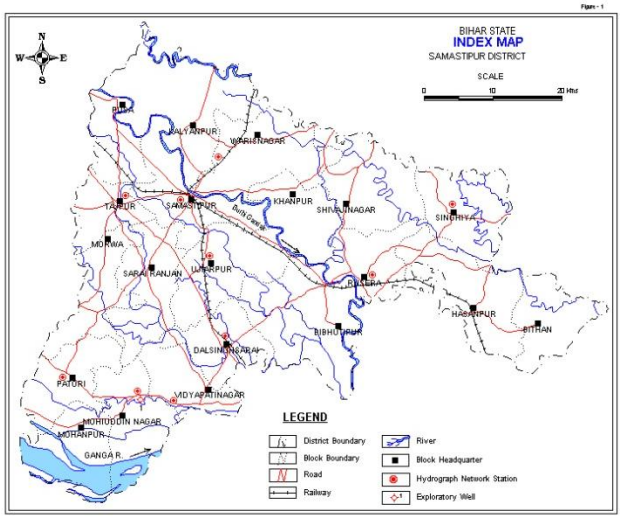
भूजल सूचना पुस्तिका

समस्तीपुर जिला, बिहार

Ground Water Information Booklet

Samastipur 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

September 2013

PREPARED BY - Sri R.R.Shukla, Sc-C

Ground Water Information Booklet

Samastipur District, Bihar State

CONTENTS

LIST OF FIGURES

LIST OF TABLES

SAMASTIPUR DISTRICT AT A GLANCE

Sl. No.		Statistics
1.	**GENERAL INFORMATION**	
	I Geographical Area (Sq. Km.)	2905
	II Administrative Divisions **No. of Panchayats/Villages** **Number of Tehsil/Block**	4 381/1237 21
	III Population (As per 2011 Census)	Total: 4261566 Rural: 4113769 Urban: 147797
	IV Average Annual Rainfall (mm)	1142
2	**GEOMORPHOLOGY**	
	Major Physiographic Units	Gangetic Alluvium
	Major Drainages	Burhi Gandak, Kosi, Baya,Kamla, Kareh, Jhamwari and Balan
3	**LAND USE**	
	a) Forest Area	Nil
	b) Net Area Sown	1749.24 sq.km
	c) Cultivable Area	2859.35 sq. km
4	**MAJOR SOIL TYPES**	
5	**PRINCIPAL CROPS**	Potato,Tobaco, Maize, Rice and Wheat
6	**IRRIGATION BY DIFFERENT SOURCES (Area in hectares)**	
	Dugwells	-
	Tubewells/Borewells (STW)	161,000 ha
	Tanks/ponds	-
	Canals	-
	Other Sources	-
	Net Irrigated Area	130,000 ha
	Gross Irrigated Area	161,000 ha
7	**NUMBER OF GROUND WATER MONITERING WELLS OF CGWB (2011)**	
	No. of Dugwells	09
	No. of Piezometers	Nil
8	**PREDOMINANT GEOLOGICAL FORMATIONS**	Alluvium
9	**HYDROGEOLOGY**	
	Major water bearing formations	Alluvium

	Pre-monsoon Depth to water level during 2011	7.2– 11.1 m bgl
	Post-monsoon Depth to water level during 2011	3.2 –6.45 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=4, OW=1, PZ=10
	Depth Range (m)	80-228 m bgl
	Discharge (m^3/hr)	15.7-57.7 m^3/hr
	Storativity (s)	1.02×10^{-2} to 3.5×10^{-6}
	Transmissitivity (m^2/day)	1240-9000
11	**GROUND WATER QUALITY**	Good for drinking and irrigation
	Presence of Chemical constituents more than the permissible limit (e.g.EC, F, As, F)	As & Fe at places
	Type of Water	Potable
12	**DYNAMIC GROUND WATER RESOURCES (as on 31st March 2009) In ha m.**	
	Annual Replenishible Ground Water Resources	913.36
	Net Annual Ground Water Draft	448.88
	Projected Demand for Domestic and Industrial Uses up to 2025	121.91
	Stage of Ground Water Development	49.1%
13	**AWARENESS AND TRAINING ACTIVITY**	
	One day Training Programme Organized	Mass awareness programme at Madudabad, M.Nagar block
	Date	
	Place	High School, Madudabad, M.Nagar block
	No. of Participants	200
14	**GROUND WATER CONTROL AND REGULATION**	
	No. of OE Blocks	Nil
	No. of Critical Blocks	Nil
	No. of Blocks Notified	
15	**MAJOR GROUND WATER PROBLEMS AND ISSUES**	Quality problem
	Note: Latest available data may be incorporated	
		High As, Fe and Mn in Mohanpur, Vidyapatinagar, Shahpur Patori and Mohiuddinnagar.
	Note: Latest available data may be incorporated	

