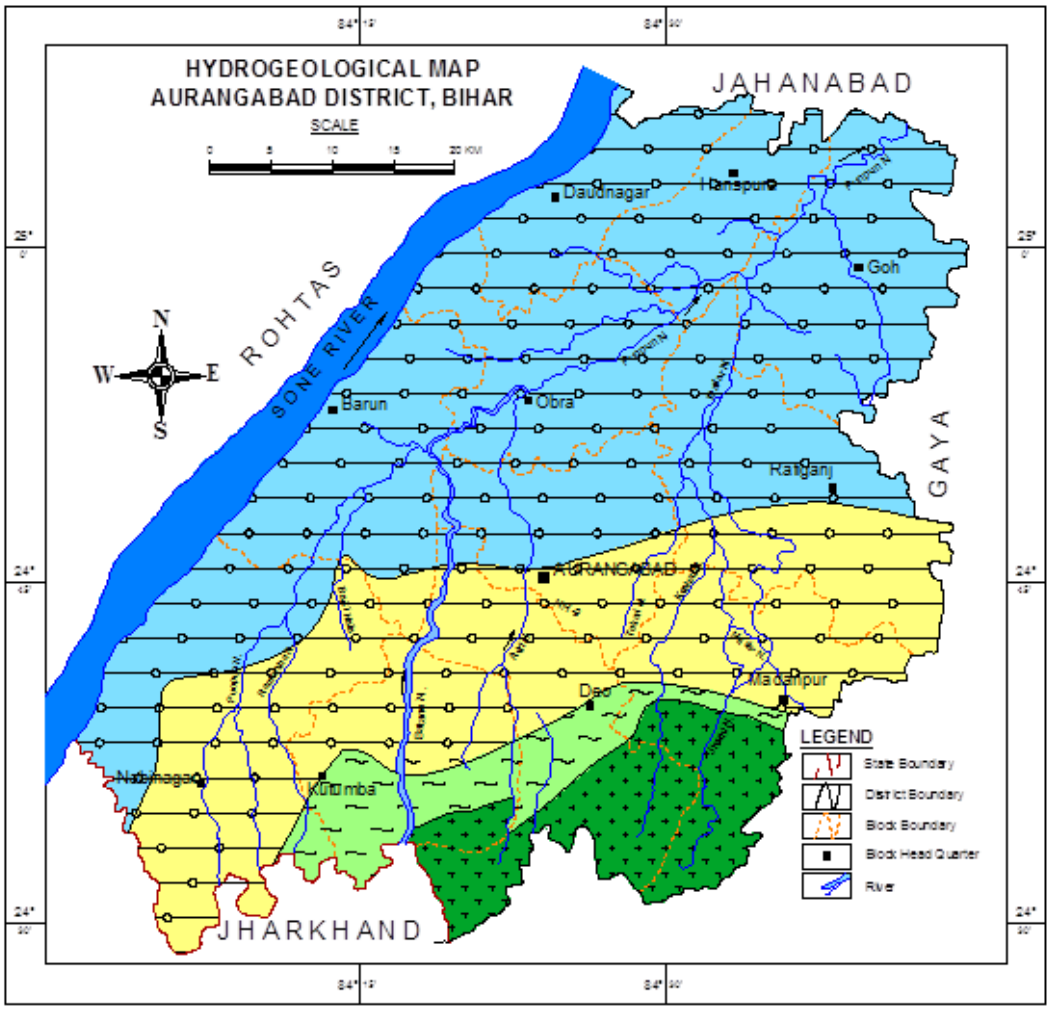


Plate 9: *Older Alluvial soil displaying calcretized zone near Kasma.*

4.0 GROUND WATER SCENARIO

4.1 Water Bearing Formations

Unconsolidated Quaternary Alluvium, weathered zone and consolidated (fissured) formation-Granite gneiss form three hydrogeological units in the district (Fig 4). About 95% of the geographical area of the Aurangabad district is covered with Quaternary Gangetic alluvial deposits. The groundwater occurs under unconfined conditions in the shallow aquifer whereas in the deeper aquifers it occurs under confined conditions. The shallow tube wells in the depth range of 30-50 m are capable of yielding 15-20 m^3/hr discharges, whereas, the deeper aquifers are capable of yielding 50-100 m^3/hr. The thickness of the weathered zone ranges from 5 m to 30 m. Ground water occurs under unconfined condition within the weathered mantle. Joints, cracks, fractures and other types of secondary porosity control the occurrence and movement of groundwater. The discharge and yield of the wells varies from place to place due to in-homogeneity of the fractures. The results of the exploratory drilling carried out by the Central Ground Water Board at Deo in the hard rock area indicate presence of 2 to 3 sets of productive fractures down to a depth of 135 m (33-35 m, 68-70 m & 79-80 m depth ranges). The yield from the wells varied between 30-40 m^3/hr. The transmissivity of the fracture zones varied between 16-28.5 m^2/day, whereas, the storativity was estimated at 0.0111 indicating unconfined character of the aquifer.



