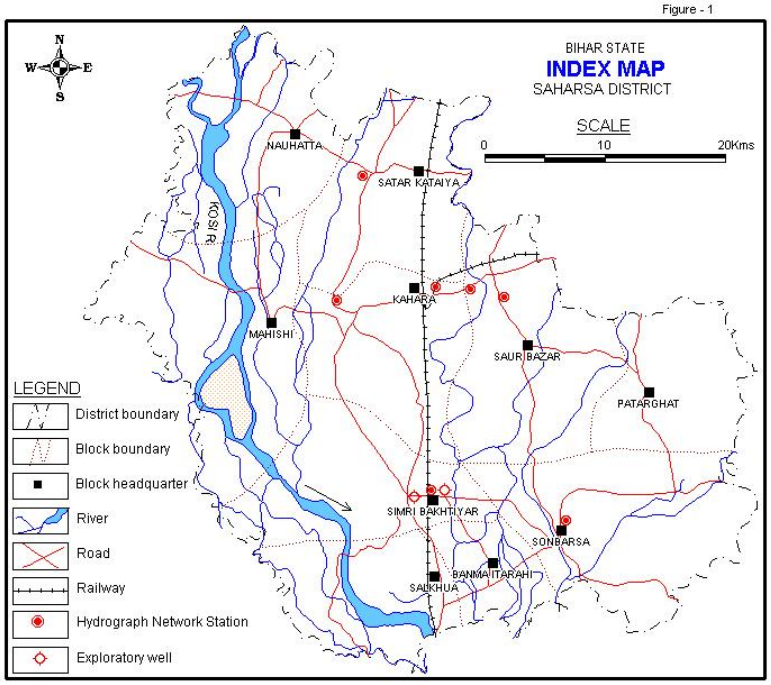
भूजल सूचना पुस्तिका

सहरसा जिला, बिहार

Ground Water Information Booklet

Saharsa District, Bihar State

Figure - 1



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

September 2013

PREPARED BY - Sri S. Sahu Sc. C

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SAHARSA DISTRICT

DISTRICT AT A GLANCE

Sl. No.		Statistics
1.	**GENERAL INFORMATION**	
	I. Geographical Area (Sq. Km.)	1645*
	Administrative Divisions	Saharsa Sadar Simri Bakhtiarpur
	II. Population (As per 2011 Census)	Total: 1,900,661 Rural: 744121 Urban: 156540
	III. Average Annual Rainfall (mm)	1360
2	**GEOMORPHOLOGY**	
	Major Physiographic Units	Younger Alluvium with Newer Flood Plains
	Major Drainages	Kosi River
3	**LAND USE**	
	a) Forest Area	Nil
	b) Net Area Sown	1071 sq. km*
	c) Cultivable Area	1071 sq. km*
4	**MAJOR SOIL TYPES**	Sandy loam, Loam, silty loam
5	**AREA UNDER PRINCIPAL CROPS**	Rice-279 km^2, wheat-496 km^2 *
6	**IRRIGATION BY DIFFERENT SOURCES (Areas and Number of Structures)**	
	Dug wells	2 (2001 MI Census)
	Tube wells/Bore wells	13335 (2001 MI Census)
	Tanks/ponds	855, 16 km^2 *
	Canals	101 km^2 *
	Other Sources	1200, 221 km^2*
	Net Irrigated Area	553 km^2*
	Gross Irrigated Area	760 km^2*
7	**NUMBER OF GROUND WATER MONITERING WELLS OF CGWB (As on 31-03-2007)**	
	No. of Dug wells	7
	No. of Piezometers	Nil
8	**PREDOMINANT GEOLOGICAL FORMATIONS**	Quaternary Alluvium
9	**HYDROGEOLOGY**	
	Major water bearing formations	Sand zones in Quaternary Alluvium
	Pre-monsoon Depth to water level during 2011	2.22–5.72 m bgl
	Post-monsoon Depth to water level during 2011	1.2–4.6 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)	2 EW, abandoned due to caving
	Depth Range (m)	68-165 m bgl
	Discharge (m/s)	150 – 200 m^3/hr
	Storativity (s)	NA
	Transmissitivity (m^2/day)	NA
11	**GROUND WATER QUALITY**	Fresh and potable
	Presence of Chemical constituents more than the permissible limit (e.g.EC, F, As, F)	Iron
	Type of Water	Ca-HCO_3
12	**DYNAMIC GROUND WATER RESOURCES (2009) IN ha.m**	
	Annual Replenishible Ground Water Resources	58684
	Net Annual Ground Water Draft	20052

	Projected Demand for Domestic and Industrial Uses up to 2025	4895
	Stage of Ground Water Development	36.7 %
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**	No such groundwater issue in district other than patches of elevated iron contamination

Note: Latest available data may be incorporated

*Source: Department of Agriculture and Cooperation, Govt. of India.

1.0 INTRODUCTION

1.1 Location, Area and Administrative Details

Saharsa is one of the thirty-eight districts of Bihar state. Saharsa town is the administrative headquarters of this district. The district is a part of a larger territory, the Kosi Division and it became a district on 1 April 1954 and subsequently has become smaller with other districts being carved form it, most notably Madhepura in 1981. The area of the district is 1,645 km^2. The Kosi River flows at the western boundary of the district.

The district comprises two sub-divisions, namely Saharsa Sadar and Simri Bakhtiarpur, and ten blocks, namely Nauhatta, Simari, Bakhatiyarpur, Salkhua, Kahra, Mahishi, Sonbarsa, Saurbazar, Patarghat, Sattar, Kateya and Banma Itahari. According to the 2011 census Saharsa district has a population of 1,900,661 (female: 997,174 and male: 903,487). The bulk of the population (1,744,121) lives in rural areas and the urban population makes only 8.24% (156,540). Population density of the district for 2011 is 1,127 people per sq. km. There was change of 26.02% in the population compared to population as per 2001. With regards to Sex Ratio in Saharsa, it stood at 906 per 1000 male compared to 2001 census figure of 910. Average literacy rate of Saharsa in 2011 were 53.20% compared to 39.08 of 2001. If things are looked out at gender wise, male and female literacy were 63.56 and 41.68 respectively.

