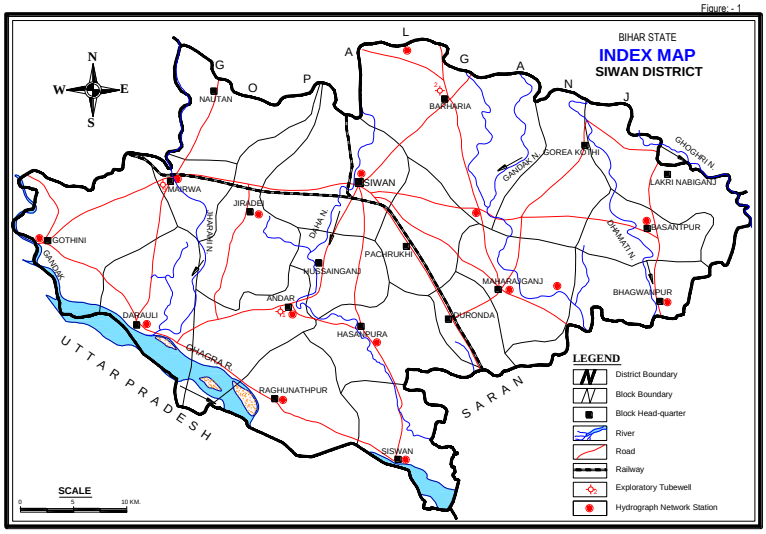
भूजल सूचना पुस्तिका

सीवान जिला, बिहार

Ground Water Information Booklet

Siwan 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

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GROUND WATER INFORMATION BOOKLET, SIWAN DISTRICT, BIHAR STATE
SIWAN DISTRICT AT A GLANCE

Sl. No.	ITEMS	Statistics	
1.	GENERAL INFORMATION		
	i) Geographical area (Sq Km)		2219
	Administrative Division		
	i) Number of Tehsil/ Block		19
	ii) Number of Punchyat/Villages		1536
	iii) Population (As on 2011 Census)		3318176
	iv) Average Annual Rainfall (mm)		1087
2.	GEOMORPHOLOGY		
	Major physiographic unit :		
	Major Drainages:	Ghaghra	
3.	LAND USE (Sq Km)		
	a) Forest area:		Nil
	b) Net area sown:		1735.47
	c) Cultivable area:		
4.	MAJOR SOIL TYPE		
5.	AREA UNDER PRINCIPAL CROPS		
6.	IRRIGATION BY DIFFERENT SOURCES (Areas Sq km and Number of Structures)	Area	No.
	Dugwell	-	14272
	Tubewell/Borewell	910.47	28757
	Tank/ponds	23.2	-
	Canals	39.63	-
	Other sources	16.07	293
	Net irrigated area	991.30	
	Gross irrigated area	1113.33	
7.	NUMBER OF GROUND WATER MONITORING WELLS OF CGWB (2011)		
	No of Dug wells	10	
	No of Piezometers	Nil	
8.	PREDOMINANT GEOLOGICAL FORMATIONS	Quaternary Alluvium	
9.	HYDROGEOLOGY		
	Major Water bearing formation		
	(Pre-monsoon Depth to water level during 2011) m bgl.	3.31 to 9	
	(Post-monsoon Depth to water level during 2011) m bgl.	1.95 to 5.73	

	Long term water level trend in 10 yrs (2002-2011) in m/yr		-
10.	GROUND WATER EXPLORATION BY CGWB (As on 31-03-2013)		
	No of wells drilled (EW, OW, PZ, SH, Total)		3 + 3
	Depth range (m)		198 to 200
	Discharge (litres per second)		**44 to 54**
	Storativity (S)	**1.1 X 10^{-3}**	**to 3.3 X 10^{-4}**
	Transmissivity (m^2/day)		**2000 to 3800**
11.	GROUND WATER QUALITY		
	Presence of Chemical constituents more than permissible limit (e.g EC, F, As, Fe)		
	Type of water	Potable	
12.	DYNAMIC GROUND WATER RESOURCES (2009)- in mcm		
	Annual Replenishable Ground water Resources		739.95
	Net Annual Ground Water Draft		426.58
	Projected Demand for Domestic and industrial Uses up to 2025		74.02
	Stage of Ground Water Development		57.7
13.	AWARENESS AND TRAINING ACTIVITY		
	Mass Awareness Programmes organized		Nil
	Date:		
	Place:		
	No of participant :		
	Water Management Training Programmes organized	Nil	
	Date	-	
	Place	-	
	No of participant	-	
14.	EFFORT OF RTIFICIAL RECHARGE & RAIN WATER HARVESTING		
	Project completed by CGWB(No & Amount spent)	Nil	
	Project under technical guidance of CGWB (Numbers)	Nil	
15.	GROUND WATER CONTROL AND REGULATION		
	Number of OE Blocks	Nil	
	Number of Critical Blocks	Nil	
	Number of Blocks notified	Nil	
16	MAJOR GROUND WATER PROBLEMS AND ISSUES		