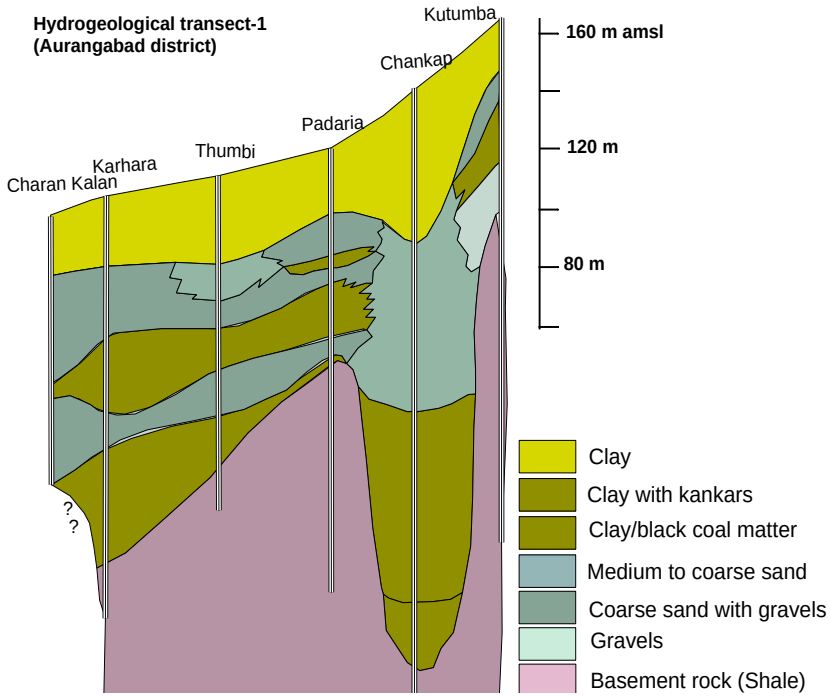
FORMATION	LITHOLOGY	THICKNESS	GROUND WATER POTENTIAL
Unconsolidated	Alluvium	Tickness varies from 50 - 100m.	Yield vary from 100 - 200 cu. m./hr
	Marginal Alluvium	Thickness varies from 30 - 50m.	Yield vary from 50- 100 cu.m./hr.
Consolidated	Weathered zone	Thickness varies from 10 - 15 m.	Yield vary from 60 to cu.m./day
	Granite gneiss	Fractured and joint	Fractured and joint

Figure 4: *Hydrogeological map of the Aurangabad district depicting various formations and their probable groundwater yield capability.light blue and yellow indicates alluvium. Light green is weathered zone and piedmont surface. Deep green is hard rocks.*

The hydrogeological transects (Fig 5) indicate the existence of prolific aquifers in the northern and northwestern parts of the district thick deposits of sand of size varying between fine to coarse in the areas. The lithology becomes more clayey towards south. The central and southwestern parts of the district are clayey in character with infrequent minor sand zones. The

Sone River has played an important role in building the stratigraphic succession in the Aurangabad district.

