

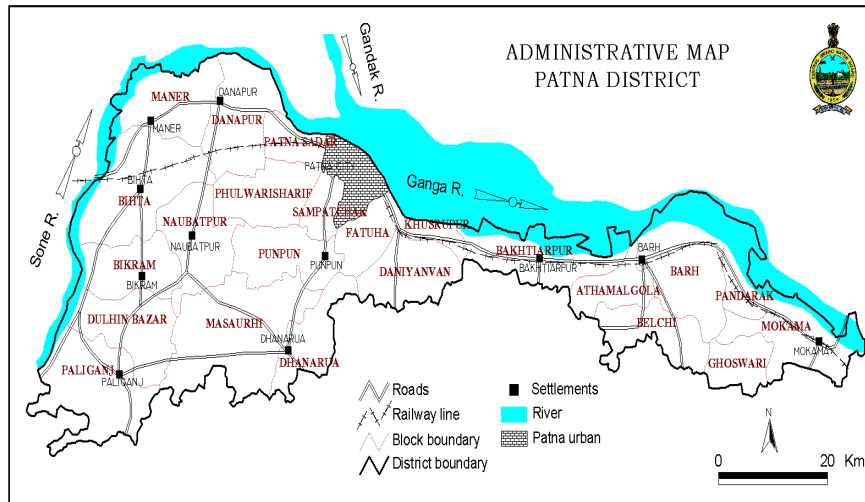


भूजल सूचना पुस्तिका

पटना जिला, बिहार

Ground Water Information Booklet

Patna 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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Patna district

DISTRICT AT A GLANCE

Sl. No.	ITEMS	Statistics
1	GENERAL INFORMATION	
	i) Geographical area (Sq.km)	3172
	ii) Administrative Divisions	6
	Number of Tehsil/Block	23
	Number of Panchyat	344
	Villages	1433
		1294 (Inhabited)
		139 (Uninhabited)
	iii) Population (As on 2011 Census):	
	Rural	3262711
	Urban	2510093
	Total	5772804
	iv) Average Annual Rainfall (mm)	1076
2	GEOMORPHOLOGY	
	Major physiographic units	Quaternary Alluvium
	Major Drainages	Ganga, Sone, Punpun, Phalgu
3	LAND USE (ha)	
	a) Forest area:	56 ha
	b) Net area sown:	195760
	c) Total Cropped area:	227135
4	MAJOR SOIL TYPES	Heavy clay (Kewal) Loam (Domat) Very Light soil (Balsundri) Alkaline (Rehara)
5	AREA UNDER PRINCIPAL CROPS	
6	IRRIGATION BY DIFFERENT SOURCES (Area in ha, Govt. of Bihar 2008-09)	Area (ha)
	Dug wells and Tube wells	85000 ha
	Canal	24000 ha
	Net irrigated area	109000 ha
	Gross irrigated area	1,63,000 ha
7	NUMBERS OF GROUND WATER MONITORING WELLS OF CGWB (2011)	
	No. of Dug wells	11
	No. of Piezometers	7
10	PREDOMINANT GEOLOGICAL FORMATIONS	Quaternary to recent alluvium of varying grades of sand
11	HYDROGEOLOGY	
	➤ Major Water bearing formations	Alluvium
	➤ Pre-monsoon Depth to water level during	3.64 – 10.09 m bgl

	<p>2011</p> <ul style="list-style-type: none"> ➤ Post-monsoon Depth to water level during 2011 ➤ Long term water level trend in 10 years (2002-2011) in m/yr 	1.40 – 7.12 m bgl
12	GROUND WATER EXPLORATION BY CGWB (As on 31.03.2013)	
	No. of wells drilled (EW, OW, PZ, SH = Total)	31 EW, 12 OW, and 11PZ (Total 54)
	Depth Range (m)	77 – 353.7 m bgl
	Discharge	45 – 535 m ³ /hr
	Storativity (S)	7.7 X 10 ⁻² to 3.22 X 10 ⁻⁶
	Transmissivity (m ² /day)	3786 - 19540 m ² /day
13	GROUND WATER QUALITY	
	Presence of Chemical constituents more than permissible limit (e.g., EC, F, As, Fe)	Arsenic contamination affecting the shallow aquifer in parts of the district
	Type of water	Potable
14	DYNAMIC GROUND WATER RESOURCES (as on 31st March 2009) – in mcm	
	Annual Replenishable Ground Water Resources	96455 ham
	Net Annual Ground Water Draft	52760 ham
	Projected Demand for Domestic and Industrial Uses upto 2025	12859 ham
	Stage of Ground Water Development	54.7%
15	AWARENESS AND TRAINING ACTIVITY	
	Ground Water Management Training & Rain water Harvesting	(A) Nine Mass Awerness programme & (B) Eight Training Programmes (Details are given in the text)
16	EFFORTS OF ARTIFICIAL RECHARGE & RAINWATER HARVESTING	
	Projects funded by CGWB (No. & Amount spent)	1 nos. Rs. 5,84,000
	Projects under technical guidance of CGWB (Numbers)	-
17	GROUND WATER CONTROL AND REGULATION	
	No. of OE Blocks	Nil
	No. of Critical Blocks	Nil
	No. of Blocks notified	Nil
18	MAJOR GROUND WATER PROBLEMS AND ISSUES	-

“Ground Water Information Booklet” Patna District, Bihar state

1.0 Introduction

1.1 Administration

Patna district is situated in the South Bihar alluvial plains. The district is bounded in the north by river Ganga, in the south by Jahanabad and Nalanda districts, in the east by Lakhisarai district and in the west by Bhojpur district. The district is situated between North latitudes 25° 13' and 25° 45 'and East longitudes 84° 43' and 86° 44' falling in Survey of India toposheet nos. 72C/11, C/12, C/14, C/15, C/16, G/2, G/3, G/6, G/7, G/11, G/14, G/15 and K/3. The total geographical area of the district is 3172 sq.km.