Table 1: *Demographics of Saharsa district, Bihar.*

Description	2011	2001
Actual Population	**1,900,661**	**1,508,182**
Male	997,174	789,432
Female	903,487	718,750
Population Growth	**26.02%**	**33.03%**
Area Sq. Km	1,687	1,687
Density/km2	**1,127**	**895**
Proportion to Bihar Population	1.83%	1.82%
Sex Ratio (Per 1000)	**906**	**910**
Child Sex Ratio (0-6 Age)	933	912
Average Literacy	**53.20**	**39.08**
Male Literacy	63.56	51.66
Female Literacy	41.68	25.27
Total Child Population (0-6 Age)	**387,479**	**316,930**
Male Population (0-6 Age)	200,497	165,793
Female Population (0-6 Age)	186,982	151,137

Literates	**804,996**	**465,577**
Male Literates	506,374	322,163
Female Literates	298,622	143,414
Child Proportion (0-6 Age)	**20.39%**	**21.01%**
Boys Proportion (0-6 Age)	20.11%	21.00%
Girls Proportion (0-6 Age)	20.70%	21.03%

Agriculture is the major occupation of Saharsa district and paddy is the main crop. Saharsa is famous for its varieties of Mango's and Summer Berry known as Litchi. Makhana, cultivated in the flood plains of Kosi River forms one of the most important cash crops.

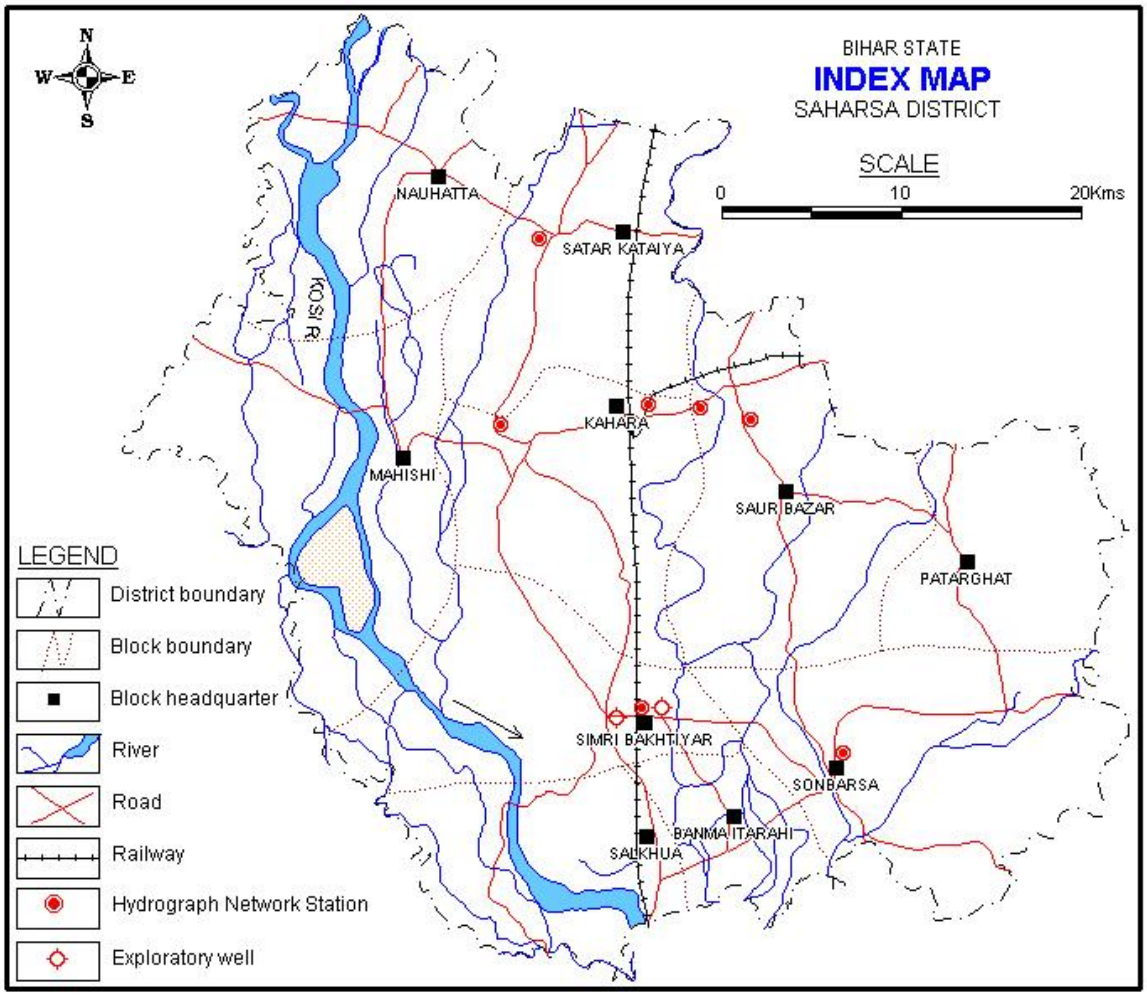


Figure 1: Map of Saharsa district showing administrative details.

1.2 Basin/Sub-Basin and Drainage

The Saharsa district is located at the north eastern parts of Bihar state, which is situated in the middle parts of Ganga Basin. The district falls in the Kosi Sub-basin. The active Kosi River, an

important northern tributary of the Ganga River, originates at an altitude of 7000 m above msl in the Tibet Himalayas and is the third largest Himalayan River, after the Indus and the Brahmputra. The river has remained dynamic from historic parts and as such few palaeochannels of the river are traced in the district. Mis-fit channels with significant drainage during monsoon flow across the district towards south. The Kosi River has formed a megafan of ~13,000 km2 in Bihar state. The Saharsa district is situated at the south-eastern parts of the megafan (Fig. 2).