(a



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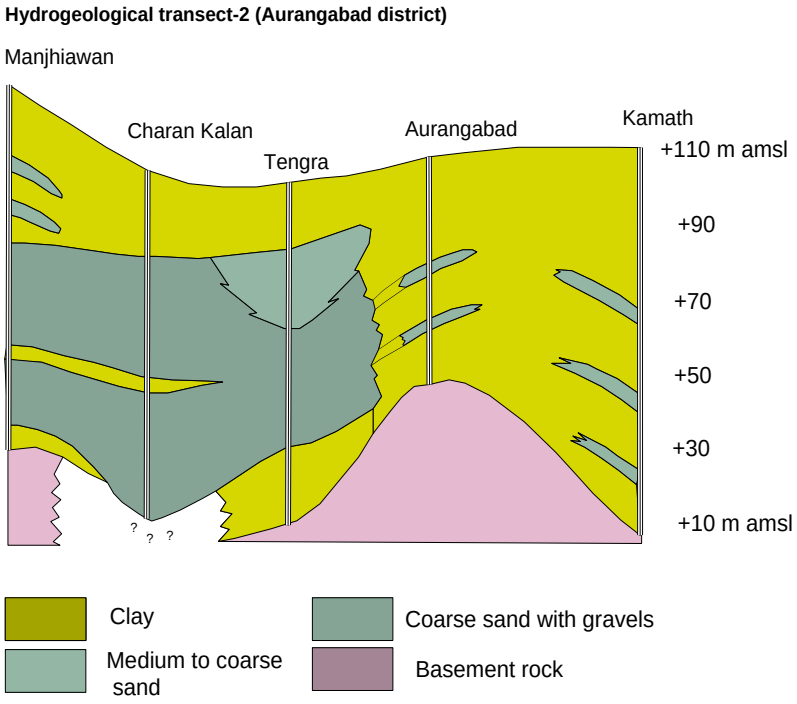


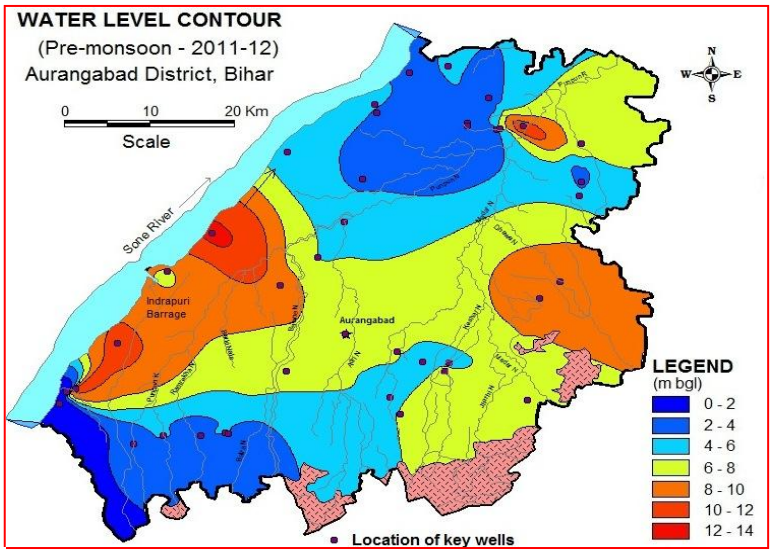
Figure 5: *(a) Hydrogeological transect in north-south direction from Charan Kalan to Kutumba. It depicts two aquifers within ~100 m depth merging towards north. (b) The hydrogeological transect in west-east direction at abouth central parts of the district. It shows two considerably potential aquifers merging at the central parts of the section. The eastern parts of the transect around Aurangabad proper and further east shows dominance of clay with hardly any sand zone.*

4.2 Depth to Water Level

The pre-monsoon depth to water level (DTW) map depicts the variation of water level within the range of <1.0 and 12.23 m below ground level (m bgl) (Fig 6.a). The deeper water levels (>8 m bgl) are observed in the areas close to Sone River and at the down reaches of

Punpun River at the western and northeastern parts respectively, whereas the shallow water levels (<6 m bgl) are observed at the northern and southern of the district. The post-monsoon depth to water level records autoflow-wells at the southwestern corner of the district with piezometric level resting at a maximum of 1.50 m above ground level (- 1.5 m in the map). The DTW map of the season depicts the variation of water level within -1.50 m agl to and 10.40 m bgl (Fig 6.b). Seasonal water level fluctuation (rise in water level) remains within 0.84-5.93 m.

(a)



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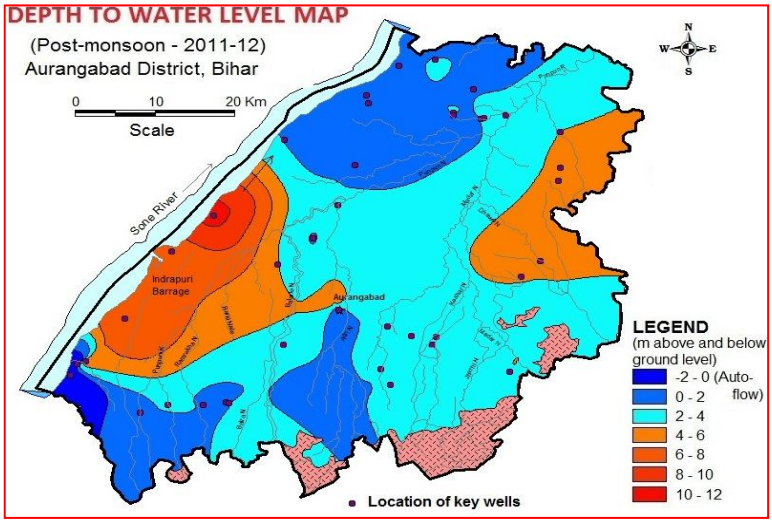