1.0 INTRODUCTION

1.1 Administration

Siwan district is located in the North western part of Bihar. The Siwan district, having an area of 2219 Sq.Km falls under toposheets No. 72 B/3, B/4, B/7, B/8, B/11, B/12 72 C/1 & C/5. It extends between north latitude $25^0$22' and $26^0$27' and East Longitude $84^0$2' and $84^0$46'. The district is bounded by Gopalganj in the north, river Ghaghra on Southwest, on South-east and east by Saran district and West by U.P. state. The district has its headquarter at Siwan and has 19 development blocks and 1536 villages. The population of this district is 3318176 as per 2011 census.

1.2 Basin/Sub-basin, Drainage

This district falls in the Indo Gangetic plain covering part of Gandak and Ghagra sub-basin of Ganga basin.

The district is mainly drained by river Ghaghra which is called Saryu in Uttar Pradesh. The river originates from the lower Himalaya in U.P. travelling south-easterly and entering in the district at Guthni. Besides the river Ghaghra there are many ephemeral streams. These are Gandak, Nikri, Jharhi, Daha and Dhamhi. Apart from these sources there are many Jhills and Tals also. During the process of shifting of coarse these rivers leave behind cut off, meanders, abandoned channels and a number of marshes locally known as chaurs. The chaurs are also responsible for water logging in the area with the onset of monsoon and contract to become localised during summer. Apart from these drainage system there is a very good network of canal system also in this district.

1.3 Irrigation Practices

As per the available statistics, area irrigated by different sources e.g. canal, tube wells, dug wells etc. continuity only 59% of the total cultivated area. The operation of canals is the weather and northern part of the district has

greatly enhanced the irrigation facilities but still the tail end area is deprived of canal water.

As some places deep tubewells and shallow tubewells also help in irrigation upto some extent.

1.4 Studies/activities carried out by CGWB

The Central Ground Water Board has carried out hydrogeological surveys followed by ground water exploration in the district. A report entitled "Hydrogeology and Ground Water Resource Development Plan of Siwan district, Bihar" was issued in the year 2. A total of 3 exploratory wells has been drilled in the district. Water levels of 13 hydrograph stations representing phreatic aquirfer are being monitored four times a year since 1975. Chemical quality of ground water of phreatic aquifer is monitored for premonsoon period. Ground water resource has been estimated for the district (GEC-1997, norm) as on 31st March 2009.

2.0 Rainfall and Climate

Monsoon sets sometimes in the third week of June and it lasts till the end of September. The average annual rainfall in Siwan district is 1029.03 mm. The maximum rainfall in the district comes from South West monsoon with a little about 10% spread over the summer and winter. There is a large variation in the rainfall over year to year. Rainfall increases from Southwest to north-east. The behaviour of isohate has been given in the
Plate-2.

After analysis of rainfall data it is revealed that there is a wide variation in the average annual rainfall values, least being at Duraundha and maximum at Maharajganj.

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. The summer starts from mid of March and it continues up

to mid of June after that monsoon starts and it goes up to mid of October. The nights are generally hot from the end of May till the first break of monsoon.

The climate is generally hot and dry, the winter temperature ranges from 16^0C to as low as 4^0C whereas during the summer the mercury shoots to 46^0C. During rainy season it be comes cooler and temperature drops to 35^0C to 25^0C.

3.0 Geomorphology and Soil types

3.1 Geomorphology

The district forms a part of the vast alluvial terrain of Gandak and Ghaghra sub-basins forming a part of Indo-Gangetic alluvium consisting of a thick pile of unconsolidated quaternary sediments. They are recent to sub-recent deposits underlain by erosional basement of Vindhyan formation of pre-cambrian age. The thickness of alluvium is still not yet confirmed through bore-holes. These quaternary sediments consist of sequences of finer clastics like clay and silts with various grades of sand and gravel associated with Kankar. The lithological characteristics are mainly governed by the depositional environments namely distance from the provinance, agencies of deposition and the medium of transport. Marked lateral and vertical variations is texture and composition of sediments support these propositions.

The Gangetic alluvial deposits can be sub-divided into two types viz. newer alluvium and older alluvium. The older alluvium of pleistocence age in the area is rather dark in colour occupies the higher ground and generally rich in kankar which are concretion of nodules of impure calcium carbonate ranging in size from small grains to loose lumps whereas the newer alluvium of recent age occupying the lower grounds constituting of a thick sequence of clay, silt and sand with occasional kankar.

