भूजल सूचना पुस्तिका

नालंदा जिला, बिहार

Ground Water Information Booklet

Nalanda District, Bihar State

Ruins of Nalanda University, Nalanda

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

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NALANDA DISTRICT

DISTRICT AT A GLANCE

Sl. No.	Items	Statistics
1.	GENERAL INFORMATION	
	Geographical Area (Sq. Km.)	2367 Km^2
	Administrative Divisions No. of Panchayats/Villages Number of Tehsil/Block	Biharsharif, Rajgir and Hilsa 253/1084 20
	Population (As per 2011 Census) Population Density	Males: 1497060 Females: 1380593 Total: 2877653 1222 per Km^2
	Average Annual Rainfall (mm)	1002.2
2	GEOMORPHOLOGY	
	Major Physiographic Units	Quaternary Alluvium and Archaeans
	Major Drainages	Phalgua, Mohane ,Jirayan, Kumbhar
3	LAND USE	
	Forest Area	46.4 Km^2
	Net Area Sown	1570.58 Km^2
	Cultivable Area	1948.43 Km^2
4	MAJOR SOIL TYPES	Udifluvents, Ustorthents.
5	PRINCIPAL CROPS	Paddy, Potato, Onion
6	IRRIGATION BY DIFFERENT SOURCES (Area in hectares) Govt. of Bihar	
	Wells / Tube wells	118000
	Tanks	4000
	Canals	16000
	Other Sources	13000

	Net Irrigated Area	151000
	Net sown Area	179263
	Total Gross Irrigated Area	163000
7	NUMBER OF GROUND WATER MONITERING WELLS OF CGWB (as on 31st March, 2011)	
	No. of Dugwells	8
	No. of Piezometers	Nil
8	PREDOMINANT GEOLOGICAL FORMATIONS	Quaternary Alluvium and Archaeans
9	HYDROGEOLOGY	
	Major water bearing formations	Unconsolidated fine to coarse sand (minor quartzite)
	Pre-monsoon Depth to water level during 2011	2.35- 9.13 m bgl
	Post-monsoon Depth to water level during 2011	0.58- 3.02 m bgl
	Long term water level trend in last 10 yrs(2002 – 2011) in m/yr	No significant decline
10	GROUND WATER EXPLORATION BY CGWB (As on 31-03-2013)	
	No. of well drilled (EW,OW, PZ, SH, Total)	EW-15, OW -11
	Depth Range (m)	12-212 (granular), 50-60 (fracture)
	Discharge (m^3/hr)	4.9 in fracture and 7.98 to 224 in granular zone
	Storativity (s)	4.3×10^{-7} to 2.8×10^{-3}
	Transmissitivity (m^2/day)	0.786 to 62.23 m^2/day & 8882m^2/day (Noor Sarai)
11	GROUND WATER QUALITY	
	Presence of Chemical constituents more than the permissible limit (e.g.EC, F, As, F)	EC (1500 mg/L at Ekangarsarai)
	Type of Water	Potable
12	DYNAMIC GROUND WATER RESOURCES (as on 31st March 2009) in mcm.	
	Annual Replenishible Ground Water Resources	661.95 MCM
	Net Annual Ground Water Draft	429.72 MCM
	Projected Demand for Domestic and Industrial Uses	55.09 MCM

	up to 2025	
	Stage of Ground Water Development	64.9 %
13	AWARENESS AND TRAINING ACTIVITY	One Mass Awareness Programme at Bihar Sharif & One Tier- III Training Programme at Islampur.
	Two day Tier III Training Programme Organized at	Islampur
	Date	23.02.13 to 24.02.13
	Place	Islampur
	No. of Participants	152 Participants
14	GROUND WATER CONTROL AND REGULATION	
	No. of OE Blocks	Nil
	No. of Critical Blocks	Nil
	No. of Blocks Notified	Nil
15	MAJOR GROUND WATER PROBLEMS AND ISSUES	Nil
	Note: Latest available data may be incorporated	