Figure 6: *(a) Depth to water level map of pre- and (b) post-monsoon periods for Aurangabad district in SBP. The map displays the autoflow condition in the district at its southwestern corner.*

Plate 10: *Autoflow-well at Tetaria more in Nabinagar block.*

4.3 Ground Water Quality

The general range of various chemical constituents in standard drinking water are given in the following table 5:

Table 5: *Ground water quality parameters and their BIS norms.*

Chemical constituents (mg/l)	Drinking Water Standard (As per BIS norms)	
	Highest Desirable	Maximum Permissible
pH	6.5 – 8.5	No relaxation
E.C (Micro-siemens/cm at 25^{0}C)	500	2000
Total Hardness ($CaCO_3$)	300	600
Bicarbonate	200	600
Calcium	75	200
Magnesium	30	100
Chloride	250	1000
Sulphate	200	Up to 400 if Mg is <30
Nitrate	45	100
Sodium	-	-
Potasium	1.90 - 50	-

Except few patches, the groundwater in the shallow aquifer in major parts of the district is fresh and potable with all the major parameters of quality falling well within the permissible limit (Table 6). Electrical conductivity (EC) of groundwater has been observed beyond 2000 ms/cm at locations such as Pritampur and Rishiap falling in the block of Deo and Aurangabad. Fluoride levels greater than the permissible limit of 1.5 mg/L are observed in the blocks of Madanpur, Deo and Nabinagar blocks.

Table 6: *Ground water quality in Aurangabad district (year 2011)*

Sl No	Location of water sample	mg/L									EC (ms/cm)	TDS
		pH	Ca	Mg	Na	K	CO3	HCO3	Cl	TH as CaCO3		
1	Pritampur	7.72	216	63.18	275	135	0.0	1037	536.1	800	3560	5651
2	Rishiap	7.52	98	43.74	275	3	0.0	402.6	465.1	425	2630	4174
3	Kutumba	7.8	66	99.63	122	9.7	0.0	603.9	262.7	575	1777	2821
4	Mahuari	7.88	44	34.02	57	3.5	0.0	427	67.5	250	858	1362
5	Barem	7.75	94	37.67	125	6.9	0.0	427	149.1	390	1491	2367
6	Sheikhpur	7.55	58	13.37	55	40	0.0	329.4	63.9	200	735	1167
7	Dehri lock	7.5	54	10.94	15	1.6	0.0	219.6	17.8	180	393	624
8	Akbarpur	7.9	20	34.02	65	0.8	0.0	378.2	39.1	190	732	1162
9	Karhara	7.92	26	26.73	42	0.6	0.0	317.2	21.3	175	606	962
10	Gopalpur	7.94	34	44.96	82	1.5	0.0	469.7	81.7	270	985	1564
11	Shivganj	8.03	30	26.73	52	1.6	0.0	335.5	46.2	185	680	1079
12	Neema	8.31	12	42.53	122	3.1	0.0	463.6	78.1	205	1041	1652
13	Goh	7.8	38	20.66	67	1	0.0	372.1	35.5	180	705	1119
14	Pachrukhia	7.8	16	20.66	65	1.1	0.0	329.4	10.7	125	589	935

Plate 11: *(a) Defluoridation plant installed with a tube well in Aurangabad district. (b) A case of mottled teeth in a child (Erki village). (c) & (d) Child with skeletal fluorosis and abnormal growth of body and mind (Erki village).*

4.4 Ground Water Resources

Aurangabad district possesses a total of 91046 ham as the annual replenishable groundwater resource (As on 31st March 2009). The average stage of groundwater development is only 23.2 % (Table 7). Though, the groundwater level in majority blocks register declining trend, it is still not alarming and significant. As such, all the blocks in the district are safe from groundwater development point of view and thus the district possesses a huge potential for developing the resource. Ground water resource in meter is given Fig 7.