The entire district is underlain by flat alluvial formations of considerable thickness. The uniformity of flatness is quite often disturbed by marshy lands and natural depressions etc. along rivers and stream courses various topography has developed. Broadly the entire tract can be divided as under

(a) **Alluvial low tracts** – They are usually found in the immediate vicinity of the major river Ghaghra which is subjected to periodical submergence by flood water.

(b) **Upland Tracts** – They are usually found away from the major river Ghaghra, thus being immense to its influence.

(c) **Diara Land** – They are found on the beds of major rivers Ghaghra which are nothing but heap of sands brought by rivers during flood gradually rise as water lying stagnant, spreads a thin layer of clay and silt over sand. There is a gradual slope from north-western to south-eastern part of the district, where Mairwa which is the highest part in the district being 65.830 m above MSL and Gangpur Siswan being the lowest point 56.90 m above MSL (Plate-2)

3.2 Soil

Considering the different conditions like texture, climate and pedogenetic situation, the Siwan district is characterised; by a wide variety of soils which can be broadly grouped into two as under as per the U.S. Survey staff (1975).

(a) **Entisols**- There are the younger alluvial soils locally known as Kachh. The Kachhs are generally a light friable loam with higher proportion of sand and silt. It is very much suitable rabi crops which do not need much water.

(b) **Incepti sols** – Calcareous alluvial soils occur mostly in the central part and locally known as Baugar. This soil is river in lime content and Kankar than the Kachh. This forms the typical paddy land of the district.

4. Ground Water Scenario

4.1 Hydrogeology

Rainfall in the primary source of ground water recharge. Out of the total rainfall which falls within the Gandak and Gharghra sub-basins of the district, a part of it directly evaporates from the land surface, partly it is absorbed by the vegetation and partly reaches the rivers and ponds as surface run-off. The remaining 20% to 30% rain water goes to the ground water body. Influent seepage from irrigation also contributes to the ground water body in the district.

The sand layers of the quaternary alluvial sequence form the major repository of ground water in the district which occur under unconfined condition in shallow zone and semi-confined to confined condition in the deeper zone.

The thickness of the aquifer in the district varies from 15 mt to 90 mt which is mainly controlled due to the irregular sloping nature of the bed on which sediments rest. The composition of the sediment is not uniform thus the aquifers are of heterogeneous in character. In general, sand layer predominant in the district barring the clay bed which gradually thickness in South. These granular zones yield 150 m3/hr to 250 m3/hr for a draw down of 4.7 mt to 8.00 mt as observed from the state tubewells.

The sub-surface lithology of the alluvial tract is known down to 200 mbgl from the lithological logs of bore holes drilled under exploratory wells construction programme of erstwhile ETO and State Tubewells Corporation. The depositional nature of sediments beyond 200 mt is still remaining unascertained. Recent geophysical traverses brought to the light that alluvial basin is very thick and is of the order of 1000 mt to 2700 mt. The transmissivity of this sand/Gravel bed is calculated to be 3000 m^2/day under confined condition. At Barharia the aquifer below 50 mt is proved to be in leaky artisan condition with a transmissivity value of 2000 m^2/day.

Pumping test carried out at Andar and Barharia reveal that is the Southern part of the district the aquifers are in the perfect confined condition with storage co-efficient value of $3.3X10^{-4}$ whereas the aquifer in the northern part is in leaky artisan condition.

The hydraulic properties of the granular zones are given in Annexure. The study of this annexure reveals that the quaternary sediments of Siwan district are good repository of ground water. The wide range of hydraulic conducting value indicates that the aquifer in the area are quite heterogeneous both vertically and laterally.

Shallow tubewells constructed by State Govt. in the area yielded as high as 134 m^3/hr to 175 m^3/hr for a draw down of 3.35 mt to 7.00 mt. The deep tubewells constructed by CGWB at Andar, Barharia and Mairwa yielded 161

m^3/hr to 195 m^3/hr for a draw down 7.00 mt to 12.0 mt. The yield of dug wells depends upon the thickness of aquifer tapped, diameter of wells, depth of wells, nature of lining and discharge of wells at which they are pumped.

The ground water hydraulics langely depend upon the nature of sediments i.e. gain size and sorting and is depositional setup. Occurrence and movement of ground water in this hydrogeological unit is controlled by primary porosity of the sediment. In the entire district, ground water occurs under both phreatic and confined condition and at some places they are also found to be under semi-confined condition.