1.0 INTRODUCTION

1.1 Location, Area and Administrative Details

Nalanda district is famous all over the world for the ancient International Monastic University established in 5th century BC, which taught Vedas, Logic, Grammar, Medicine, Meta-Physics, Prose Composition and Rhetoric. Nalanda district is located within the Mid-Ganga basin, in the southern margin of the Gangetic plains with Chhotanagpur Gneissic Complex (CGC) and bounded in the north, South, East & west by Patna, Gaya & Nawada, Shekhpur and Jahanabad district, respectively. It lies between latitude 24^0 57' 57.78" and 25^0 27' 39.636" N and longitude 85^0 9' 54.9" and 85^0 55' 27.084" E and covers an area of about 2367 km^2 and represents mainly flat alluvium terrain except Rajgir hills in the south.

Biharsharif, Rajgir and Hilsa are the three sub-divisions of the district with a total of twenty community development blocks namely Giriyak, Rahui, Nursarai, Harnaut, Chandi, Islampur, Rajgir, Asthawan, Sarmera, Hilsa, Biharsharif, Ekangarsarai, Ben, Nagarnausa, Karaiparsurai, Silao, Parwalpur, Katrisarai, Bind, Tharthari (Fig-1). According to the 2011 census Nalanda district has a population of 2877653 of which male and female were 1,497,060 and 1,380,593 respectively, roughly equal to the US state of Kansas. This gives it a ranking of 134th in India (out of a total of 640). There was change of 21.39 percent in the population compared to population as per 2001 census. The district has a population density of 1,222 inhabitants per square kilometre. Nalanda has a sex ratio of 922 females for every 1000 males and a literacy rate of 66.41 %.

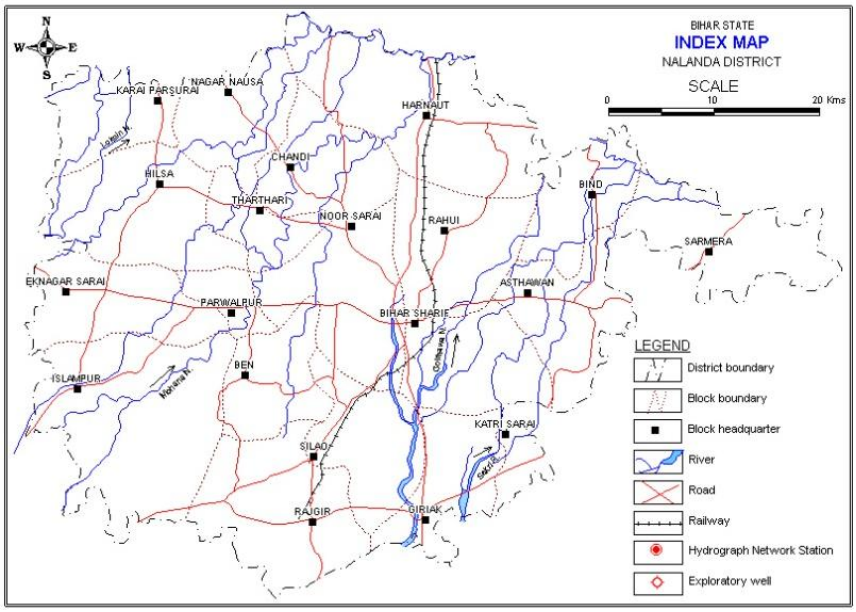


Figure-1: Administrative & Drainage map of Nalanda district, Bihar.

1.2 Basin/Sub-Basin and Drainage

River Phalgu, Mohane , Jirayan and Kumbhar are main river of the Nalanda district, which are ephemeral in nature. Number of distributaries also covers the entire area of the district.

1.3 Agriculture and Irrigation practices

Agriculture is the main source of occupation. The farmers mainly grow paddy, apart from it they grow Potato, and Onion. The cultivated area in the district is 1948.43 Sq.Km.

1.4 Studies/ activities carried out by CGWB

In Nalanda district 15 exploratory wells and 11 observation wells have been constructed. All the bore wells were drilled in Quarternary alluvial formation except at one site at Brahmakund which is in quartzites belonging to Pre-Cambrian age. The exploratory drilling has been done down to a depth of 162.00 m below ground. In most of the wells bedrock have been encountered at shallow depth ranging from 92.00 m (Mahadeopur) to 162.00 (Kisan college, Biharsharif). Three to four potential ground water zones are met within these depth ranges.