Table 7*: Stage of ground water development of Aurangabad District as on 31st March 2009.*

Sl.No	Assessment Unit/ District	Net Annual Ground water Availability	Existing Gross Ground Water Draft for Irrigation	Existing Gross Ground water Draft for Domestic and Industrial Water Suply	Existing Gross Ground Water Draft For all Uses (10+11)	Allocation for Domesticand Industrial Requirement suply upto next 25 years	Net Ground Water Availability for future irrigation development (9-10-13)	Stage of Ground Water Development (12/9)*100 (%)
1	2	9	10	11	12	13	14	15
1	Aurangabad	9771	974	415	1389	748	8049	14.2
2	Barun	10953	1844	288	2132	469	8640	19.5
3	Daudnagar	5484	1090	306	1396	530	3864	25.5
4	Deo	5481	749	246	995	400	4332	18.1
5	Goh	8548	2695	330	3025	538	5315	35.4
6	Haspura	5202	2156	225	2381	366	2681	45.8
7	Kutumba	7232	1433	327	1760	533	5266	24.3
8	Madanpur	7433	1449	297	1746	483	5501	23.5
9	Nabinagar	14247	1064	527	1592	911	12272	11.2
10	Obra	6756	1371	320	1690	521	4864	25.0
11	Rafiganj	9939	2476	550	3026	965	6498	30.4
	Total	**91046**	**17302**	**3831**	**21132**	**6464**	**67280**	23.2

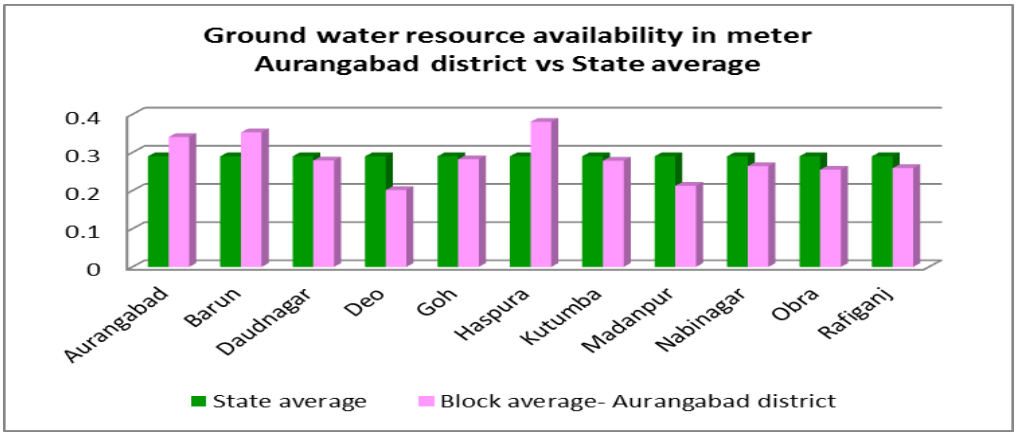

Figure 7: *Ground water resource availability in 'm' per unit area of Aurangabad vs Bihar state.*

5.0 GROUND WATER MANAGEMENT STRATEGY

5.1 Ground Water Development

As per MI census 2001, a total of 11715 shallow tube wells (~ 3 STWs per km^2) were operating in the district. Most of the STWs in the district are constructed within the depth range of 30-50 m. These wells can sustain the discharge of a 5 HP pump of about 20 m^3/hr discharge. The granular zones tapped trough deep tube wells within the depth of 100 m in the northern parts of the district can yield up to 150 m^3/day.

5.2 Design and construction of tube wells

(a) Sallow Tube Wells

The STWs in the depth range of 30–50 m bgl can yield up to 50 to 75 m^3/hr. A well assembly of about 76 to 102 mm diameter with about 10 to 20 m slotted pipe can be used for construction of such wells.

(b) Deep Tube Wells

Table 8: *Proposed Model of DTWs in Aurangabad District*

Sl.No.	Discharge (m^3/hr)	Proposed Depth of well (m bgl)	Proposed Diameter of well (mm)	Assembly Length (m)
1	100	100	306 – casing pipe 153 – slotted pipe 153 – blank pipe	25 24 51

The slot size should be recommended depending on the grain size of the granular zones as given below;

Table 9: *Proposed slot openings for tube wells in Aurangabad District*

Fine sand	: 1/64” (0.04 cm) to 1/32” (0.08 cm)
Medium to coarse sand	: 1/16” (0.15 cm)
Gravel	: 1/8” to 1/16”

Both the shallow as well deep tube wells should be artificially packed with gravels of size ranging within 2–3–4 mm and a bail plug of 2–5 m should be provided in order to the yield and life of the well.