GROUND WATER INFORMATION BOOKLET

SAMASTIPUR DISTRICT, BIHAR STATE

1.0 Introduction

Samastipur district is one of the districts of North Bihar. Samastipur district is a part of Darbhanga Division. The District of Samastipur was carved out of the erstwhile District of Darbhanga on 14 November 1972. The district area falls in Survey of India toposheet no 72G, 72 F and 72 K. Samastipur district of Bihar is spread over an area of 2624.82 sq. kms. The district is bounded on the north by the Bagmati river which separates it from Darbhanga district, on the west by Vaishali and some part of Muzaffarpur districts, on the south by the Ganges, and on the east by Begusarai and some part of Khagaria districts.

Agriculture is the main economic occupation of the district and about 83 per cent of the total working population depends on it .It is the main stay of the people of the district while floriculture is utmost important for income generation. Samastipur comes under the agro-ecological zone-I of the state i.e. North-West Alluvial plains. Samastipur is noted for its fertile alluvial soil and its Rabi crops. It has been the center of the indigo industry. Wheat, pulses and edible oil seeds are also grown here. The soil is sandy loam with moderately high organic matter, which is suitable for vegetables and spices cultivation. Samastipur district is known for the production of spices esp. turmeric and garlic. Turmeric of this district has potential to become a brand in the international market due to high curcumin percentage. Agriculture is the main stay of the people of the district while floriculture is utmost important for income generation. Agro climatic and farming situation of the district is given below.

Table-1 Agroclimatic and farming situation of Samstipur District (Source: RAU,Pusa,Samastipur, Bihar)

Farming Situation	**North-West-Alluvial Planes (Non-canal irrigated calcareous soil)**
Rainfall	1142 mm
PH	7.0-8.5
Soil	Light to clay in texture
Climate	Semi arid to Sub-tropical
Temperature	6° C to 45°C
Main crops	Rice, Maize, Wheat, Pulses, Oilseeds, Tobacco, Sugarcane, Spices and Vegetables.
Cropping Sequences	Rice-Wheat, Maize-Wheat, Maize-Potato
Principal Crops of *Rabi*	Maize and Wheat

The ground water information booklet of the district contains information, in brief, pertaining to administrative set-up, climate, irrigation practises, geomorphology, soils, hydrogeology and ground water potential.

1.1 Administration

The district is at present comprises of 4 sub-divisions, and 14 Community Development Blocks. It has 5 towns and 1237 villages. The district headquarters is located at Samastipur which is situated at the bank of Budhi Gandak River. The district headquarters is connected to all block headquarters by all weather roads. Infrastucture wise Samastipur is very strong. It is the Divisional Headquarters of the North Eastern railway. The district has direct train link with Patna, Kolkata, Delhi, Dhanbad, Jamshedpur and other places of importance. National Highway No. 28 passes through the district Samastipur is the Divisional Headquarters of the North Eastern railway. The district has a population of 3,413,413 (2001 census).The district is situated between $25^0$30’00’’ to $26^0$05’00’’ latitudes north & 85037’50’’ to $86^0$23’30’’ longitude east. The total population of district is 4261566, out of which rural population is 4113769 and urban population is 147797 (as per 2011 census). The district boundaries, administrative divisions, major roads, rivers, and HNS locations are presented in Fig 1.