Central Ground Water Board has a setup of 8 dug wells in the district as Hydrograph Network Stations from which water level data are collected four times in every year in order to study the general ground water trend in the district.

2.0 CLIMATE AND RAINFALL

The average annual rainfall of district is 1002.2 mm. About 92.55 % of the rainfall is received during June to October by south-west monsoon (Fig- 2). The climate of the district is sub-tropical to sub-humid in nature. The district experiences severe cold during winter whereas on the other hand in summer it is very hot.

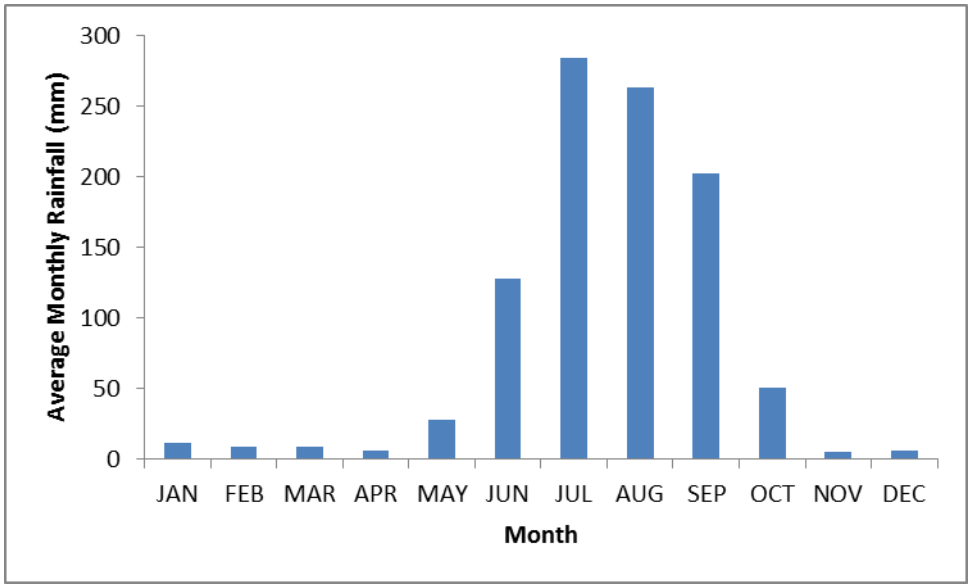


Figure- 2: Average Monthly Rainfall in Nalanda district, Bihar.

3.0 GEOMORPHOLOGY, SOIL & ROCK TYPES

3.1 Geomorphology

Geomorphologically, Nalanda district is located within the Mid-Ganga basin, in the southern margin of the Gangetic plains. A series of inselbergs surrounded by Indo-Gangetic alluvium of Pleistocene age are also a notable feature of the district. These inselbergs marks the northern most boundary of the Precambrian peninsular shield. The district is bounded in the north, South, East & west by Patna, Gaya & Nawada, Shekhpur and Jahanabad district, respectively. Nalanda district mainly represents flat alluvium terrain except Rajgir Hill in the south. The maximum elevation of Rajgir Hill is around 338 m above MSL. The Rajgir Hill, forms a part of the long structural hill trending in SE-NW direction. A little south of the present town of Rajgir, the parallel ranges of Rajgir Hill encompasses a valley.

3.2 Soils

Nalanda district is characterized by four types of soil viz. Clay loam, fine loam, loam and course loam, mainly derived from alluvial deposit of southern Ganga Plain.

3.3 Rock Types

The crystalline rocks exposed in Rajgir Hills and forming the bedrock slopping towards north consist of phyllites and quartzites alongwith pegmatitic intrusions. The Precambrian crystallines in the area have undergone intense structural disturbance manifested in the form of multiple folding.