4.2 GROUND WATER RESOURCES

The main source of the ground water recharge in the district is rainfall. Apart from this, the return flow from ground water irrigation, seepage from canal, ponds, tanks and direct infiltration from river beds during stream flow are the other secondary sources of recharge. The annual recharge of ground water bodies constitute the replenishable or dynamic resource.

The blockwise ground water resource of Siwan district has been calculated upto 31.03.2009 as per the norms laid down by the Ground Water Estimation Committee, Ministry of Water Resources, Govt. of India, 1997. the detail is being given in annexure.

Recharge has been calculated by water level fluctuation method. The specific yield of the alluvium in the district has been assumed between 12 to 18%.

	In MCM
Total Ground Water Resource	739.95
Total ground Water Resource for irrigation	377.86
Gross annual Ground water Draft	426.58
Allocation for Domestic and Industrial Requirement Supply upto year 2025	7402
Stage of Ground Water Development	57.7

As per estimation of blockwise draft data the level of development is maximum in Siwan block (72 %) whereas in the block of Nautan (37.1 %) the development is the minimum.

4.3 Chemical quality of Ground Water

The chemical quality of ground water chiefly depends upon the reaction of solution and precipitation infiltrating in the sub-surface strata. Considering this fact a large number of water samples were subjected to partial and complete analysis. The study of the analytical data reveals that in general quality of ground water is suitable for domestic and irrigation purposes barring exceptional cases which are localised one. The range of different cations and onions are as follows:-

Chemical constituents	**Range**
PH	7.90 – 8.65
Electrical Conductivity	215-1544 micromohs/Cm at 25^0C
Calcium	6-58
Magnesium	6.08-64
Sodium	9.4-152
Potassium	0.4-8.2
Biocarbonates	207-488
Chloride	18-224
Total Hardness	55-330

4.4 Status of Ground Water Development Block wise

The occurrence and movement of ground water is governed by geology and geomorphology of any area. An attempt has been made to summarize block wise information on suitable well type, depths, discharge and suitable drilling method.

5. Ground Water Management Strategy

5.1 Ground Water Development

The development of ground water resource of Siwan district shows that at present the stage of development is about 55 % At present all blocks are still coming under safe category.

As the district is an agricultural district. So, even in the areas where ground water development in high, such development can be done phase wise with a cautions and judious way.

Present Ground Water Development

It has been observed that nearly 60% of the net irrigated area of the district is served by ground water structures based upon minor irrigation system. The canal irrigation is still far away from satisfaction and nearly 15% of the area is irrigated by canal. The draw back with canal irrigation system is that the canal water is still unavailable at tail end area and in upper reaches it is not relieved in time. The maintenance of the canal system is also not satisfactory.

In the entire district, still most of the villages depend upon wells, tanks, ponds, hand pumps/tubewells, rivers and other sources for drinking water supply still only a limited towns / villages are promoted by water supply.

To meet the requirement of ground water in Siwan district so many tubewells were completed by E.T.O. and State Govt. agencies. Later on by CGWB, at three sites exploratory tube wells were constructed. The heavy-duty tube wells were constructed by tapping the granular zones of 90 m to 100 mt with a thickness of about 20mt to 50 mt. whereas in the State shallow tubewells granular zones between 50 to 90 mt has been tapped. The discharge of heavy-duty tubewell ranges between 134 to 250 m^3/hr whereas for shallow tubewell it varies between 20 to 50 m^3/hr. In this regard a number of dug wells were also constructed with a diameter between 1.10 to 2.40 mt the discharge of well depends generally on the thickness and nature of aquifer tapped upto 14.00mt.

Future Ground Water Development Possibility

As per available present ground water utilisation it is observed that there is still a good chance to enhance the ground water development leaving some of blocks which has gone under grey category and even some blocks will go under grey category in future. So, by using different types of structures; based upon high yielding and low yielding discharge tubewells the demand of drinking and irrigation requirement can be met as per the demand of user agencies.

5.2 Water Conservation and Artificial Recharge

All the blocks of the district fall under safe category. Artificial recharge and Rainwater harvesting technique may be adopted in the Siwan and Barharia blocks where stage of ground water development is high. As the entire district is covered by alluvial formation contour bunding and recharge ponds are most suitable structure in the rural areas of the blocks.

6.0 Ground Water Related Issue and Problems

There is no any ground water related issues and problems in the district.

7.0 Mass Awareness and Training Activity

7.1 Mass Awareness Programme

Till date no any mass awareness/training programme has been organised in the district

8.0 Area Notified by Central Ground Water Authority (CGWA) / State Ground Water Authority (SGWA)

All blocks of Siwan district are under safe category for ground water development point of view. No blocks has been notified by CGBA/SGWA.