The district is divided into 6 subdivisions and 23 blocks which are as under

S.No	Sub-divisions	Blocks
1	Patna Sadar	1) Patna Sadar, 2) Phulwarisharif, 3) Sampatchak
2	Patna City	1) Fatuha, 2) Khusrupur, 3) Daniyanvan
3	Danapur	1) Danapur, 2) Bihta, 3) Maner, 4) Naubatpur
4	Masaurhi	1) Masaurhi, 2) Dhanarua, 3) Punpun
5	Paliganj	1) Bikram, 2) Dulhinbazar, 3) Paliganj
6	Barh	1) Bakhtiarpur, 2) Athamalgola, 3) Belchi, 4) Pandarak, 5) Barh, 6) Mokama, 7) Ghoswari.

1.2 Basin/Sub-basin and Drainage

The district falls in the Ganga Basin and is drained by the mighty Ganga in the north, by the Sone in the West, and by the Punpun, Phalgu and their tributaries in the central part of the terrain.

1.3 Agriculture and Irrigation practices

The principal crops grown in the district are Agahani rice, Bhadai Maize, Wheat, Gram, Sugarcane and Jute. Kharif crops are grown from the end of June to the end of October and Rabi from the end of October to the end of March. The Summer crops are grown from April to June, where sufficient irrigation facilities exist. The gross cropped area is 256694.99 ha. and net area sown is 201103.63 ha. indicating cropping intensity of 127.64 % in the district, which is slightly lower than the State average both Tal and Diara areas are mostly mono cropped. Total area under net irrigation in the district is 1,09, 000 ha (Govt. of Bihar,) of which groundwater irrigation alone accounts for nearly 80%.

1.4 Studies/ Activities carried out by CGWB

Ground Water monitoring in the district is being carried out by a network of 11 dugwells and 7 piezometers. Hydrogeological surveys have been carried out during the year 1980-1981 and 1996-1997. A total of 31 exploratory wells have been constructed by CGWB to access the aquifer potential and decipher the hydrogeological regime of the

area. In addition, in the past four production wells have also been constructed at Danapur, Kidwaipuri, Kadamkuan and Rajbhawan on the request from the concerned State and Defence authorities.

2.0 Climate and Rainfall

The climate of the district is somewhat extreme in nature, i.e., quite hot during the summer and fairly cold during the winter. January is the coldest month. The temperature starts rising from March and reaches its peak in May. Rain starts sometime in mid June and lasts till mid September. Maximum rains occur during the monsoon months of July and August. Sometimes winter rains occur in Jan-February. The normal annual rainfall in the district is around 1076 mm.

3.0 Geomorphology & Soils

3.1 Geomorphology

The district forms a part of the Ganga basin and is characterized by a monotonously flat relief with elevation. In general, the western part of the district is sloping due north and north-east, with elevation of the land surface varying from 68 m in the south to 48 m in the north, and from 67 m in the west to 45 m in the east. A notable geomorphic feature is the strong natural levee formation or upland all along the southern bank of the Ganga which acts as a natural barrier thereby causing many of the streams flowing from south to run parallel to the course of Ganga before finally joining it further east of the district boundary.

3.2 Soils

Soils are predominantly sandy loam with clay loam at places with low to medium nutrient status. It is generally alkaline with pH value ranging from 6.3 to 8.2. Traditionally soils in an area are classified on the basis of mode of deposition. Soils are divided into three groups viz. (i) Recent alluvium (ii) Tal and (iii) Older alluvium. The soils of the district have developed on alluvial deposits transported from relatively younger geological formations where physical weathering is predominant and the soils developed in them are generally coarser in texture.

4.0 Ground Water Scenario

4.1 Water Bearing Formation

The area is underlain by Quaternary alluvial formation comprising various grades of clay, silt, sand with occasional gravel. From the groundwater potential point of view the entire district falls under good to very good category (Fig. 2). The presence of *kankar* (nodules of CaCO_3) and fine sand at places render the top clay zone semi-

pervious in nature, where ground water occurs under phreatic condition. The deeper aquifers are made up of medium to coarse grained sand with occasional gravels.

A total of 31 exploratory wells have been drilled in the district. The available data reveals that the cumulative thickness of the granular zones together constitute almost 50 to 70 % of the alluvial thickness upto a depth of 250. The deep tube wells tapping these deeper aquifers can yield upto 300 m³/hr for a drawdown of 6 m. The transmissivity of the aquifer varies from 3786 m²/day to 19540 m²/day.

4.2 Depth to water level

CGWB has established a network of observation wells under National Hydrograph Network (HNS) programme to ascertain fluctuation and quality of groundwater in the district. There are 11 HNS monitoring locations (Fig. 3) which are being monitored every year regularly during January, May, August and November. In addition, a total of 7 piezometers are being monitored in Patna Urban area to account for the behavior of the deeper aquifers which are under intensive development for urban water supply of Patna.