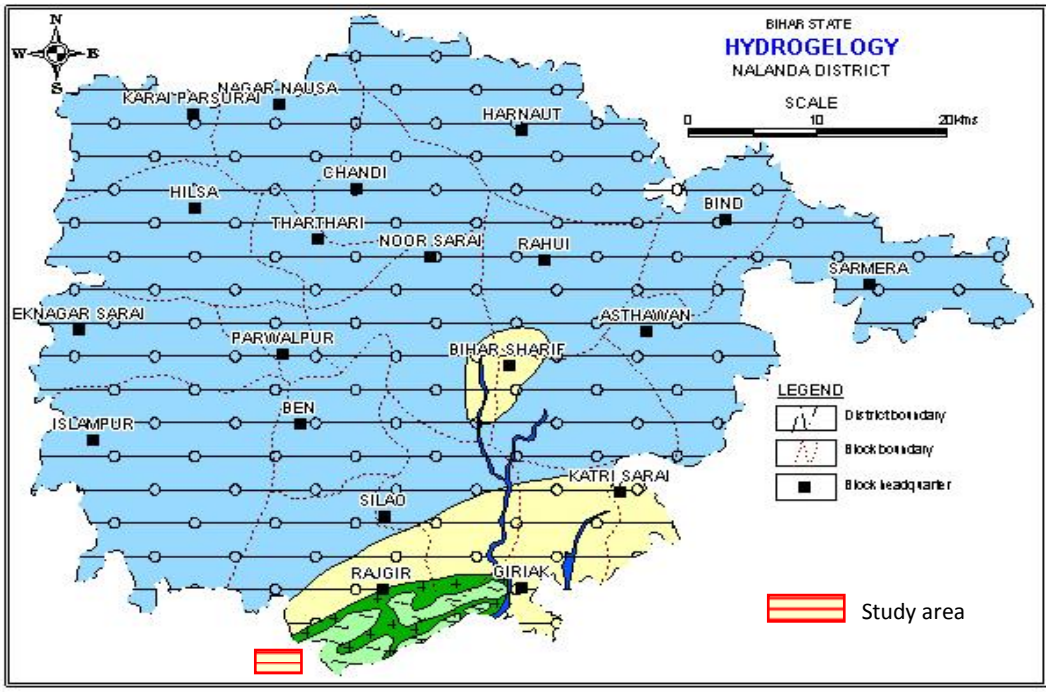
4.0 GROUND WATER SCENARIO

4.1 Water bearing formations

Nalanda district located in the south-central parts of Bihar is covered mostly by alluvium, except the hard rock areas in Rajgir. In the alluvial areas, a number of aquifers exist. The alluvial deposits have been explored to the depth of 250 m below ground in the northern part of the district. Both shallow (~ 50 m bgl) as well as deep (50-250 m bgl) tube wells can be constructed to meet the irrigation and potable water supply. In the hard rock areas, the well discharges are highly variable laterally and therefore site selection for well construction should be preceded by geophysical investigations. The hydrogeological map of Nalanda district is presented in fig. 3.

A 70 to 100 m wide belt of pediplain made up of thick heterogeneous material interfingering with alluvial deposits and boarders the northern edge of Rajgir Hills. In further north it merges with the alluvial deposits laid down by the Ganga River and its right hand tributaries. Morphostratigraphically, the alluvial deposits has been demarcated as Nawada

Formation (or as Older Alluvium by, Bisaria 1984) of Lower Holocene to Upper Pleistocene age. This unit represents the oldest and the highest fluvial landform in the Gangetic alluvial deposits in South Ganga Plain. Lithologically, this unit is characterized by predominance of clay beds, inter-bedded with sands of various size grades (Chakraborty and Chattopadhyay 2001, Saha 2005). In northern part of the study area, where this unit is fully developed, four alluvial fills, starting with coarse sand and gravel at base and clay at the top, are noticed within a depth of 100-120 m bgl (Bisaria, 1984).