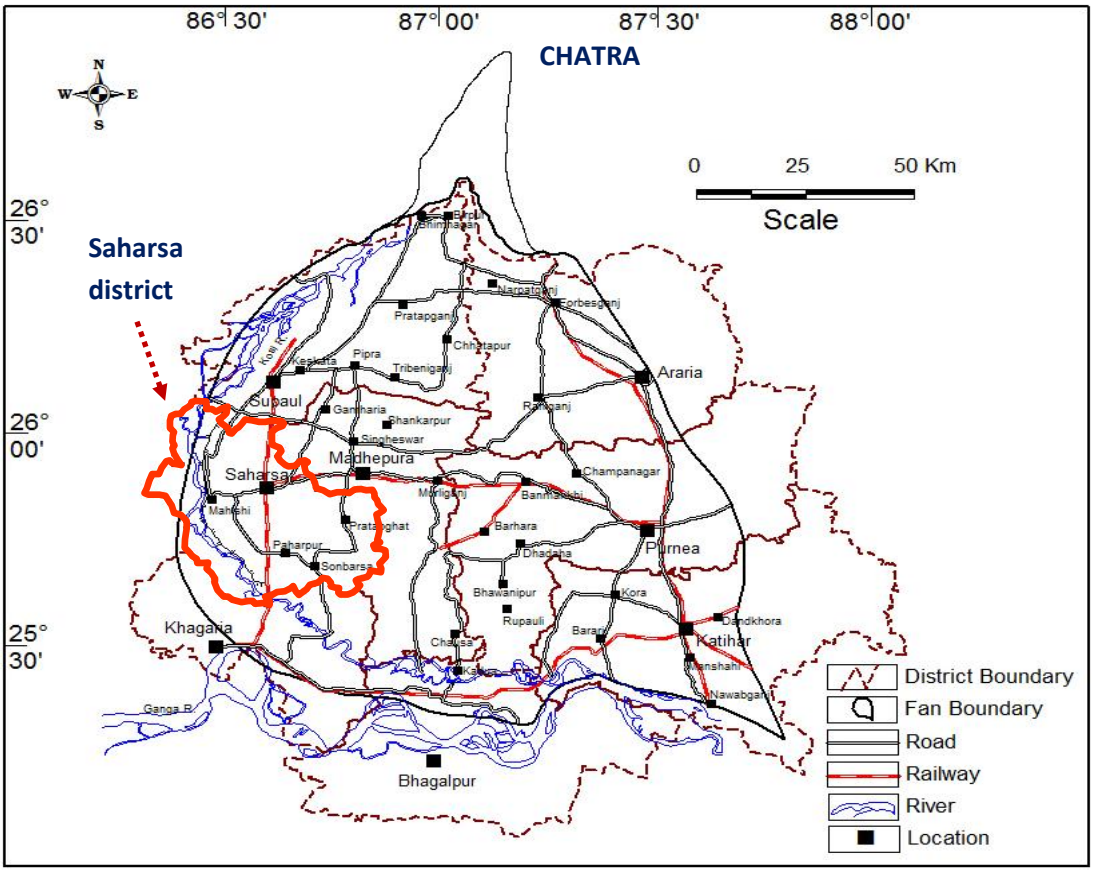


Figure 2: Map of Kosi megafan and the location of Saharsan district in it.

The district is regularly visited by the flood water of Kosi. The flood of the year 2008 owing to breach of eastern embankment at Kusaha, was devastating in nature. This created havoc with large-scale inundation and devastation in Supaul, Saharsa and Madhepura districts, causing huge property and life loss along with the loss in agriculture (Fig 3).

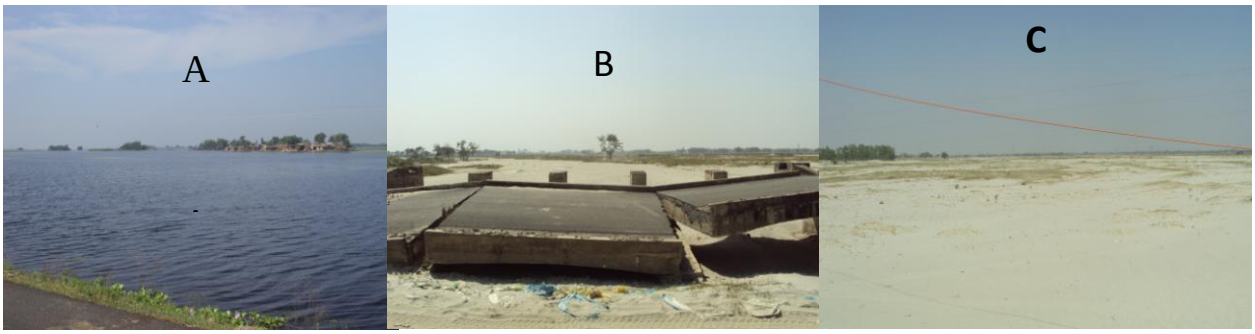


Figure 3: (A) Large scale inundation in the downstream parts of the Kosi River due to bank breaching in 2008. (B) Collapse of bridges and sand filling in the old small channels in the megafan. (C) Agricultural lands covered with sand, making them uncultivable.

1.3 Water use habits

Saharsa district has abundant surface and groundwater resources. The groundwater level remains usually shallow (Fig 4). Hand boring with one length of pipe is suffice to give adequate discharge to a 5 HP diesel pump set.

Figure 4: Water table exposed in a small pit of hardly 1.5 m deep during November in Saharsa district, Bihar.

Like most of other villages in North Bihar Plains, the people in the villages of Saharsa district depend upon groundwater for their domestic supply, including drinking water. Unlike many other parts of the Bihar state, dug wells are frequently met in every village, but presently most of them are not in use. Since water in the district lies very close to ground surface, this was a convenient way of getting potable water by digging and setting a ring well of hardly 7 m deep. In

last decade and half, people have got a more easy way to access the groundwater by auguring a hole up to 5–7 m (usually one length pipe) and putting a locally designed hand pump assembly into that. In many cases bamboo is also used as the hand pump assembly pipe.