During pre-monsoon season, the minimum and maximum water levels were observed as 3.64 and 10.09 m bgl respectively. About 20 % of the wells have the water level in the range of 2 – 5 m bgl. In majority of the wells (70 %), the water levels remain in the range of 5 – 10 m bgl. The spatial distribution of water levels during this season reveals that the south-west and central parts of the district are observed with a depth range from 2 to 5 m bgl while in the eastern part the depth to water level are > 10 m bgl (Fig. 4).

The water level measurement during post-monsoon season ranges from 1.40 to as deep as 7.12 m bgl. There are each 45.45 % of wells observed in depth range of 0 – 2 and 2 – 5 m bgl whereas about 18.18 % of wells observed in 5 – 10 m bgl depth range. Spatial distribution of water level shows that maximum area is covered with the range of 2 to 5 m bgl. In the southern, central & eastern part of the area water level is > 10 m bgl (Fig. 5).

4.3 Ground Water Resources

Annually replenishable dynamic ground water resource of the district has been estimated (GEC-1997, norm) as on 31st March 2009 for all the blocks. The net annually replenishable ground water resource of the district is 96455 ham. The gross ground water draft for all uses is 52760 ham. The present stage of ground water development of the district as on 31st March 2009 is 54.7 %. At present maximum ground water development is in Sampatchak block (79.6%), while minimum is in Paliganj block (27.1%). Details of ground water resources of all blocks are shown in Table 1

4.4 Ground Water Quality

The water samples collected from the network of observation wells (dug wells) tapping water table aquifer and also from deep tube wells tapping confined or leaky confined

aquifer were subjected to chemical analysis in the laboratory of CGWB, MER, Patna. The quality of ground water in the water table aquifer is acceptable for various uses as per the quality criteria laid down by ISI, as nowhere it crosses the excessive limit. The ground water in the confined/semi-confined aquifers is better than that of the water table aquifer as it is within the 'permissible' limit as per the quality criteria. The tube well water is recommended for drinking and other domestic purposes in the district.

However, Arsenic concentration has been reported from Patna district. Central Ground Water Board has carried out deep exploratory drilling in Maner, Barh and Gayaspur villages. The various chemical parameters for locations in the selected wells is given in Table 4 where EC ranges from 310 to 2200 micro Siemens/cm at 25 °C. The contour map of EC distribution in the district is given in Fig. 2.

4.5 Status of Ground Water Development

5.0 Ground Water Management Strategy

5.1 Ground Water Development

The present stage of ground water development of the district as on 31st March 2009 is 54.7 %. At present maximum ground water development is in Sampatchak block (79.6%), while minimum is in Paliganj block (27.1%). Exploitation of ground water in the district can be done through both Shallow and Deep tube wells. While the small and marginal farmers can opt for shallow tube wells, farmers' co-operative can opt for high discharge deep tube wells. The deep tube wells tapping the granular zones at depth can yield upto 300 m³/hr for a drawdown of 6 m. Groundwater based irrigation accounts for nearly 80% of the total irrigation in the district.

5.2 Water Conservation & Artificial Recharge

A demonstrative artificial recharge structure has been constructed in the campus of Department of Geology, Patna University, Patna under the Central Sector Scheme.

6.0 Ground Water related issues & problems

The rivers Sone, Punpun and Phalgu in the district are susceptible to floods, especially in their lower reaches. Arsenic contamination has been reported from the shallow aquifers in parts of the district from Maner, Danapur, Barh and Bakhtiyarpur blocks.

7.0 Awareness & Training Activity

7.1 Mass Awareness programme (MAP) & Training Programmes (TP) by CGWB

A) Mass Awareness programme:-

A total of 9 mass awareness programmes have been successfully organized in the district to increase awareness of common people about artificial recharge and conservation of ground water resources. The details are as under.

1. Mass Awareness Camp was organized in the office premises on 10th May 1999
2. Mass Awareness camp organized in Patna city on 18th Dec 1999
3. Mass Awareness Camp at Congress Maidan Kadamkuan, Patna on 20.04.2000.
4. Mass Awareness Camp at Fire Brigade Ground, Near Pachim Darwaja, Patna. 21.04.2000
5. Mass Awareness Camp at Golghar, Patna, 30.4.2000
6. Mass Awareness camp at Blue Bird Society, Patna. 29.11.2000 (NGOs from Patna.)
7. Mass Awareness Camp on 12.3.2005 on Artificial Recharge to Ground Water and water conservation at Inter College Maner, Patna.
8. Mass Awareness Camp at Sampatchak, on ground water resource of Bihar on 25.3.2006
9. Mass Awareness programme in Conference Hall of CGWB, Patna Bihar on 31.3.2006

B) Training Programme:

A total of 8 training programmes have been organised in the district. The details are as under.