AGE GROUP	LIHOLOGY	SYMBOL	HYDROGEOLOGICAL CONDITIONS	GROUND WATER POTENTIAL	GROUND WATER STRUCTURE FEASIBLE
Quaternary	Recent alluvium- clay, silt, sand, etc.		Thick unconfined to confined aquifer thickness varies from 50 to 150m.	Yield potential 50 to 200 cu. m./hr.	Medium to heavy duty tubewell
			Marginal alluvium unconfined aquifer 20 to 50m.	Yield potential 20 to 50 cu. m./hr.	Shallow tube well
Archaeans	Weathered zone		Thickness of weathered zone to 10 to 20m.	Large to moderate yield prospect 5 to 20 cu.m./hr	Dugwell
	Granite gneisses, Quartzites, and Quartz schist		Ground water restricted to fracture zones having secondary porosity	Limited yield potential less than 5 cu.m./hr.	Borewell/ Dugwell

Figure- 3: Hydrogeological map of the Nalanda District.

4.2 Depth to Water Level

Depth to water level in Nalanda district during pre-monsoon period (May 2011) ranges between 2.35 to 9.13 m bgl, In the central part of the district water level ranges between 2 to 5 m bgl, (Fig- 4) whereas, during the post-monsoon period (Nov. 2011) it was ranged from 0.58 to 3.0 m bgl (Fig- 5).

During the pre-monsoon period, 37.5% of well show the water level 2 to 5 m bgl and 62.50 % of the well show between 5 to 10 m bgl. But during post-monsoon period, 50% of the well show the 0 to 2 m bgl and 50% for 2 to 5 m bgl.

4.2.1 Water level fluctuations

Water level fluctuations between May 2011 and November 2011 has been analysed for 8 HNS. The analyses show rise in water level about 38%, 25% & 38% for 3, 2, & 3 NHS and no fall was encountered.

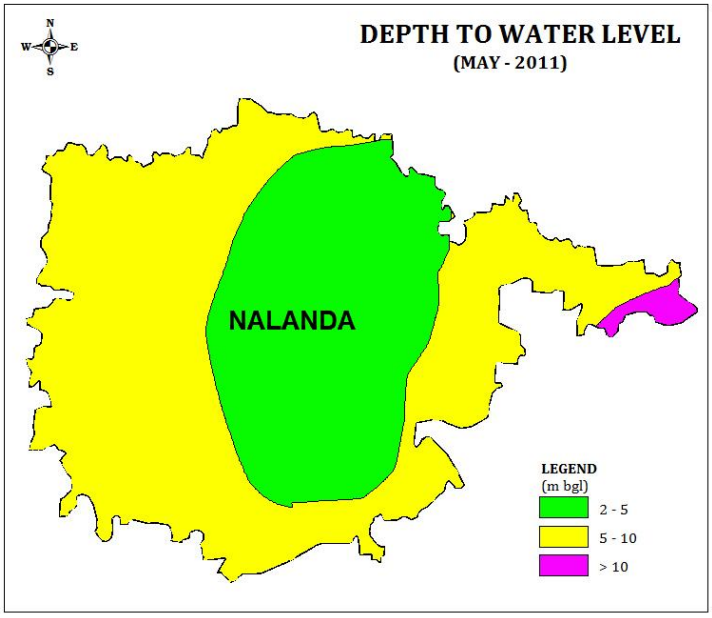


Figure- 4 : Pre-monsoon depth to water level map of Nalanda district.

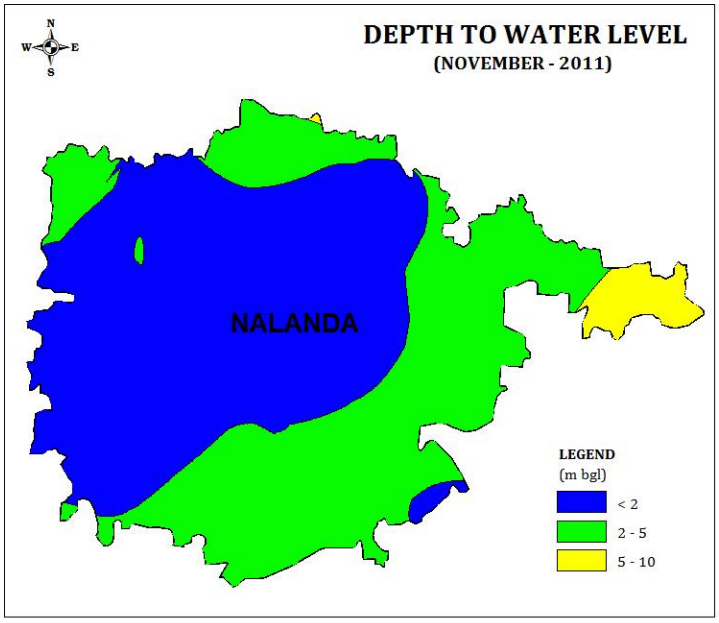


Figure- 5 : Post-monsoon depth to water level map of Nalanda district.