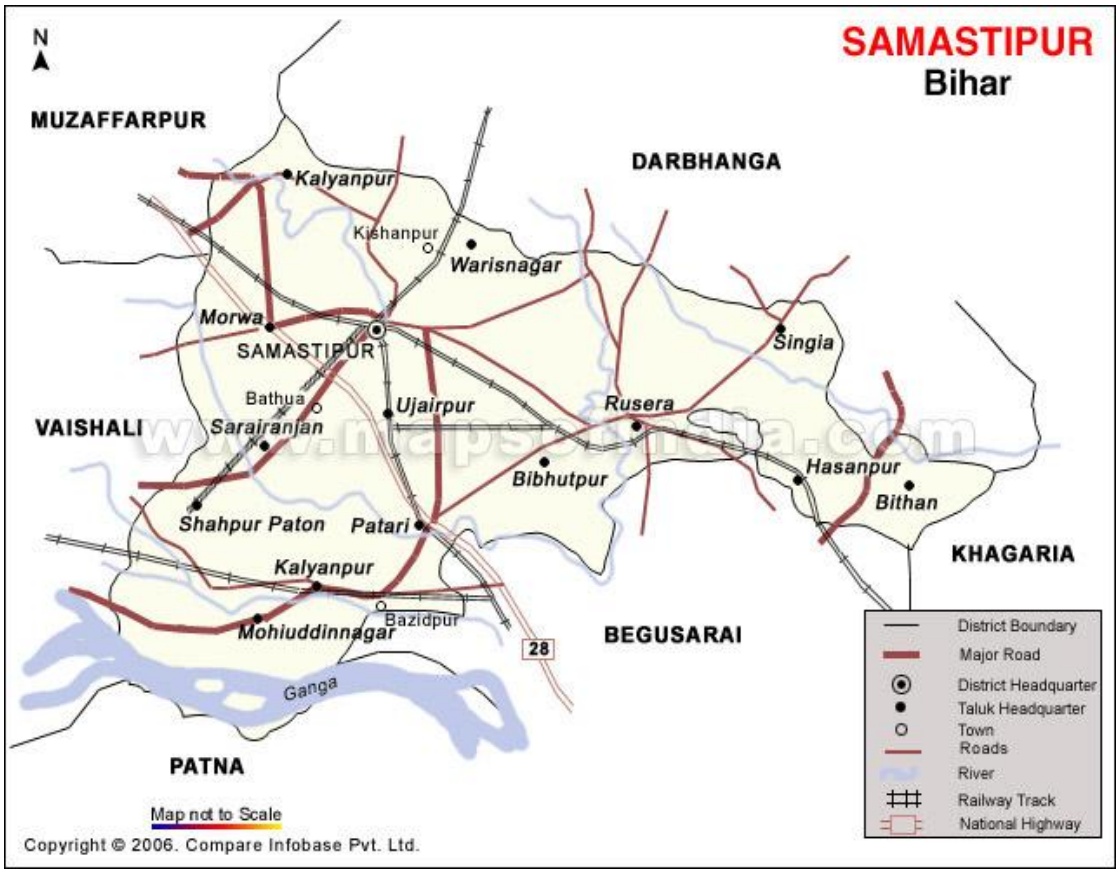


Fig. 1 Index map of Samastipur district

1.2 Basin/sub-basin, Drainage

The district is a part of great Ganga basin. The river Gange skirts the district on the south and flows towards east. Rivers like Burhi Gandak, Bagmati, Baya, Kamla, Kareh, Nun and Jhamwari and Balan traverse Samastipur district. However, the Burhi Gandak and the Ganga constitute the principal drainage in the area.The Baya, the Bagmati and the Balan are comparatively smaller streams.The still smaller streams, which are under various stages of aggradation, are the Janwari, the Nun nadi, the Bainti and the Baluahi. They are ephimeral in nature.

1.3 Irrigation practices

Assured irrigation facility to increase the cropping intisity is very crucial for the survival of the agriculturae economy of the area. Irrigation in the district is provided by different sources like wells ,tubewells, tanks, ponds, rivers i.e.by both surface and ground water. However rainwater is still majour source of irrigation in most part of the district.

Though the part of the district falls in the tail end of the Gandak canal, ground water provide main source of irrigation. Lift irrigation, pond irrigation and canal are main surface water source for irrigation and deep, shallow tube wells and bamboo boring are source for irrigation from ground water. The main agency setting for irrigational infra structure in the area are irrigation and agriculture dept. Irrigation is significantly depend on ground water through bamboo boring and shallow tubewells. The total cropped area is 179056 hectrare and net sown area is 117303 hectare.

1.4 Studies/Activities of CGWB

Central Ground Water Board has covered the district under systematic hydrogeological survey and the district has also been covered under ground water management study. District hydrogeological report and ground water management study report has been issued.

The district has drawn attention of the Board as at some places geogenic contamination of ground water of shallow aquifer with arsenic has been found. The concentration of arsenic is above permissible limit of 50 ppb (BIS 1991). During 2006-07 Central ground water board had carried out exploratory drilling in geogenic-contaminated areas of the district tapping arsenic free aquifer disposed at deeper level. There are nine Hydrograph Network Stations in the district, which monitored 4 times in a year to measure the water level of the phreatic aquifer.

2.0 Climate and Rainfall

The district lies in the monsoon tropical zone and is characterized by Semi arid to Sub-tropical climate. The maximum temperature in the district varies from 21.2° C to 36.5°C. The winter season commences in November and lasts till February. January is the coldest month with mean daily temperature in the range of 7-10^{o}c and mean daily maximum temperature in the range of 20-25^{o}c.