1. Training Programme on Rain Water Harvesting at Golghar Campus Patna, on 31.3.2003
2. Training programmes were organized on 12th Jan 2005 ‘Artificial Recharge to Ground water and water conservation’ at Indira Gandhi Planetarium, Patna.
3. Training Programme on 31st March 2006 at Conference Hall of CGWB, Patna, Bihar. About more than 35 officials from various organizations attended the function as participants.
4. Training Programme at Danapur Cantonment, for Military officers of Danapur (Bihar) on 27.3.08
5. A two day training programme on Ground Water issues and artificial recharge was organized by CGWB, MER at the auditorium of Sri Krishna Science Centre, Patna on 30th and 31st March 2009
6. Capacity Building for PHED Engineers at Hotel Patliputra on 12 to 16 September 2011.
7. Tier- III Training Programme of RGI at Naubatpur on 28-29 December 2012.
8. Tier – II Training Programme of RGI was organised at Conference Hall of CGWB, Patna from 14th to 18th on “Aquifer Information System and Aquifer Management Plan”. Participants from various organization attended the function.

8.0 Areas Notified by CGWA/SGWA

Nil. All the blocks of the district are under safe category

9.0 Recommendations

- Sufficient scope still exists for development of groundwater for agricultural development in the district as the overall stage of development is just 54.7%.
- Exploitation of ground water in the district can be done through both Shallow and Deep tube wells. While the small and marginal farmers can opt for shallow tube wells, farmers' co-operative can opt for high discharge deep tube wells.
- Arsenic concentration has been reported from parts of Danapur, Maner, Barh and Bakhtiyarpur blocks. The contamination has been reported from the shallow aquifers. Deeper aquifers have been found free from contamination as such community water supply in the contaminated areas should be made from the deeper aquifers (> 120 m depth).
- Rainwater harvesting and artificial recharge needs to be taken up for the deeper aquifers which are under intensive development in Patna Urban area.

Table 1: Details of exploratory wells in Patna district.

S.No.	Location/ Block	Depth Drilled mbgl	Length of Casing pipe/ Depth const. m	Static Water level m bgl	Discharge m ³ /hr	Drawdown m	Specific Capacity m ³ /hr/m	Trans- missivity m ² /day	Storativity
1	Sanathan Dharmshala, Patna	250.12	179.5	16.3	209	2.22	92.89	6980	
2	Cogress maidan, Kadamkuan, Patna	251.7	219	9.5	224	4	56	5892	
3	Mithapur (Jakkanpur)	215.31	194.7	7.7	375.06	6	62.51		
4	Fire brigade station, Patna city	226.7	213						
5	Karbigahiya, Patna	250.64	215.8	9.26	176.2	2088	61.18	8057	
6	Golghar, Patna	277.9	172.6	9.2	193.04	2.04	94.6	14113	
7	Begumpur, Patna city	216.72	191	9	177.14	3.11	56.96	3786	
8	Khagaul/Danapur	262.27	125		222.56	3.7	60.15		
9	Anisabad, Patna	219.08	172						
10	Khajekalan, Patna city		160		199.85	3.16	63.24		
11	Bikarm		152	2.73	535.2	4.4		19540	
12	Chajubarh, Patna	196	164	11.5	194.62	2.7		7894.56	
13	Harding Road, Patna	245.4	205	9.39	194	2.21		7101	
14	Chaudharana	190.32	176	9.6	211.43	2.9	75.37	15479	
15	Achudwara, Barh	353.3	161						
16	Aunta Mokama	238	219	9.63	208.93	2.89	72.29	5924.04	
17	Digha	325	185	8	208.93	2.15	83.8	7068	7.70X10 ⁻²
18	Moldlar tola, Mokama	225.85	192	8.96	194.62	2.39	81.09	5684.13	
19	Choudi barh	250.66	165	5.61	179.63	2	84	6315.65	
20	Khasmahal pandarak	226.2	220	8.48	271.3	4.53	90.13	7006	
21	Fatuha dak bungalow	250.11	166						
22	Salimpur	229.4	180						

23	Phulwarisharif	230.62	165	8.35	179.63	2.46	73.61	7894.56	
24	Pirdamaria	221.3	161	9.8	195	2.22	82.7	12235	
25	Alamganj	225	164	11.21	180	2.2	85.08	9882.9	5X10 ⁻³
26	Bakhtiyarpur	260.48	135						
27	Barh, PHED Campus	253.4		9.15	194.62	2.49			
28	Rarjan	200.14	190.7						
29	Maner	300							
30	Gayaspur	252.7	194	9.18	194.61	2.69	-	19425	-
31	Barh	237	230	9.19	191.25	4.4	-	9333	1.79x10 ⁻²

Table 2: Analysis of water quality parameters observed in HNS wells, Patna district.

District	Location	E.C. micro Siemens/cm at 25 degree C	pH	CO ₃ mg/l	HCO ₃ mg/l	Cl mg/l	SO ₄	NO ₃ mg/l	F mg/l	PO ₄	Ca mg/l	Mg mg/l	TH as CaCO ₃ mg/l	Na mg/l	K mg/l
Patna	Mokama	-	8.8	24.0	268	121	38	228	0.6	< 0.1	24	73	360	120	27.0
	Barh	1370	8.2	NIL	390	156	180	Tr	0.4	< 0.1	60	61	400	151	2.0
	Bakhtiarpur	1030	7.9	ND	262	78	-	-	-	-	24	36	210	86	5.0
	Maner	310	8.2	ND	140	14	-	-	-	-	16	15	100	17	2.6
	Bharatpura	1000	8.2	ND	525	21	-	-	-	-	12	17	100	143	2.2
	Patna City	2200	7.6	ND	329	366	-	-	-	-	48	63	380	248	12.0
	Fatuha	590	7.9	ND	238	28	-	-	-	-	20	17	120	53	1.7
	Dulhin bazaar	470	8.2	ND	189	36	-	-	-	-	32	12	130	38	3.8
	Deokoli	-	8.3	ND	165	14	-	-	-	-	24	12	110	26	1.7