1.4 Land use, Agriculture and Irrigation Practices

There are four cropping seasons prevalent in the study area namely, 1) *Garma (March-June),* 2) *Bhadai (April/May – August/Sept.),* 3) *Aghani (June- November),* and 4) *Rabi December-March).* Bhadai and Aghani seasons are clubbed for all practical purposes as Kharif season. The staple cereal of this district is rice. The principal crops grown during different seasons are produced in the following table:

Table 2: *Agricultural seasons and major crops in Saharsa district, Bihar.*

Season	Kharif	Rabi	Garma
Crops	Paddy, Maize, Pulses, Fiber	Maize, Wheat, Pulse	Paddy, Maize, Moong

Year: (1996-97)

. Irrigation plays a vital role in the agriculture in this district and irrigation is practiced from both surface and groundwater Though the district falls in the Eastern Kosi Command Area and a good part of the irrigation in the district is met from canal water, in summer, canal system remains dry and the agriculture meets the irrigation demand from sources like groundwater and surface water bodies. It is observed that groundwater forms a major irrigation source in the district with more than 50 % of the net irrigated area getting the source from groundwater (NIC-1997-98, Govt. of Bihar). Ground water is exploited for irrigation mainly through shallow tube-wells and bamboo borings. Since water level remains shallow and cost of making a shallow tube well is low, people try to have their own bore well in their agriculture fields. In general, a local design of well assembly is lowered in the boreholes. Bamboo borings are of shallow depth and are extensively used for irrigation mainly due to low cost of the structures. Most of the tube wells are within a depth of 5-15 m with their tops directly fitted with 3-5 HP diesel operated pumps.

As per the record of Department of Agriculture and Cooperation, Govt. of India, the net and gross area cropped in the district of Saharsa is 1071 km^2 and 1900 km^2 respectively. The forest cover was negligible at 1.7 km^2. As per the data of 1998-99 (Department of Statistics and Evaluation, Govt. of Bihar), the gross area irrigated by canals, tube wells and other sources stands at 210 km^2, 850 km^2 and 30 km^2 respectively. The net areas irrigated by the same sources are 150, 570

and 20 km^2 respectively. This indicates that the irrigation through tube wells constitute a significant part of the total irrigation need in the district.

1.5 Studies/Activities carried by CGWB

Earlier, CGWB has drilled two of Exploratory Wells were in the district down to a depth of 165 m. The drilling data shows that the granular zones have been encountered right from the depth of 10 m bgl and continuing throughout with limited clay lenses between them. Both the wells were abandoned due to caving. 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

The area has warm and humid climate with high temperature and medium to high rainfall. The temperatures are lowest during December-January with an average minimum of 8^0C to 10^0C and maximum of 24^0C to 25^0C. The temperatures in the hottest months of April to June are minima 23^0C to 25^0C and maxima 35^0C to 38^0C. The normal rainfall for the district stands at 1360 mm with the monsoon (June-Sept) component of 1138 mm (84%). of the rainfall (80% to 90%) is received from mid-June to mid-October (Fig 5). The late September-October rains (locally known as 'Hathia') are very crucial to agriculture in the region and their timing and distribution make all the difference between plenty and scarcity.

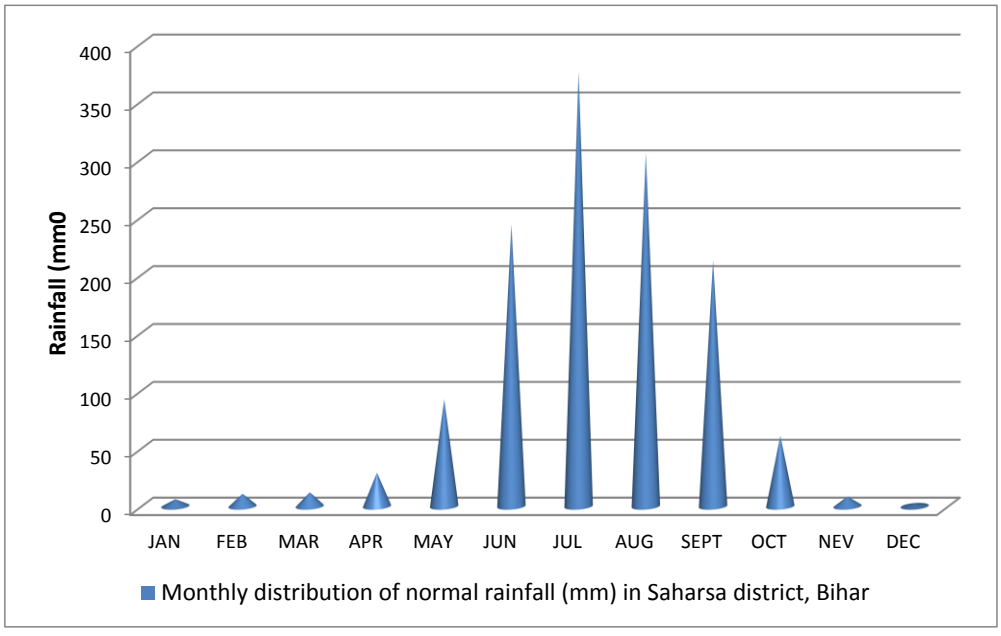


Figure 5: Monthly distribution of normal rainfall in the Saharsa district, Bihar state.

3.0 GEOMORPHOLOGY AND SOIL

3.1 Geomorphology

The North Bihar Plains are mainly characterized by fan (megafan) and interfan areas. In the west of lies the Gandak Megafan, whereas in the east lies the Kosi megafan. A major part of the Saharsa district forms a part of the Kosi megafan. The active Kosi River flows at the western parts of the district. Siwaliks in the foothills of the Himalayas form the northern boundary of the megafan. The land surface in the district, with an average elevation of 44 m amsl, slopes southward with ~40 cm/km at the northern half, while it is ~50 cm/km at the southern half.