Summer season starts from March and lasts up to June and it is characterized by gradual rise in temparature,occasional thunder showers coupled with hail storms at places and high westerly wind (Luh) . Summer season is followed by the monsoon season which lasts till September.Monsoon season is characterized by cloudy weather, high humidity and frequent rains. October is transitional period. Rainfall generally increases from southwest towards northeast. Most of the total annual rainfall is received during the monsoon months from June to

September. The average annual rainfall is 1142 mm.

3.0 Geomorphology and Soils

The district is a part of great Ganga basin. The district is flat without any elevated land to break the monotony of area. However, levees, small mounds and shallow depressions or the chaurs are only relief observed in the area. These are locally called 'Tal', some of which are permanently water logged.

Physiographically it represents a monotonous flat land with master slope of the area, north of latitude 26^{o}-5' is from north to south, and south of this, it is from north –west to south-east.This feature is reflected in the drainage pattern of the district.The rivers are flowing from north –west to south-east in the district. The change in the level of the Samastipur district is only 0.18m/km. On regional scale area is almost a flat topography. The general elevation of the land surface varies from 40-42mamsl.The plain of the area is characterized by thick pile of alluvial deposits with varying depth and formed by aggregation of alluvial fans of river Burhi Gandak and Bagmati.

Based mainly on the depositional /erosional history, extent of oxidation and pedogenic character, the relative proneness to annual flooding and land use practice of the study area have been classified into two major geomorphic units.

. The geomorphic units in the order of antiquity are

I. Kamla Surface or the present flood plain: It is It is equivalent to "Diara unit"
II. Jaynagar Surface: It is older flood plain and is equivalent to "Vaishali" surface of the Gandak basin.

The contacts between the two units are marked at times by erosional scarps, occasionally by 'onlap'. The contact between two is frequently being so indistinct to be transitional in nature.

Soil

Samastipur comes under the agro-ecological zone-I of the state i.e. North-West Alluvial plains. Samastipur is noted for its fertile alluvial soil and its Rabi crops. The soil is sandy loam with moderately high organic matter, which is suitable for vegetables and spices cultivation. The soil pH ranges from 5.8 to 8.00. This soil is Light to clay in texture. The soil association groups of the Samastipur district are

(a) Young alluvial soil: they are generally calcareous and are light to heavy textured. They have more than 20% $CaCO_3$ in their silt and clay fractions. The free CaCO3

percentages in the soil occur up to extent of sixty. In the district, patches of saline and saline-alkali soils are also found.

(b) Recent alluvial-calcareous soil: They are taxonomically classified as unifluvents, fluaquents and calciudipsamments. They occur in strips along the bank and diaraland of river Gandak. They are light textured and well drained having free $CaCO_3$ between 3 to 10%.

4.0 Ground Water Scenario

4.1 Hydrogeology

The district lies in the Gangatic alluvial plain. The lower Ganga basin consists of deposits of thick pile of unconsolidated quaternary alluvial sediments. The alluvial deposit consists of sequence of clay, silt and sands, including occasional beds of coarse sand and gravel with kankar interspersed at different depth. Thick quartnary alluvial deposits occupy the entire study area.

Based mainly on the nature of the sediments, degree of compaction, extent of oxidation and pedogenic character, the quaternary alluvial sediments of the district have been classified into three geological units (table-3) and they have been assigned informal geological status such as formation or member. These units are the Kamla member, Jaynagar member, Khajauli Member of Jaynagar formation. They are in order of younger to older. The Khajauli Member is the oldest one and is not exposed on the surface. Near Dalsinghsarai two more lithounits namely the Madhubani formation and Mirgani formation were encountered which may probably represent still older formation.The entire study area consists of Kamla member, Jaynagar member, Khajauli Member of Jaynagar formation in order of antiguity.The first two unit occur as out crops while the last one is seen only in subsurface.

The geological set up in Samastipur district is covered by alluvial sediments of quaternary age (Recent to Holocene age). Silty clay, sandy loam and in varying proportions and minor sand beds constitute the uppermost layer of alluvial sediment. Kankar is interspersed in clay and at patches Kankar beds forming thick beds are also present at different depths.

Older alluvium belonging to Pleistocene age occurs in topographically highland in large parts of the district and they are not flooded during monsoon .The younger alluvium belonging to Holocene period occurs along the river courses forming their floodplains and terraces.