9.0 RECOMMENDATIONS

1. Based upon the following conclusions the following points are recommended.
2. As the district is an agricultural based district and its all socio-economic fabric is directly related with agriculture, so the main emphasis is to be given for development of ground water especially in the care of irrigation.
3. In view of inadequate surface water irrigation the gap between the demand and supply can be filled by integrated use of surface water resource available in the district.
4. The special attention should be given towards the structures already eveated but which have become defunct. These structures unit be rehabilitated so that it creates a confidence among the beneficiaries and it can help to boost the overall productivity through multiple cropping pattern.
5. The behaviour of water table should be watched constantly. In this contest, the rise and fall in water level should be studies and monitored so that the ister taken of additional irrigation structures can be planned accordingly.
6. The mitigate the water logging problem in the district the conjunctive use of surface water and ground water should be taken up in phase manner. The lining of the canals in strongly recommended.
7. To keep in view the efficiency and proper discharge, 9 minimum standard for well spacing should be maintained. For this a minimum distance for shallow wells should be kept 150 mt whereas for deep

tubewells it should be 600 mt. Selection of pumping system should be such that they are 7 optimum efficiency.

8. To minimise the cost the brass stainer should be replaced by low cost materials. In the district there are 2 to 3 types of aquifers, so just to give benefit the small and marginal farmers it is always suggested that the shallower aquifers should be left far them.

9. To increase the agricultural productivity, scope it environmental hazards like flooding etc can be reduced.

10. To minimise the cost of crops, farmers should adopt the most suitable cost effective cropping patterns.

PROPOSED MODEL OF TUEWELL IN SIWAN DISTRICT

Sl.No.	Discharge m^3/hr	Proposed depth of wells	Proposed well Assembly		H.P. of suitable pump
			Dia of the pipe	Length	
1.	150	100	306 mm Housing 153 mm slotted 153 mm blank pipe	25 24 51	22
2.	200	120	357 mm housing 204 mm slotted 204 mm blank	30 30 60	35
3.	250	180	357 mm housing 204 mm slotted 204 mm blank	35 35 110	42

DISTRICT : SIWAN

EW OW TOT

Sl.No.	Location/ Block	Depth Drilled mbgl.	Length of Casing pipe/ Depth const. m.	Granular/ Zone/ fracture Tapped m.	Static Water level m. bgl.	Discharge m^3/hr.	Drawdown m.	Specific Capacity m^3/hr./m.	Trans-missivity m^2/day	Storativity	Diameter of assembly mm.	Formation	Quality Water
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	**ANDAR**	198	192	102.00-108.00 126.00-132.00 150.00-156.00 174.00-186.00	2.27	160.72	7.09	22.66	3820	$03.30X10^{-4}$		ALLLUVIUM	POTAE
	OW	200											
2	**BARHARIA**	200	132	041.00-047.00 054.00-066.00 072.00-097.00 116.00-127.00	2.01	194.4	11.87	16.38	2009	$01.10x10^{-3}$	305 152	-do-	-do-
	OW	100.7											
3	**MAIRWA**	200	192	050.00-070.00 115.00-155.00 174.00-189.00	NOT TESTED				ABONDONED		305 152	-do-	-do-
	OW	200											

Assessment of Dynamic Ground water resource of the Bihar state
Siwan 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 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	Andar	4699	1649	163	1812	246	2803	38.6
2	Barharia	4896	2945	441	3386	667	1284	69.2
3	Basantpur	2368	968	143	1111	216	1184	46.9
4	Bhagwanpur	4152	2381	299	2680	452	1319	64.6
5	Darauli	5177	2647	249	2896	376	2154	55.9
6	Daraunda	3912	2108	244	2352	369	1435	60.1
7	Goryakothi	4877	2929	314	3243	475	1472	66.5
8	Guthani	3479	1740	186	1926	281	1458	55.4
9	Hussainganj	3191	1693	256	1949	387	1111	61.1
10	Hasanpura	2846	1691	225	1916	340	814	67.3
11	Jeradei	3122	1824	239	2063	361	937	66.1
12	Lakri Nabiganj	2557	1454	184	1638	278	825	64.1
13	Maharajganj	4553	2201	361	2562	556	1796	56.3
14	Mairwa	4164	1295	241	1536	374	2495	36.9
15	Nautan	3501	1171	127	1298	192	2138	37.1
16	Pachrukhi	3677	2314	281	2596	425	937	70.6
17	Raghunathpur	5138	2160	233	2393	352	2626	46.6
18	Siswan	3233	2119	208	2327	315	800	72.0
19	Siwan	4455	2496	478	2974	740	1219	66.8
	Total	**73995**	**37786**	**4873**	**42658**	**7402**	**28807**	57.7