4.3 Ground Water Quality

The hydrogeochemical data of the study area for the period of pre-monsoon 2011 are given in Table-1.The hydrogen ion concentration (pH) ranges from 7.36 to 8.03 with an average of 7.73. Based on pH, groundwater of the district is mildly acidic to slightly alkaline in nature. EC value ranges from 670 to 1500 µS/cm, with an average value of 1036.37 µS/cm. All the samples have TDS > 500 mg/l and averaging 1029 mg/l. Four out of 8 samples have TDS value of > 1000 mg/l. Hardness values vary from 160 to 4901 mg/l. The average value is 283 mg/l. Na is the most abundant cation, with concentrations varying from 44 to 252 mg/l and averaging 109.9 mg/l and K ranges from 1 to 80 mg/l averaging 22.7 mg/l. One location i.e at Ekasgarsarai the concentration of Na is above the permissible limit (WHO 1997).

Table 1: Hydrogeochemical analysis of groundwater sample of Nalanda District.

SN	District	Location	EC (µs @25°c)	pH	CO_3^{2-}	HCO_3^-	Cl^-	Ca^{2+}	Mg^{2+}	TH	Na^+	K^+	TDS
					(in mg/lit)								
1	Nalanda	Biharsharif	1080	7.72	0	390	110	88	34	360	80	1	1063
2	Nalanda	Ekangarsarai	1500	8.03	0	543	103	30	19	160	252	35	1142
3	Nalanda	Giriak	670	7.81	0	329	32	82	7	235	44	2	731
4	Nalanda	Harnaut1	1121	7.70	0	519	89	74	17	255	128	14	1096
5	Nalanda	Hilsa	700	7.90	0	360	25	48	26	225	52	2	738
6	Nalanda	Nischalganj	1410	7.36	0	573	149	94	62	490	94	6	1468
7	Nalanda	Pawapuri	960	7.51	0	476	50	52	34	270	93	6	981
8	Nalanda	Rajgir	850	7.83	0	445	35	56	11	185	60	80	872

4.4 Ground Water Resources

The block-wise ground water resource is given in Table 6. The net annual replenishable ground water resource as on 31st March 2009 works out to be 66195 ham. The gross annual draft for all uses stands at 42972 ha.m (Table- 2). The average stage of ground water development for the district is 64.9%. The stage of ground water development is lowest in Sarmera (48.2%) and highest in Nagarnausa (96.3%). The stage of ground water development in all the blocks is within 70%, and there is no long-term decline in water levels recorded in the blocks. Thus, all the blocks are under safe category. The stage of ground water development is depicted in Figure 6.

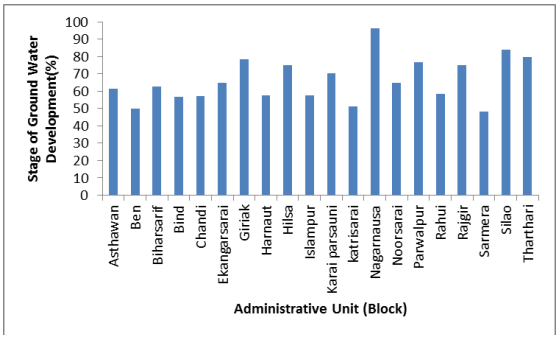


Figure- 6: The Stage of Groundwater Development in Blocks of Nalanda District, Bihar.

Table 2: Net Groundwater Availability (ham) and Stage of Groundwater Development in Nalanda District, Bihar (As On 31st March 2009).