Table-2.0 Geological Succession of Quaternary Sediment of Samstipur district

Age	Geological unit	Geological Formation	Lithology
Holocene	Jaynagar formation	Kamla member	Grey and dirty Sand, siltyclay in the
		Jaynagar member	Grey silt, siltyclay and sandwith kankarand faint brown/yellow stains
		Khajauli Member	Pale yellow to yellow clay,silty clay, followed by sand, with occasional kankar and small Ferruginous concreations.
----------Erosional Unconformity----------			
Pleistocene		Madhubani formation	Brown clay,mottled with red ferruginous concreations and kankar
		Mirgani formation	Brick red ,grey mottled clay, with red ferruginous concreations and kankar

4.2 Mode of Occurrence of Ground Water

Ground water in the study area is mainly recharged through Rainfall. The district is characterized by occurrence of various grades of sand admixed with kankars in alluvial sediments forming fairly prolific aquifers in the district. Ground water in the district occurs under water table, semi-confined to confined condition. The ground water occurs under water table condition near surface and occurs under semi-confined to confined condition in deeper level.The ground water occurs under water table condition in aquifer disposed at shallow depth. This aquifer is commonly tapped by dug-wells of depth ranges from 5 to 10 m bgl. The hydrogeological map of the district along with Ec contour is shown in Fig. 2

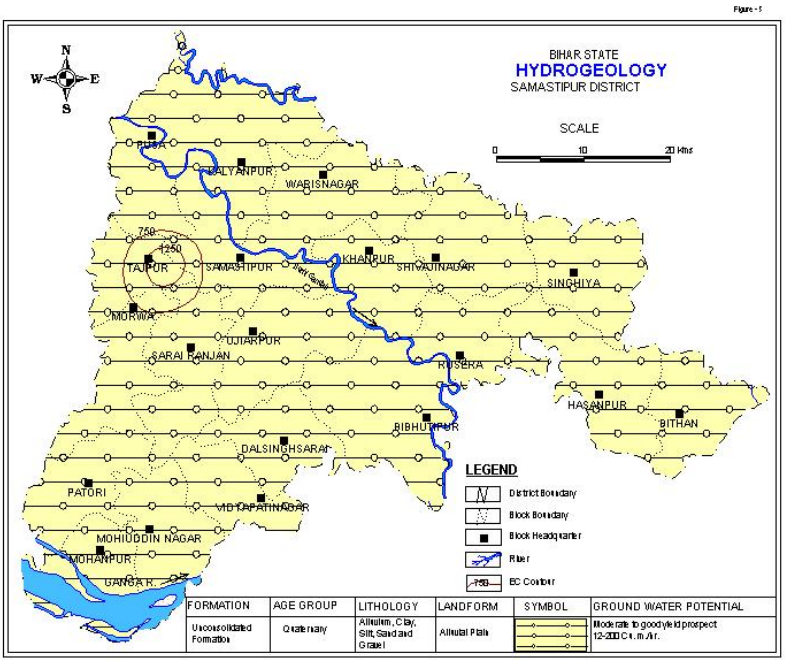


Fig 2**. Hydrogeological map of Samastipur district**

4.3 Water Level Behaviour

The water level is measured at 9 HNS stations in the district and it has been found that that the pre-monsoon (May 2011) depth to water level generally varies from 7.2 to 11.10 mbgl in major part of the district (Fig. 3). The post-monsoon water level generally varies from 3.2 to 6.4 m bgl. It remains within 5m in major part of the district (Fig. 4). The seasonal water level fluctuation from pre to post monsoon show rise of 0.85 to 5.07 m.