**Table 3- Assessment of Dynamic Ground Water Resources of the Bihar state
Patna district(as on 31st March 2009)**

(in hectare meter)

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 Supply	Existing Gross Ground Water Draft For all Uses (10+11)	Allocation for Domestic and Industrial Requirement supply 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	Athmalgola	1284	799	118	917	172	314	71.4
2	Bakhtiapur	5476	1642	453	2095	479	3355	38.3
3	Barh	3171	1286	290	1576	479	1406	49.7
4	Belchi	1911	581	83	663	120	1210	34.7
5	Bihta	5687	3160	359	3519	522	2005	61.9
6	Bikram	4421	2263	237	2500	345	1813	56.5
7	Danapur	3539	1284	614	1898	1143	1112	53.6
8	Daniawan	1943	944	102	1046	148	851	53.8
9	Dhanarua	5974	4152	298	4450	433	1389	74.5
10	Dulhinbazar	3695	1454	176	1630	257	1985	44.1
11	Fathua	3504	2203	272	2475	442	859	70.6
12	Ghoshwari	3904	1230	97	1327	141	2533	34.0
13	Khusrupur	1686	458	197	655	334	894	38.8
14	Maner	4832	1676	491	2167	547	2609	44.9

15	Masuarhi	6791	4946	568	5514	1004	841	81.2
16	Mokama	5206	1281	564	1845	1042	2883	35.4
17	Naubatpur	5560	3100	291	3390	423	2037	61.0
18	Paliganj	7177	1585	363	1948	528	5064	27.1
19	Pandarak	5883	2276	210	2486	306	3301	42.3
20	Patna Sadar	4321	1216	2008	3225	3105	0	74.6
21	Phulwarisarif	4138	2279	588	2867	413	1446	69.3
22	Punpun	4162	2624	198	2822	289	1250	67.8
23	Sampatchak	2191	1615	130	1745	189	387	79.6
	Total	96455	44052	8708	52760	12859	39544	54.7

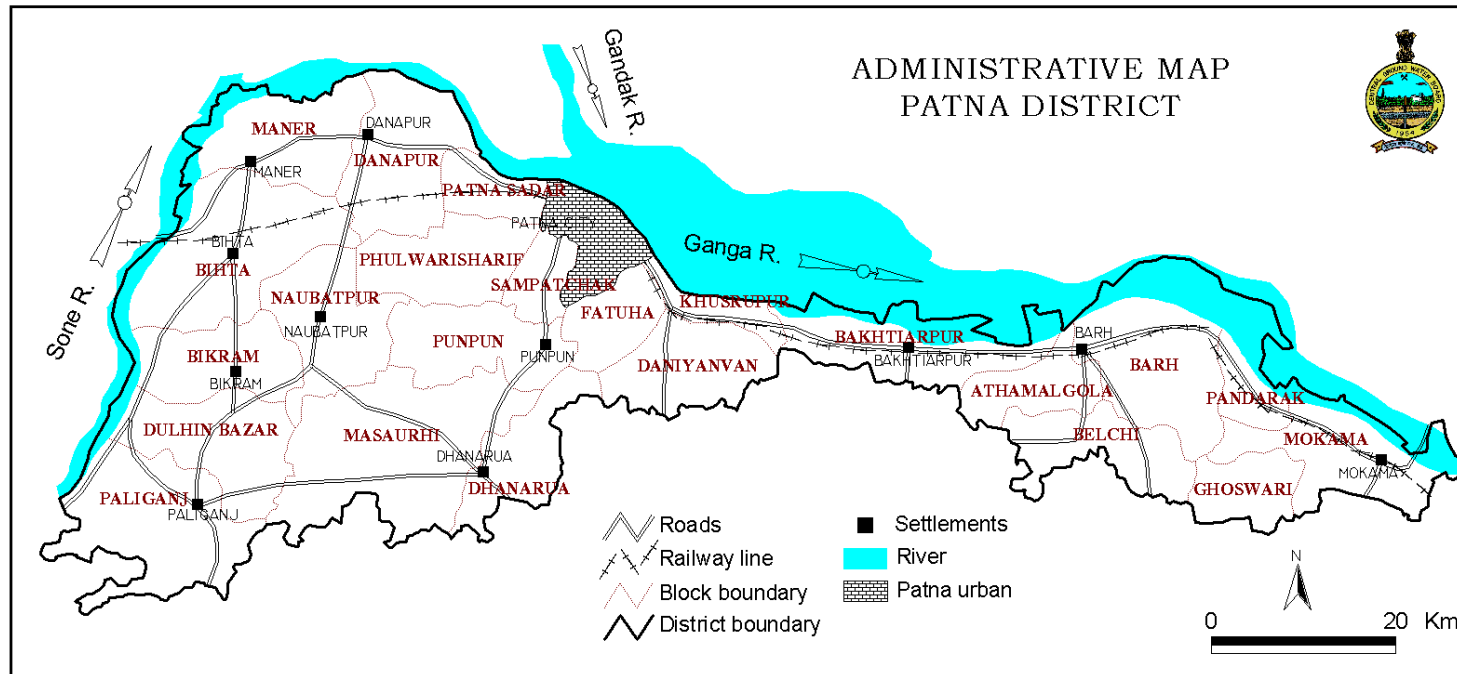


Fig. 1: Administrative map, Patna district.