Figure: - 1

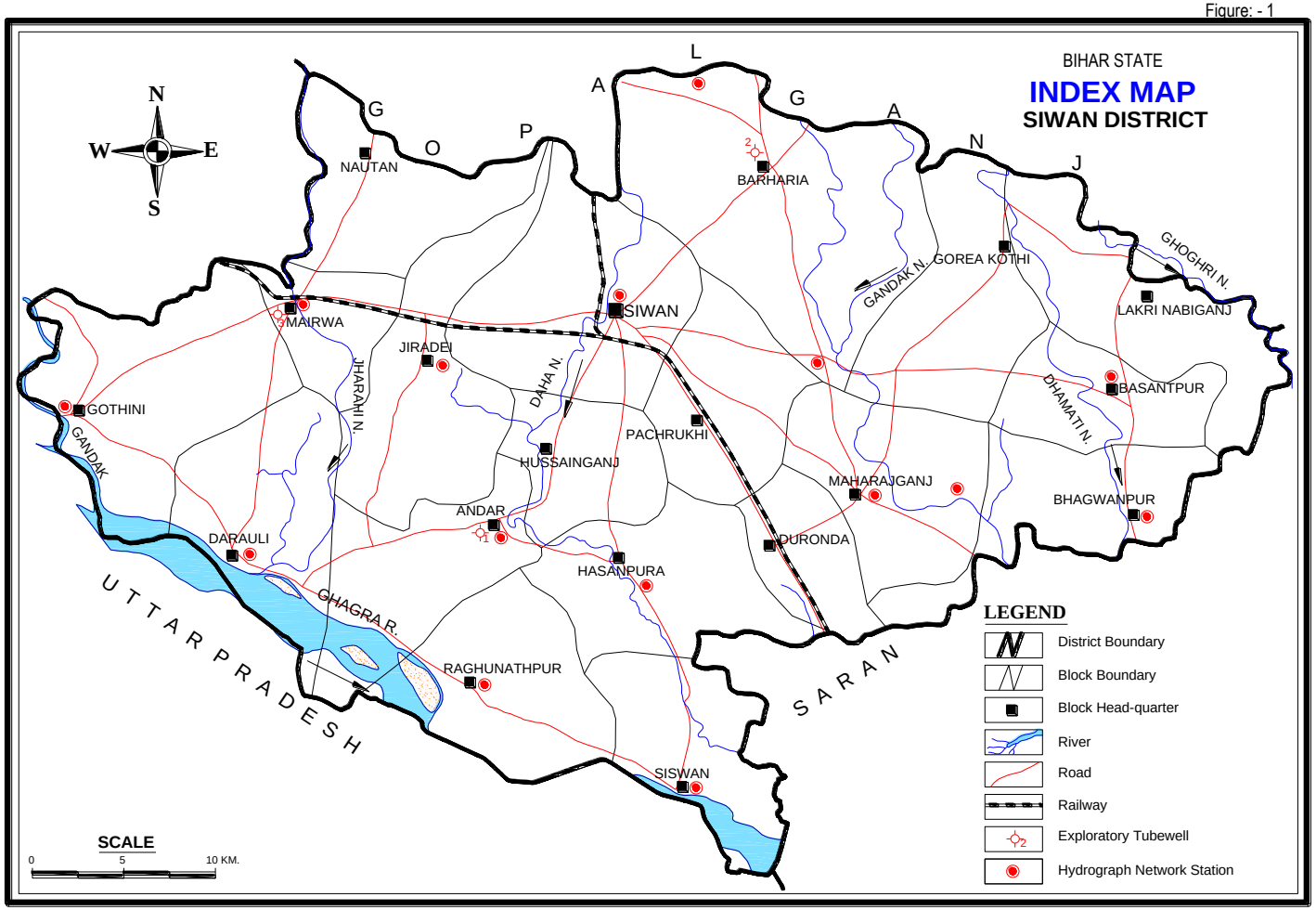


Fig. 1