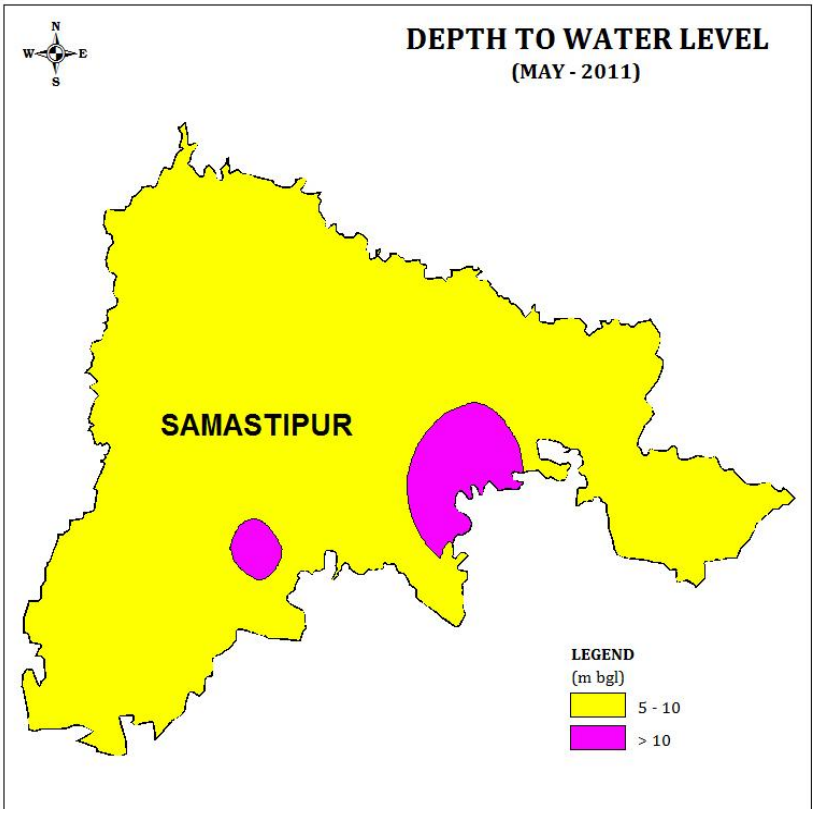


Fig 3. Pre-monsoon (May 2011) water level map of Samastipur district

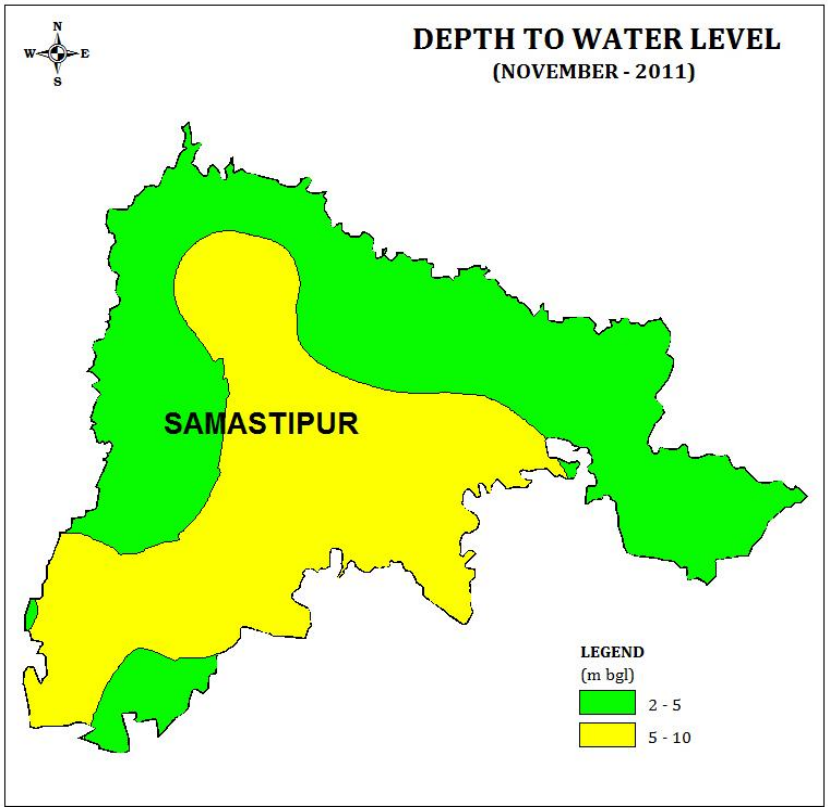


Fig 4. Post-monsoon (November 2011) water level map of Samastipur district

Ground Water Hydraulics

The hydraulic characteristics of aquifer tapped by a deep exploratory well and the zones tapped by these wells are shown in table 1. Pump test data of these wells reveal that The transmissivity ranges from 5340 to 9002 m^2/day and the storativity from 0.99 $x10^{-2}$ to 3.5 $x10^{-6}$ indicating potentiality of the aquifer.

Sl. No	Location	Type of Well	Drilling Depth (m)	Zone tapped	Dischage m^3/hr	Transmissivity m^2/day	Storativity
1	Madudabad	EW	302	90-96,116-128,132-138,222-228	208	9002	$0.99X10^{-2}$
2	Vidya PatiNagar	EW	256	210-222	56.77	1247.51	$3.5X10^{-6}$
3	Kancha	EW	200	98-100, 116-128	73.8	2702.94	$1.025X10^{-2}$
4	Shahpur Patori	EW	129	80-86, 90-102	194.5	5340	$6.3X10^{-4}$

4.4 Ground Water Resources

The net annual replenishable ground water resource as on 31st March 2009 works out to be 91336 ha.m. The gross annual draft for all uses works out to be 44888 ha.m. Allocation of ground water for domestic and industrial use for 25 years works out to be 12191 ha.m. The blockwise resource is given in Table 3.