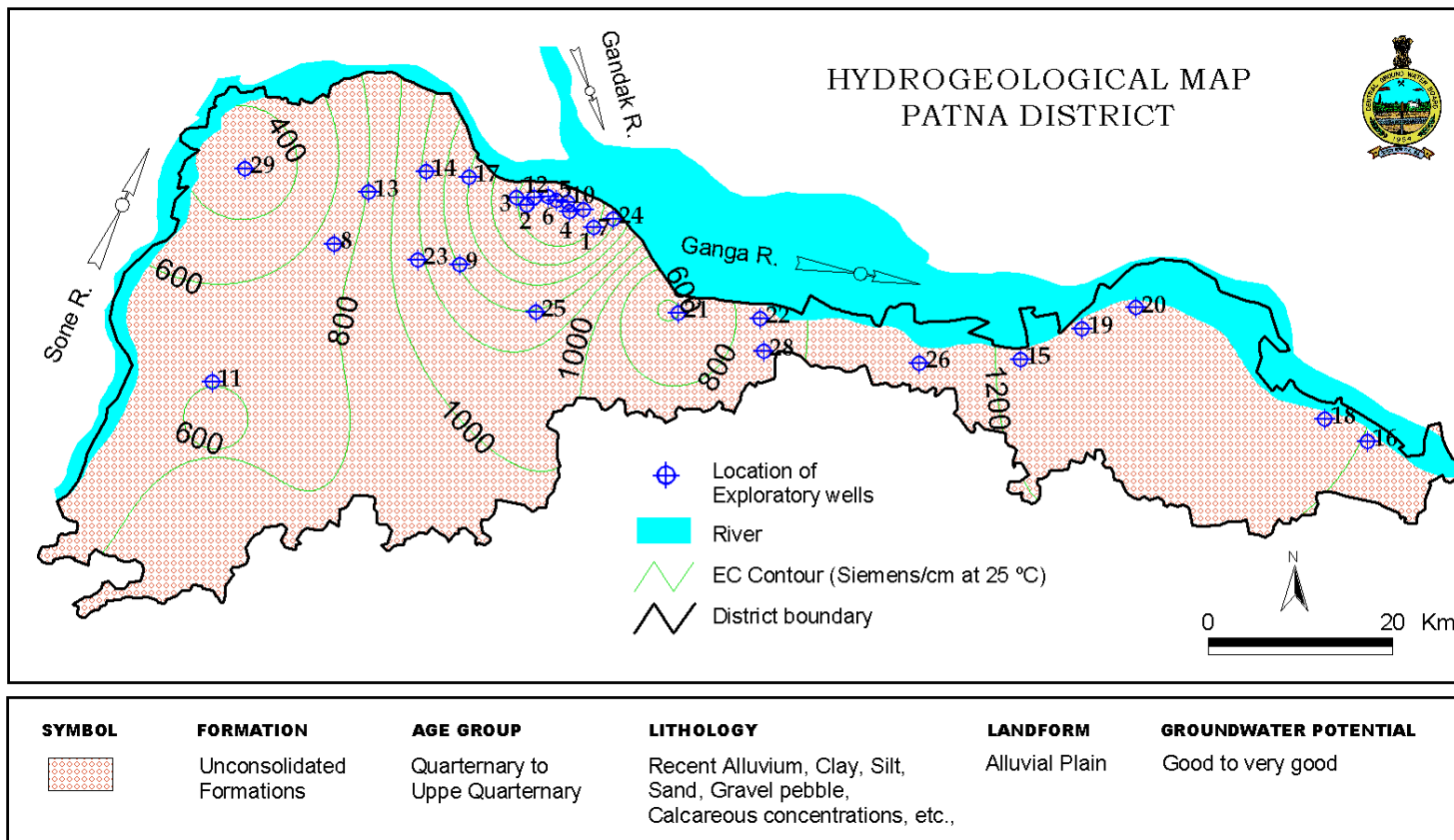


Fig. 2: Hydrogeology and location of exploratory wells, Patna district.