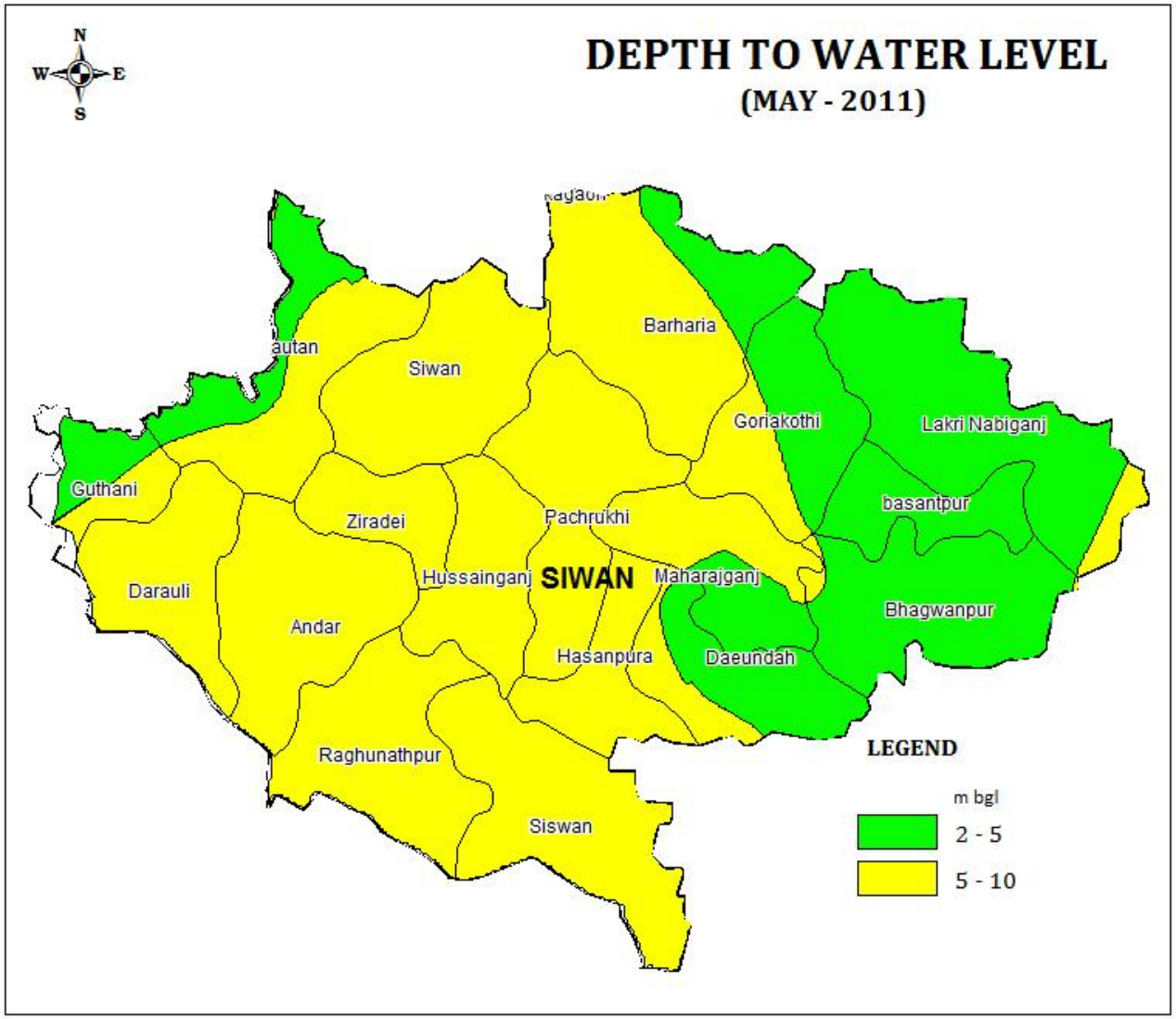


Fig. 2 Depthe to water level mao of pre-monsoon 2011.