(in hectare meters)

Sl.No	Administrative Unit (block)	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 year 2025	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	Asthawan	4148	2312	239	2551	326	1509	61.5
2	Ben	2831	1295	120	1415	164	1372	50.0
3	Biharsarif	4982	2459	664	3122	913	1610	62.7
4	Bind	2091	1090	93	1183	127	874	56.6
5	Chandi	3762	1936	209	2145	286	1540	57.0
6	Ekangarsarai	3802	2214	241	2455	330	1259	64.6
7	Giriak	2566	1891	126	2017	172	503	78.6
8	Harnaut	5248	2781	239	3019	326	2141	57.5
9	Hilsa	4735	3125	420	3545	371	1239	74.9
10	Islampur	6586	3341	438	3779	438	2807	57.4
11	Karai parsauni	1972	1288	100	1388	136	547	70.4
12	katrisarai	1210	554	63	617	86	571	51.0
13	Nagarnausa	2689	2470	120	2590	164	55	96.3
14	Noorsarai	3721	2190	228	2417	311	1220	65.0
15	Parwalpur	1616	1138	97	1235	133	345	76.5
16	Rahui	3510	1834	212	2047	290	1385	58.3
17	Rajgir	3108	2024	315	2339	250	835	75.2
18	Sarmera	3448	1531	130	1661	178	1739	48.2
19	Silao	2773	2045	284	2329	390	338	84.0
20	Tharthari	1398	1030	86	1116	118	251	79.8
	Total	**66195**	**38547**	**4425**	**42972**	**5509**	**22139**	**64.9**

5.0 GROUND WATER MANAGEMENT STRATEGY

5.1 Ground Water Development

As per the resource evaluation (31st March 2009) the average utilization of ground water in the district is 64.9 % only, which means none of the blocks in the district comes under semi-critical/critical or over exploited category. Exploitation of ground water in the district can be done through both Shallow and Deep tube wells. The deep tube wells tapping the granular zones in alluvial formation at depth of 45- 50 m can yield upto 224 m^3/hr for a drawdown of 4.04 m. Shallow tube wells in Quartzite formation tapping the fracture zone at depth of 55 to 60 m can also yield 4.9 m^3/hr for a drawdown of 40.75 m. Groundwater is the main source for irrigation in the district.

5.2 Water Conservation and Artificial Recharge

All the blocks of the district fall under the safe category as per resource evaluation (31st March 2009) due to this need for water conservation and artificial recharge not be over emphasized. In southern part of the district i.e. in an around Rajgir Hill, construction of water conservation structures will help to arrest runoff, recharge the aquifer and retain the soil moisture. Check dam, gully plug, and percolation tank are suitable structures, while recharge shaft and percolation tank are also suitable structures for rest of the area.

6.0 GROUND WATER RELATED ISSUES AND PROBLEMS

At present no such groundwater related problems arise in the district.

7.0 MASS AWARENESS AND TRAINING PROGRAMME

One Mass Awareness Programme was organised at Bihar Sharif and 144 no. of participants took parts in programme. Two day Tier- III training programme was also organised at Islampur from 23.02.13 to 24.02.13. Total no. of participants was 152.

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 SUGGESTIONS AND RECOMMENDATIONS

Keeping in view the societal implications of any study on a groundwater system on its quantitative and qualitative deterioration, it is considered imperative here to offer some suggestions and recommendation which may prove useful in future to planners and managers. These are listed below:

1. The stage of ground water development of the district is only 64.9% which indicates that there is a large scope for further ground water development. However the artificial recharge including rainwater harvesting should be taken to augment the ground water reserve.
2. Exploitation of ground water in the district can be done through both Shallow and Deep tube wells. While the small and marginal farmers can choose for shallow tube wells, farmers' co-operative can choose for high discharge deep tube wells.

3. Rainwater harvesting needs to be promoted vigorously. One way of starting water harvesting program straightaway is that pits and depressions formed in the vicinity of numerous brick kilns may be fruitfully utilized.
4. It is suggested that seminars and poster presentations in the local languages of the region be arranged for educating the public of urban and rural areas for judicious use of groundwater. The awareness of farmers towards the groundwater recharge can prove as a milestone in managing the groundwater resources.

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