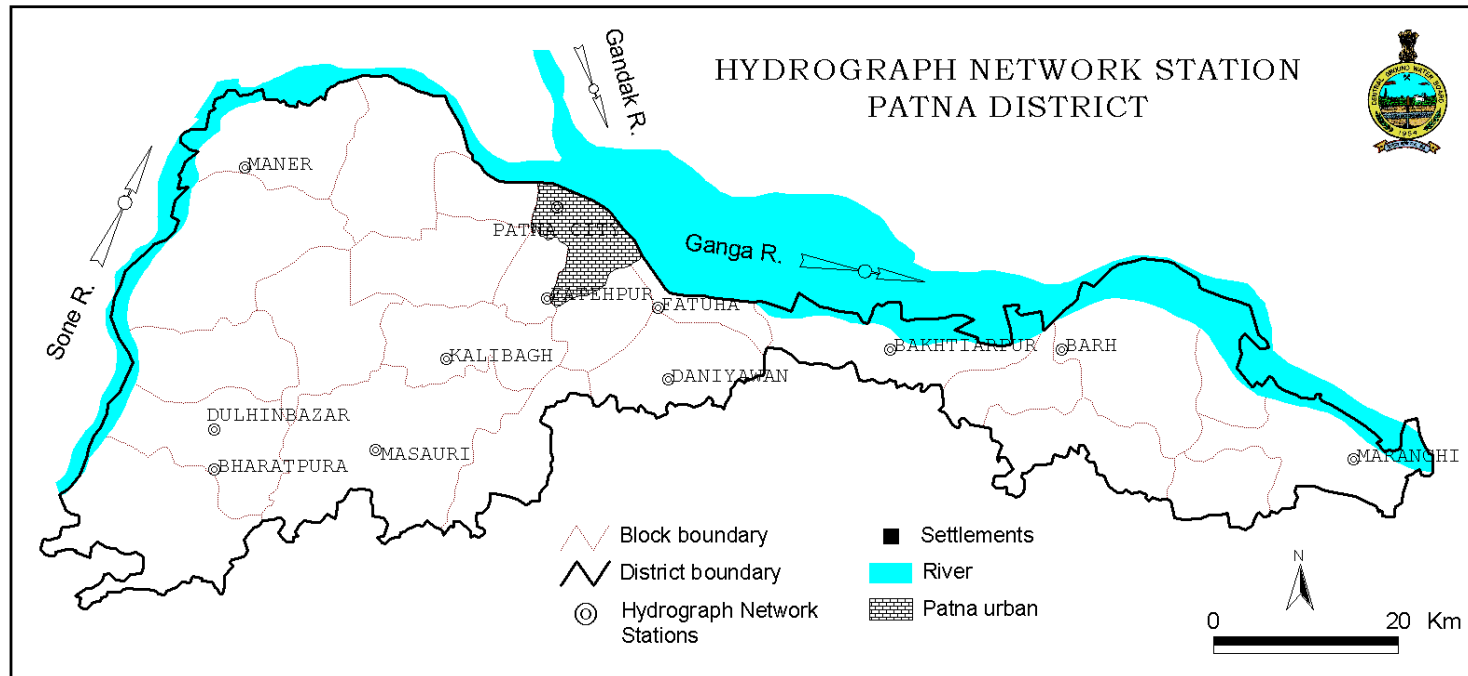


Fig. 3: Location of Hydrograph Network Stations, Patna district.