The Kosi River has its source in Nepal Himalayas and emerges on to eastern parts of the Gangetic plains near Chatra (Fig 2) after cutting across the Great Himalayan and Lesser Himalayan Ranges in a number of deep gorges. The river is known for its notorious shifting and channel abandonment approximately in every 25 years. The district Saharsa is subjected to frequent flooding related to either shifting of the river Kosi or bank over-topping/breaching by floodwater. Thus, over-bank sedimentation is a common phenomenon in the district. The Kosi River is one of the highest bed-load carrying rivers in the world. The concentration of suspended load is usually 2 to 5 g/l, but increases during the monsoon period to reach 18 g/l. The mean annual suspended load transport of the Kosi River is 130 million m^3 (Singh et al., 1993).

A number of old channel beds of the river are traceable in Saharsa district. The river plan-form with typical dune type braid bars and longitudinal bars are well preserved within this abandoned channel beds. In general, these bar deposits form either exposed sand bodies or with minor capping of flood plain mud. In many cases the abandoned channels form lakes or *Chaurs*, which gets filled with water during monsoon creating water-logging condition. Though the major river Kosi has made the regional architecture of the district, numerous interconnected minor rivers participate in carving out features of the plains by reworking and redistributing the sediments deposited by the river Kosi. These small streams (basically groundwater fed) with clayey beds mostly follow the old channels and traverse the district Saharsa in a north-south fashion.

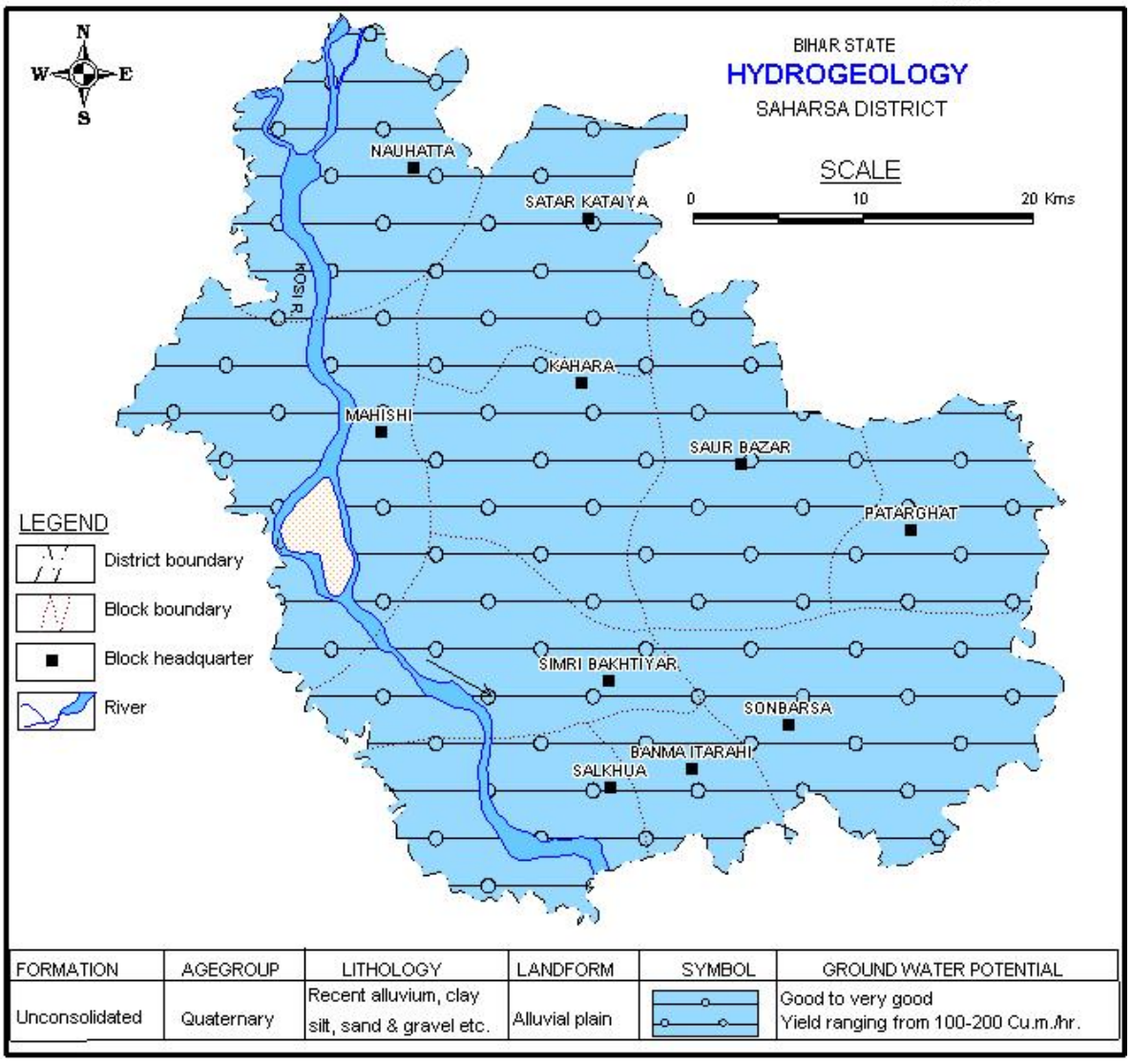
3.2 Soil

The district in general possesses alluvial soil. The soils are of poorly drained type. The areas close to the Kosi channels possess soil types of sandy loam, loamy sand and sand character, whereas, the areas away from the river channels consist of silty sand to sandy silt in nature. The soils in general are fine textured away from the river course and rivulets and coarse textured along their courses.

4.0 GROUND WATER SCENARIO

4.1 Water Bearing Formations

The typical geomorphic set-up evolved by the action of Kosi River has controlled the local land use pattern and groundwater potential in its different parts. The whole of Saharsa district in the Kosi megafan is covered with Quaternary deposits (Fig 6). The alluvial deposits in Kosi fan area form one of the most prolific aquifer systems in the North Ganga Plains (Fig 7). Shallow tube wells in the area have the potential of yielding 50 m^3/hr for nominal drawdown of 2 m only. The area is underlain by thick unconsolidated sediments of Quaternary age consisting of sands of various grades, gravels, cobbles, pebbles etc up to the explored depth of 80 m. The clay capping is thin (< 1 m to 5 m) and even absent at many places.