Table 3 Status of ground water development of the Samastipur district (as on Mar 2009, in ha m)

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 (9-10-13)	Stage of Ground Water Development (12/9)*100 (%)
1	**2**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1	Bibhutipur	7507	3810	472	4282	796	2901	57
2	Bitha	3873	1390	216	1606	364	2119	41.5
3	Dalsinghsarai	3429	1852	441	2294	609	968	66.9
4	Hasanpur	5063	1923	324	2248	547	2592	44.4
5	Kalyanpur	8306	3989	470	4459	794	3523	53.7
6	Khanpur	4915	1762	274	2036	463	2690	41.4
7	Mohanpur	2596	609	161	771	272	1714	29.7
8	Mohiaddinagar	4573	1701	332	2033	637	2234	44.5
9	Morwa	4402	1801	269	2070	454	2147	47
10	Patori	3709	994	261	1255	440	2275	33.8
11	Pusa	2633	1041	200	1241	338	1255	47.1
12	Rosera	3863	1436	437	1873	551	1876	48.5
13	Samastipur	5173	1913	541	2454	1018	2243	47.4
14	Sarairanjan	5301	2773	370	3143	625	1903	59.3
15	Shivajinagar	4792	1897	262	2159	442	2453	45
16	Singhia	4818	1603	290	1893	489	2726	39.3
17	Tajpur	2599	1813	231	2044	389	396	78.6
18	Ujiarpur	6363	2865	421	3286	712	2787	51.6
19	Vidyapatinagar	3131	1636	221	1857	374	1121	59.3
20	Warisnagar	4290	1580	307	1887	518	2192	44
	Total	**91336**	**38389**	**6499**	**44888**	**12191**	**42114**	**49.1**

4.5 Chemical Quality of Ground Water

Ground water samples collected from HNS stations were collected and analyzed and it indicate that in general, ground water of pheratic aquifer is suitable for drinking and irrigation purposes. The ground water is mildly alkaline in nature with maximum value of 8.32. Electrical conductivity (Ec) ranges from 658 micro seimens/cm to 1734 micro seimens/cm at Banmawith average value of 1017 micro seimens/cm. Chloride ranges from 18mg/l to 249 mg/ l with average value of 104mg/ l. All major parameters are within the permissible limit. The minimum, maximum and average values of parameter analyzed are given below. Arsenic concentration above permissible limit of 50 ppb has been found at few places in Southern parts of district namely Mohanpur, Patori, Vidyapatinagar and Mohaddinagar blocks. The arsenic contaminated water above regulatory limit of 50 ppb is hazardous for human health. Iron above permissible limit is also reported from few places in the district.

Table-4.0 Chemical Quality of ground water in Samasthipur district

Parameter	Minimum	Maximum	Average
EC (µs at 25°c)	658	1734	1017
pH	7.84	8.32	8.11
HCO_3^- (mg/lit)	326	572	416
Cl^- (mg/lit)	18	249	104
Ca^{+2} (mg/lit)	14	22	17
Mg^{+2} (mg/lit)	34	126	70
TH (mg/lit)	195	555	333
Na^+ (mg/lit)	47	103	73
K^+ (mg/lit)	1	12	8

4.6 Status of Ground Water Development

The stage of ground water development ii the district is 49.1%. The stage of ground water development is highest in Tajpur (78.6%) and lowest in Mohanpur (29.7%). As stages of ground water development in all the blocks are less than 70% except Tajpur (78.6%), and there is no long-term significant decline in water levels, all the remaining blocks are under safe category. Block wise Stage of Ground Water of Samastipur District is depicted in Fig.5.