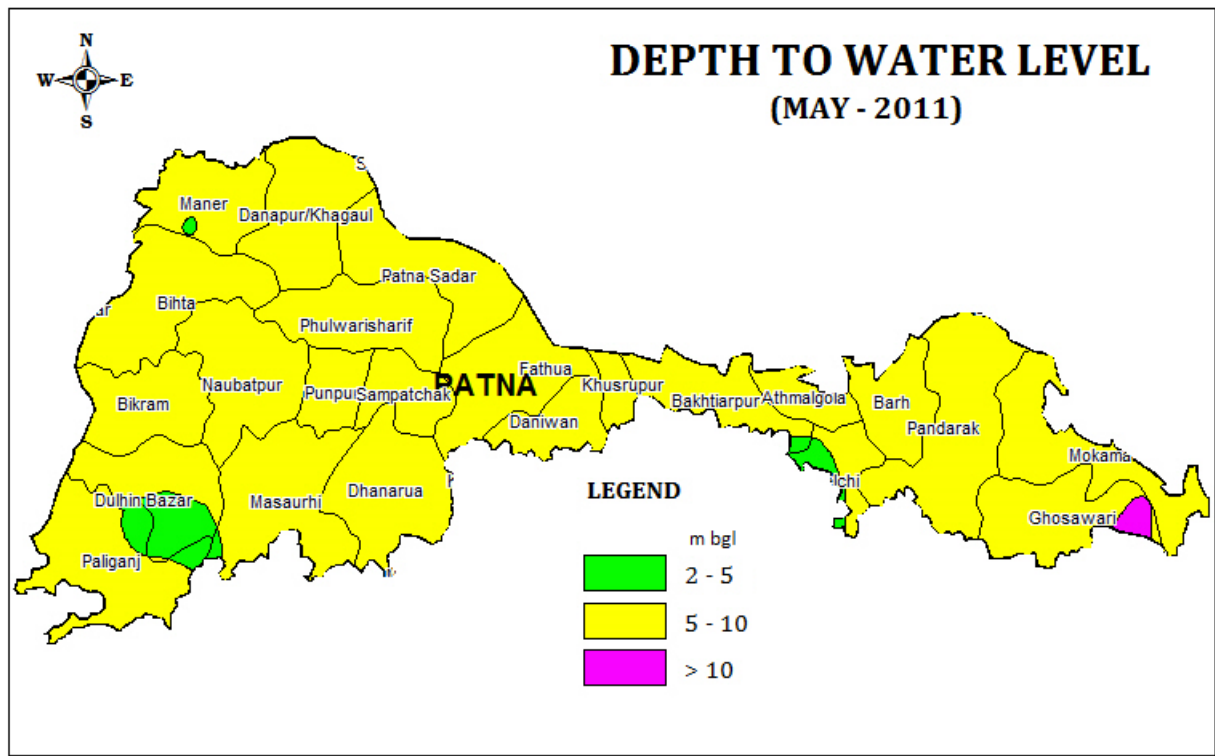


Fig. 4: Depth to water level map (Pre-monsoon 2011), Patna district

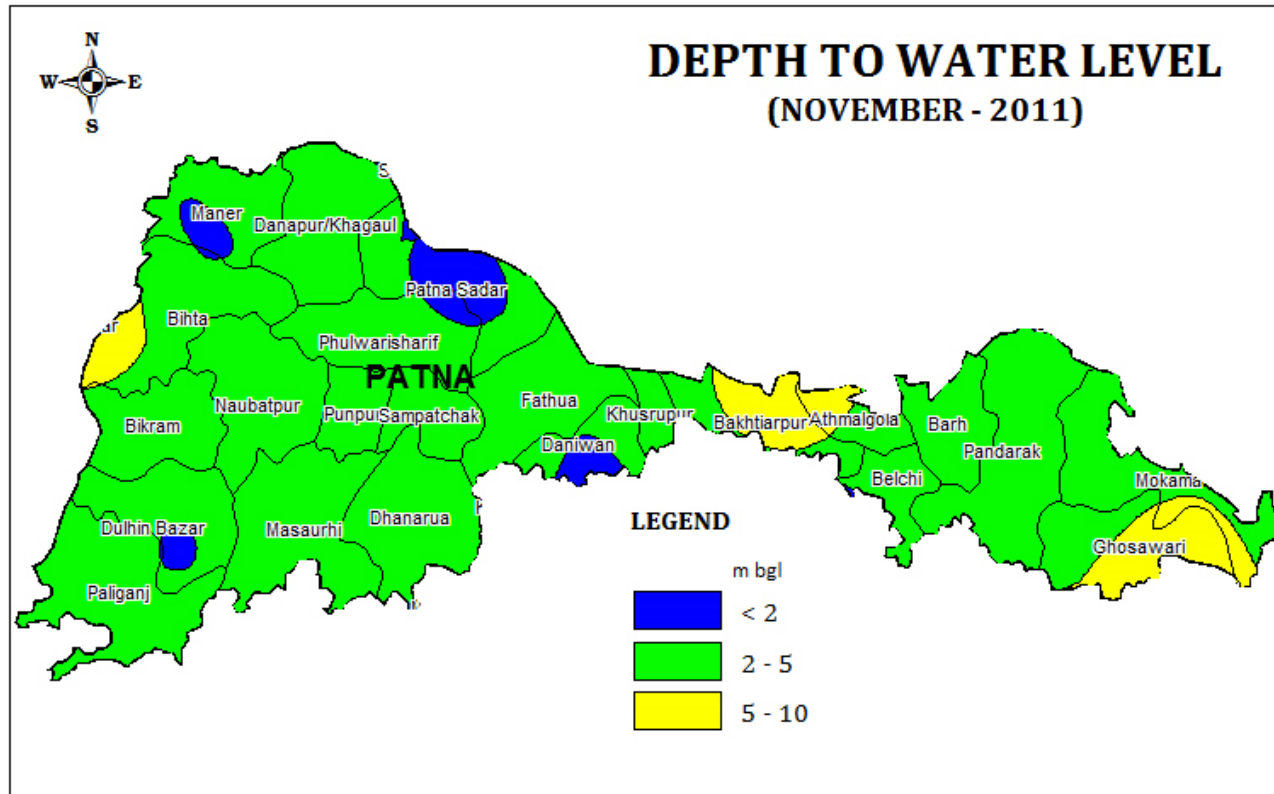


Fig. 5: Depth to water level map (Post-monsoon 2011), Patna district

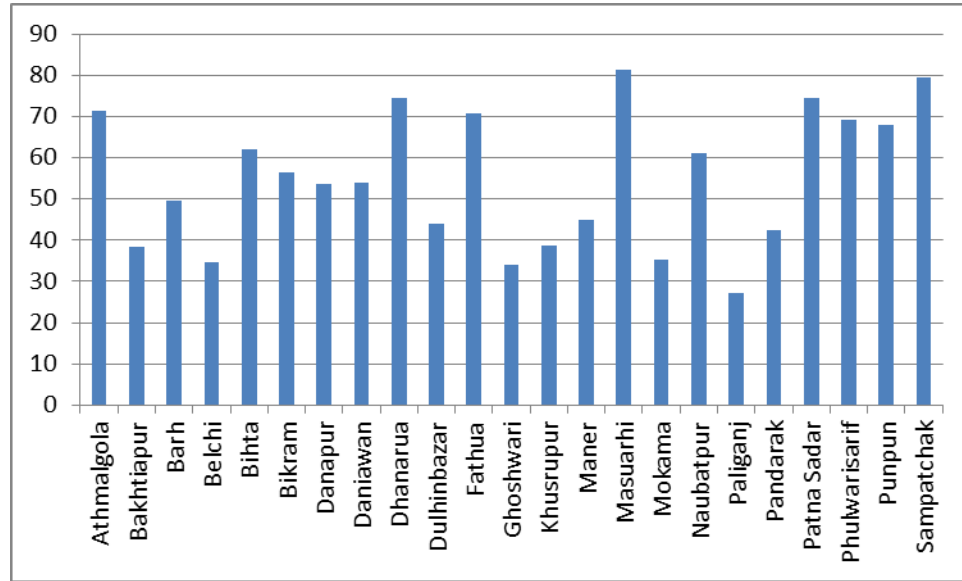


Fig. 6: Block-wise representing stage of groundwater development (%), Patna district