FORMATION	AGEGROUP	LITHOLOGY	LANDFORM	SYMBOL	GROUND WATER POTENTIAL
Unconsolidated	Quaternary	Recent alluvium, clay silt, sand & gravel etc.	Alluvial plain		Good to very good Yield ranging from 100-200 Cu.m./hr.

Figure 6: The hydrogeological map of Saharsa district, Bihar.

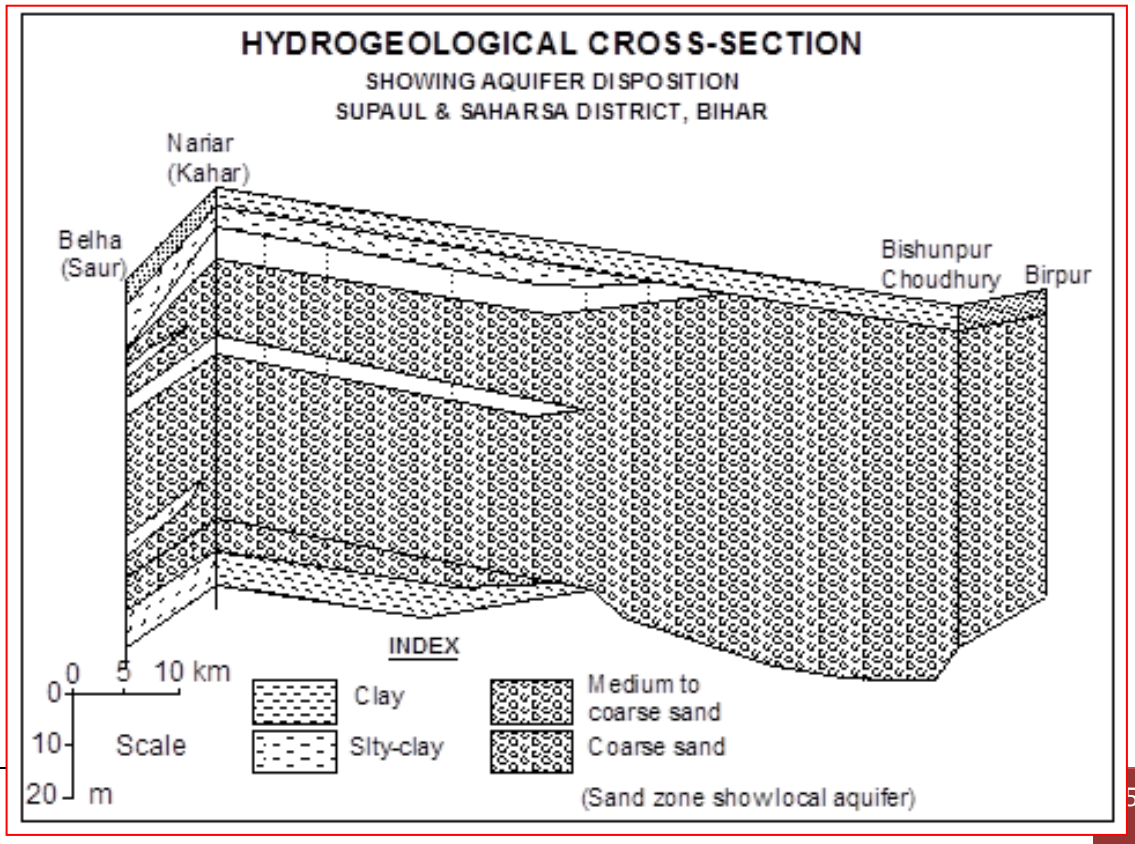


Figure 7: A hydrogeological transect depicting thick sand zones up to 80 m below ground in the district of Saharsa in Bihar.

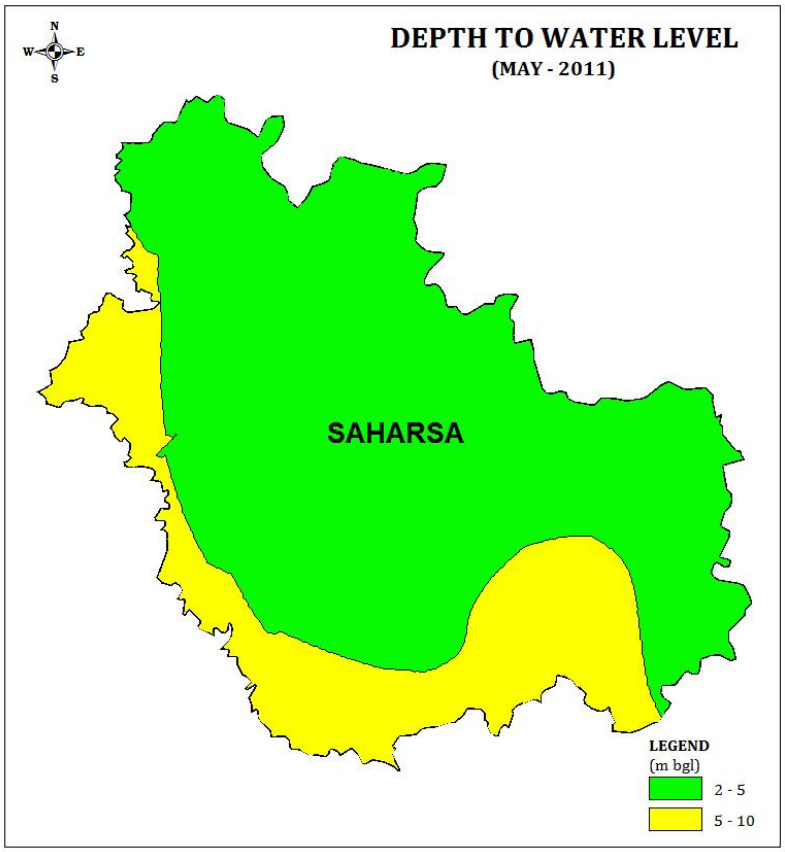
The lithological logs indicate that the ground water occurs under unconfined condition. In Saharsa district shallow tube wells are suitable up to a depth of 50 m with discharge of 20 to 40 m^3/hr. The deep tube well of more than 100 m depth can also be constructed with estimated discharge of 100-200 m^3/hr. Whereas Bamboo Boring of 20 to 25 m depth tapping water table aquifer can yield 10 to 20 m^3/hr with a safe draw down.