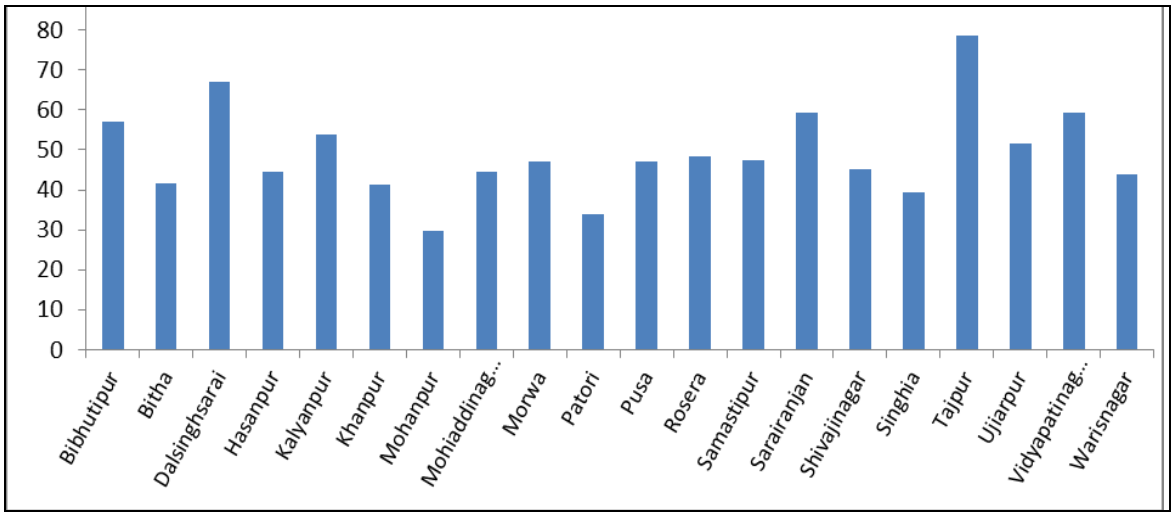


Fig .5 Block wise Stage of Ground Water Development of Samastipur district

5.0 Ground Water Management Strategy

There is need to adopt an integrated approach of development of ground water resources dovetailed with ground water augmentation to provide sustainability to ground water development.

5.1 Ground Water Development

The stage of ground water development in the district is 49.1% indicating that there is ample scope of development of ground water in the district. In the blocks where development is high, this resource should be used judiciously. The ground water development can be done by construction of shallow tube wells and deep tube wells. The younger and older alluvium of huge thickness covers the whole district. The multi-layer aquifers occur in the district. Rotary rig can be used for construction of tube wells in the district. The shallow tube well in the depth range of 30-40m are feasible throughout the area which may provide the discharge of 12-15 m3/hr. Medium duty tube wells can be constructed down to a depth of 100-120m. It may give yied of 50 m3/ hr. heavy duty tube wells could be constructed down to a depth of 100-200mwhich may provide the discharge of 150-200 m3/ hr. Adequate power supply for energisation of pumpsets will be a key factor for ground water development

Arsenic is reported from the shallow aquifer of the district.. It is advisable to tap the aquifer below 80 m to get the arsenic free water in the Arsenic affected hemlets. The cement sealing of shallow aquifer occurring upto a depth of 60 m is advisable to avoid vertical mixing

of contaminated water with fresh water. In the Arsenic affected blocks ground water development by tapping deeper aquifer is essential to supply arsenic free water to the affected villagers.

5.2 Water conservation and Artificial Recharge

All the blocks of the district fall under the safe category. The shallow aquifer of some blocks has problem of Arsenic contamination. Artificial recharge structure may only be constructed in the affected blocks to dilute the arsenic concentration.

6.0 Ground Water Related Issue and Problems

The Arsenic contamination of ground water is the major problem in the parts of Mohanpur, Vidyapatinagar and Buxpatori ar blocks of the district. The arsenic contaminated water restricted with in the shallow aquifer (upto 60 m) in the region. It is necessary to make arrangement for pipe water to the villagers from the deep tube well in the affected area. The top 60 m must be sealed using latest techniques. The stage of ground water development is low and it can be increase to get assured irrigation. Increasing the ground water development can increase the cropping intensity in the district.

7.0 Mass Awareness and Training Activity

Mass Awareness Programme (MAP) and Water Management Training Program (WMTP) have been organized at Arsenic affected Madudabad, M.Nagar block in this district.

8.0 Area notified by CGWA / SGWA

All the blocks falls safe category . As such no block has been notified under CGWA / SGWA.

9.0 Recommendation

1. The Ground Water Exploration work done by the CGWB in the arsenic affected areas of the district reveals the shallow aquifer upto 60 m are arsenic contaminated. The deeper aquifers are arsenic free.
2. The drinking water supply to the villagers of the arsenic affected blocks from the deep tube wells.
3. The shallow aquifers must be sealed while constructing the deep tube wells in arsenic affected areas to get arsenic free water.
4. The stages of ground water development in most of the blocks are below 50%. Ground water may be developed to increase the cropping intensity in the district.

5. Non-conventional energy resource can be used for the energisation of pump sets, where it seems feasible.
6. There is ample scope of large scale ground water development in the study area to meet the requirement for agriculture sector. Exploitation of ground water can be done through Shallow tube wells to meet the requirement of small and marginal farmers while deep tube wells can be operated through farmers cooperative.