5.4 Water Conservation and Artificial Recharge

In order to keep the water flowing in the rivers in the district, it is important to maintain the groundwater level at shallow depth. Artificial recharge is the technique through which, surface water/run-off is facilitated in in-filtering to sub-surface formations through artificially changing the natural conditions. Proper maintenance of Ahar and Pynes helps in recharge to groundwater also. The areas, where the long term (at least 10 years) average post-monsoon water level remains deeper (generally > 3.0 m bgl), can be taken for artificial recharge to groundwater. However, the areas close to Sone, which show mostly the deepest water levels, are not suitable for the recharge. The techniques which are suitable for the artificial recharge in the district include *Percolation Tanks, Nala Bunding* and *Gully Plugs* in hard rock areas and *Nala/contour Bunding, Percolations Tanks and Recharge Shafts in* marginal alluvial areas. The minor irrigation structures on rivers and Nalas such as the *mini check dams* constructed over the small rivers in the district can wonder in serving for irrigation and groundwater recharge.

6.0 GROUND WATER RELATED ISSUES AND RELATED PROBLEMS:

Ground water scarcity and pockets of fluoride contamination are the major issues and challenges in the Aurangabad district.

7.0 MASS AWARENESS AND TRAINING PROGRAMME

Mass awareness programme is yet to be carried out in the district.

8.0 AREA NOTIFIED BY CENTRAL GROUND WATER AUTHORITY/ STATE GROUND WATER AUTHORITY

Since all blocks of the district come under safe category from groundwater development point of view, no area is notified either by Central Ground Water Authority or State Ground Water Authority till date.

9.0 RECOMMENDATIONS

1. In the southern parts of the district in Deo, Madanpur, Nabinagar, Aurangabad Kutumba and Rafiganj blocks, large diameter dug wells can be utilized for the development of the dynamic groundwater resource.
2. Surface water bodies should be revived, which would help for irrigation and groundwater recharge.
3. Check dams, Nala Bunding, Gully Plugs on the small streams and gullies would help for checking the run-off, thus augmenting groundwater recharge and irrigation.

4. Artificial recharge to groundwater in the blocks of Deo, Madanpur, Rafiganj and Nabinagar would help in maintaining the flow in the streams in the area, which are the lifeline of farmers.
5. The autoflow zone at the southwestern corner of the district, in the adjoining tracts of Nabinagar, should be harnessed for irrigation. The autoflow continues for at least 5 months (August to December).

Annexure

Table: Ground water samples analyzed for fluoride content.

Sl No	Location	Source	Detail description of location	Fluoride content (mg/L)
1	Manjhiawan	TW	Before Dehri lock to Barun	0.54
2	Mang Rahia	TW	After Dehri lock to Barun	0.54
3	Shobhekhap	TW	In between Barun and Sheikhpura	0.51
4	Sasana	TW	1.5 km before Nabinagar	0.37
5	NTPC Surar	TW	On way from Barun to Nabinagar	0.26

6	Tetaria more	TW	After crossing NTPC campus	0.19
7	Nabinagar	TW	2 km after Nabinagar town	0.26
8	Ordi	TW	On way to Aurangabad from Nabinagar near pahari	1.93
9	Telhara	TW	On way to Deo from Amba	0.37
10	Niranjanpur	TW	On wat to Deo, 2 km after the previous one	0.54
11	Dubka (Simri)	TW	4 km before Deo	0.54
12	Bishunpur	TW	3 km before Deo	0.6
13	Bambhori	TW	Before Deo	1.55
14	Bambhori-1	TW	Before Deo	0.67
15	Erki	TW	South of Deo	0.35
16	Erki-1	TW	South of Deo	2.15
17	Deo	TW	Block office	0.57
18	Madanpur	TW	Madanpur bazaar	0.40
19	Juburi	TW		1.23
20	Kolduha	TW	After crossing Madanpur to Kasma	2.47
21	Kolduha-1	TW	-do-	1.88
22	Salaiya	TW	Haribigha	0.2
23	Bela	TW	Before Kasma	0.79
24	Maheshpur	TW	Before Kasma	0.86