4.2 Depth to Water Level

Water level in Saharsa district remains largely shallow (<5 mbgl) during the post-monsoon period, whereas, during the pre-monsoon period, the water level in the western parts of the district, adjoining to the Kosi River goes deeper (up to ~10 m bgl). It may be due to groundwater drainage to the river during the season. Fig 8 A & B depicts the depth to water level scenario in Saharsa district.

During the post-monsoon period, major parts of the district are covered by the water level range of 2-5 m bgl. Pockets, at the northern parts and south-central parts depict water levels within 2 m bgl, exhibiting the water-logging condition.

The average water table elevation ranges from 32 to 42 m above MSL.



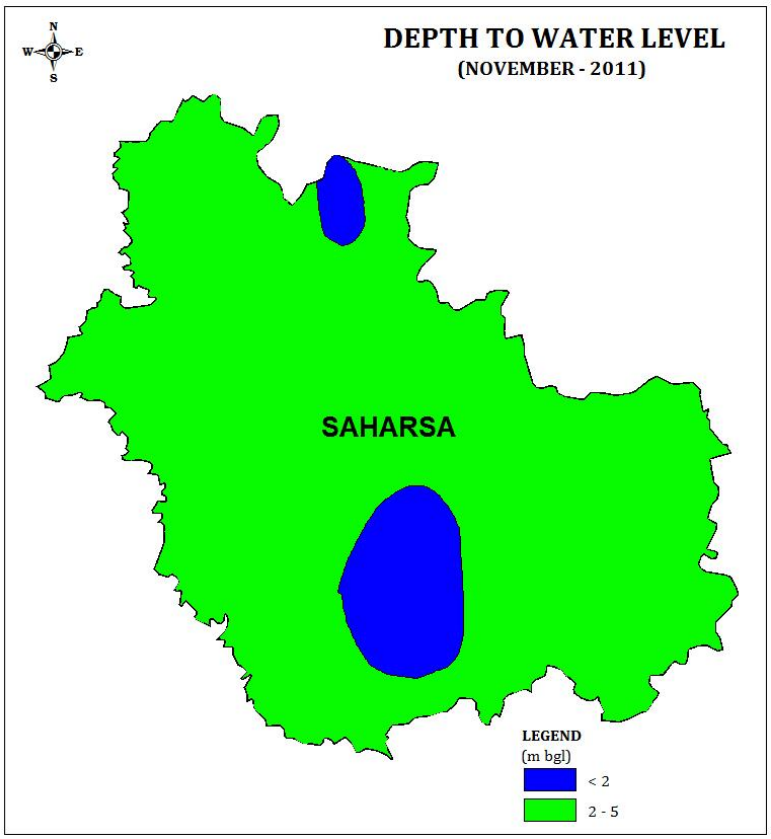


Figure 8: (A) Pre- and (**B)** post-monsoon depth to water level map of Saharsa district.

4.3 Ground Water Quality

The chemical quality of groundwater is available from the water samples collected from different key and hydrograph network stations during pre- and post-monsoon periods from time to time in the district. The chemical data obtained is produced below:

Table 3: *Ground water quality in Saharsa district.*

Chemical constituents (mg/l)	Shallow Aquifer	Drinking Water Standard (As per BIS norms)	
		Highest Desirable	Maximum Permissible
pH	7.2-8.2 (max.)	6.5 – 8.5	No relaxation
E.C (Micro-siemens/cm at	260-970	500	2000
Total Hardness ($CaCO_3$)	60-525	300	600
Bicarbonate	85-458	200	600
Calcium	18-122	75	200
Magnesium	5-54	30	100
Chloride	11-99	250	1000
Sulphate	-	200	Up to 400 if Mg is <30
Nitrate	-	45	100
Fluoride	-	0.6 – 1.2	1.5
Iron	0.105 – 16.94	0.30	1.0

The groundwater in the district is suitable for drinking.

4.4 Ground Water Resources

The block-wise ground water resource is given in Table 4. The net annual replenishable ground water resource as on 31st March 2009 works out to be 54575 ham. The gross annual draft for all uses stands at 20052 ha.m. The average stage of ground water development for the district is 36.7%; the maximum being in the block Nauhatta (51.1%) and the minimum at Simri Bakhtiarpur (25.4%). The stage of ground water development is highest in Nauhatta (51.1%) and lowest in Simari Bakhtiyarpur (25.4%). The stage of ground water development in all the blocks is less than 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 Fig 9.

Table 4: *Net groundwater availability (ham) and stage of groundwater development in Saharsa district, Bihar (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 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 (9-10-12)	Stage of Ground Water Development (12/9)*100 (%)
1	2	9	10	11	12	13	14	15
1	Banma itahari	2607	784	128	911	216	1608	35.0
2	Kahara	4826	1238	460	1698	988	2601	35.2
3	Mahishi	5403	1300	334	1633	564	3539	30.2
4	Nauhatta	4437	2017	250	2266	422	1998	51.1
5	Patarhgat	4257	1942	176	2118	298	2017	49.8
6	Salakhua	6471	1721	187	1908	315	4434	29.5
7	Satar katya	5382	1621	232	1854	392	3368	34.4
8	Saurbazar	7146	3213	292	3505	493	3441	49.0
9	Simari	6796	1333	396	1729	668	4794	25.4
10	Sonbarsa	7251	2110	320	2430	540	4601	33.5
	Total	**54575**	**17278**	**2774**	**20052**	**4895**	**32402**	**36.7**

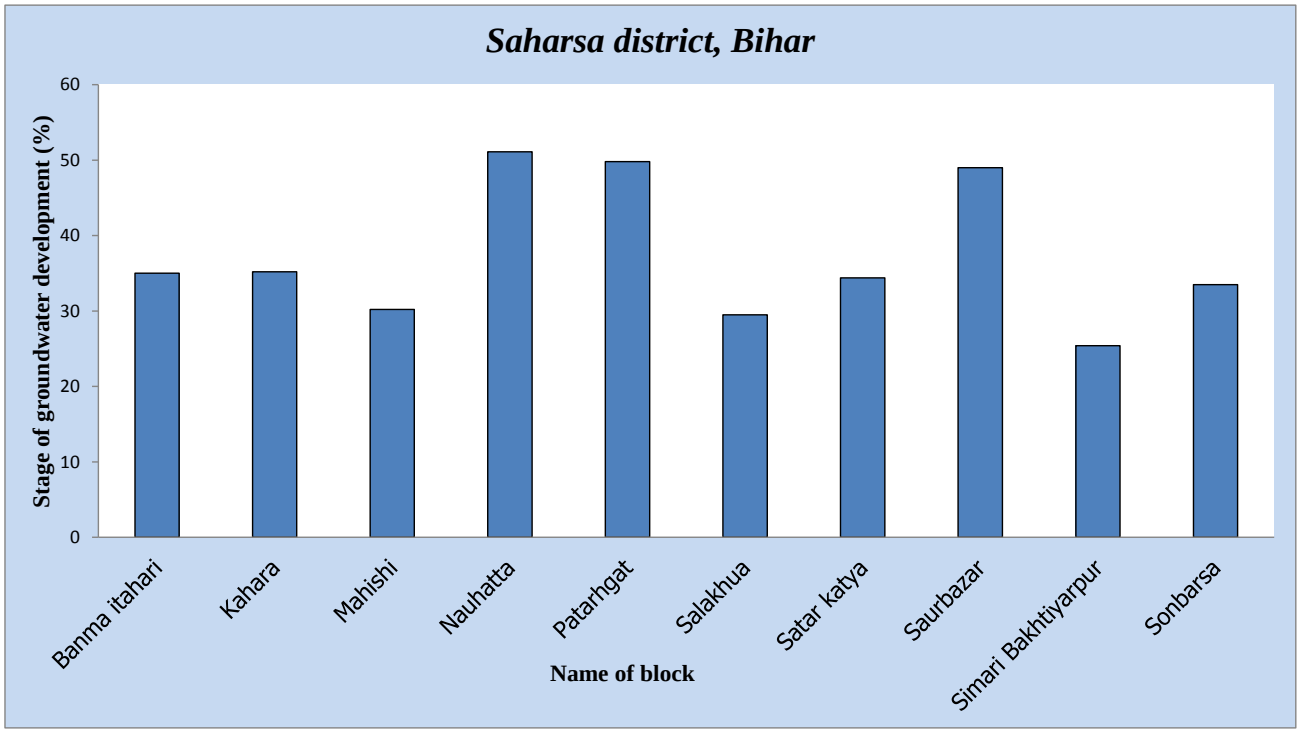


Figure 9: Bar diagram depicting the stage of groundwater development in blocks of Saharsa district, Bihar.

5.0 GROUND WATER MANAGEMENT STRATEGY

5.1 Ground Water Development

As per the resource evaluation (31st march 2009) the average utilisation of ground water in the district is less than 36.7%, which means none of the blocks in the district comes under semi-critical/critical or over exploited category. The present infrastructural facilities yield only 17278 ham of groundwater for irrigation and there is a vast surplus replenishable ground water potential of 32402 ham to be tapped.

5.2 Design and construction of Tube Wells

5.2.1 Construction and yield of wells

As per MI census 2000-2001, a total of 13335 shallow tube wells (STW) (~8 tube wells per km^2) and only 2 deep tube wells (DTW) are in use in Saharsa district. Most of the STWs in the district are constructed within the depth range of 5-15 m. The STWs with large diameter (306 mm) can yield more than 75 m^3/hr. The granular zones tapped trough deep tube wells within the depth of 100 m can yield up to 200 m^3/hr

5.2.1.1 Design of Tube Wells

(a) Sallow Tube Wells

The district is blessed with potential mono-aquifer down to the explored depth of 100 m. 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 5: *Proposed Model of DTWs in Saharsa 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 6: *Proposed slot openings for tube wells in Saharsa 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 2–4 mm and a bail plug of 2–5 m should be provided in order to the yield and life of the well.

5.3 Water Conservation and Artificial Recharge:

No such water conservation and artificial structure has been constructed in the district so far.

6.0 GROUND WATER RELATED ISSUES AND RELATED PROBLEMS:

No such issues and problems have been reported from Saharsa district other than pockets of groundwater iron contamination.

7.0 MASS AWARENESS AND TRAINING PROGRAMME:

Mass awareness programme is yet to be carried out in Saharsa 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 RECOMMENDATION

- There exists ample scope for development of groundwater for irrigation purposes without disturbing the groundwater regime in the district. About 20 to 30 shallow tube wells (STWs) can run effectively (within 50 m depth) per km^2, considering the safe operational distance between any 2 tube wells to be 200 m. In the western parts of the district, adjoining to the Kosi River, sustainable and economically more viable STWs of less depth can be constructed.
- To combat the water-logging problem, the status of irrigation from groundwater needs to be increased.
- Energisation of all the tube wells should be made on priority basis for increasing the cropping intensity. For this, financial support to small and marginal farmers should be provided.
- Chemical quality of groundwater has been observed to be in general suitable for drinking and irrigation purpose. In areas where high iron concentration is present, domestic water supply should be made after proper treatment of groundwater. Alternate deeper aquifers, free from iron may also be found for the purpose.