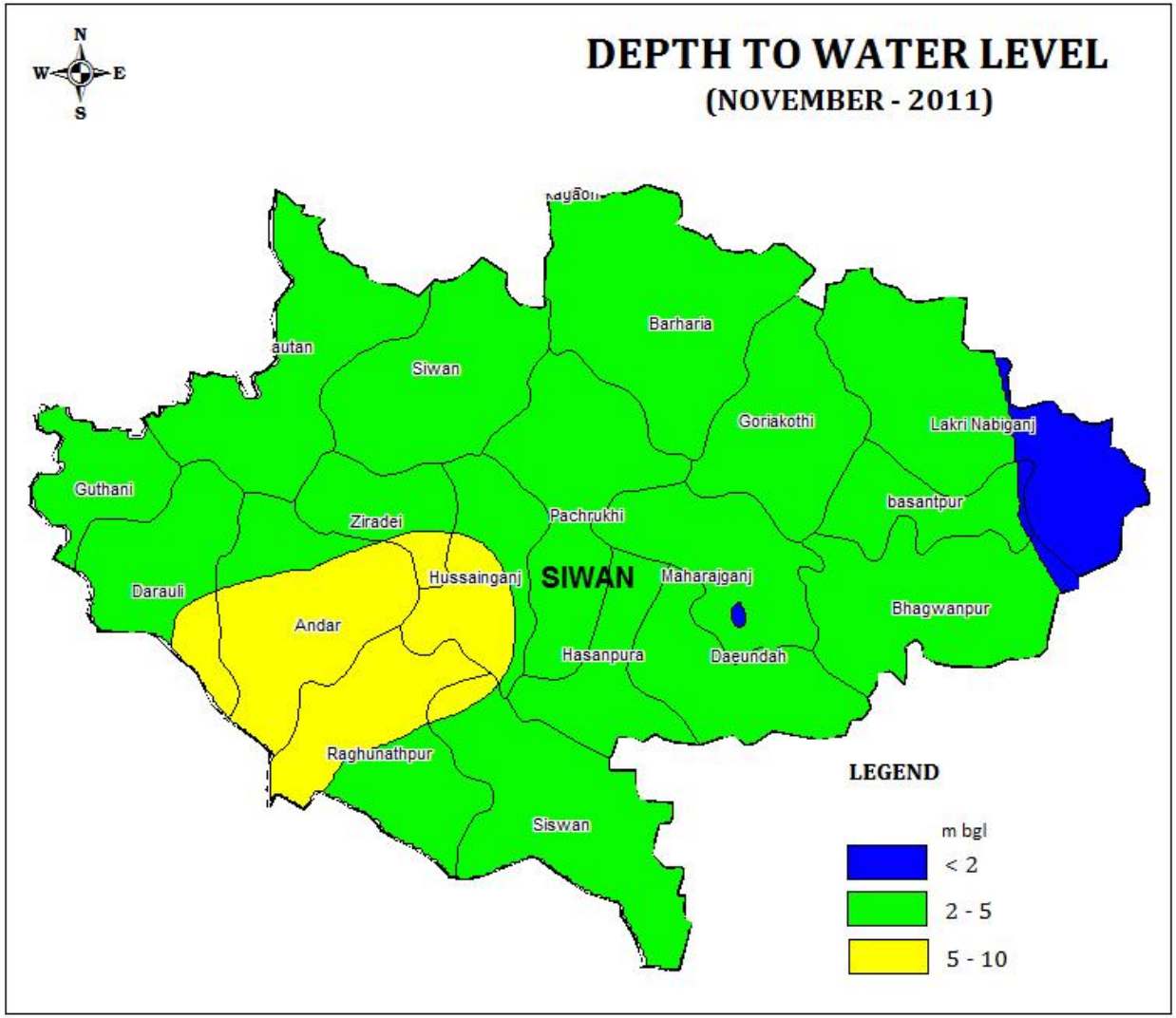


Fig. 3 Depth to water level map in post-monsoon 2011.

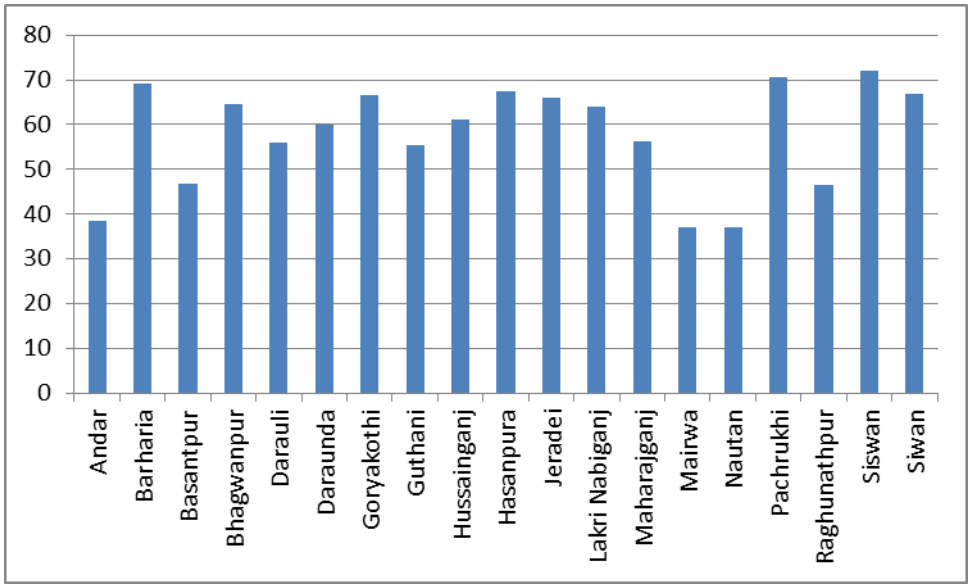
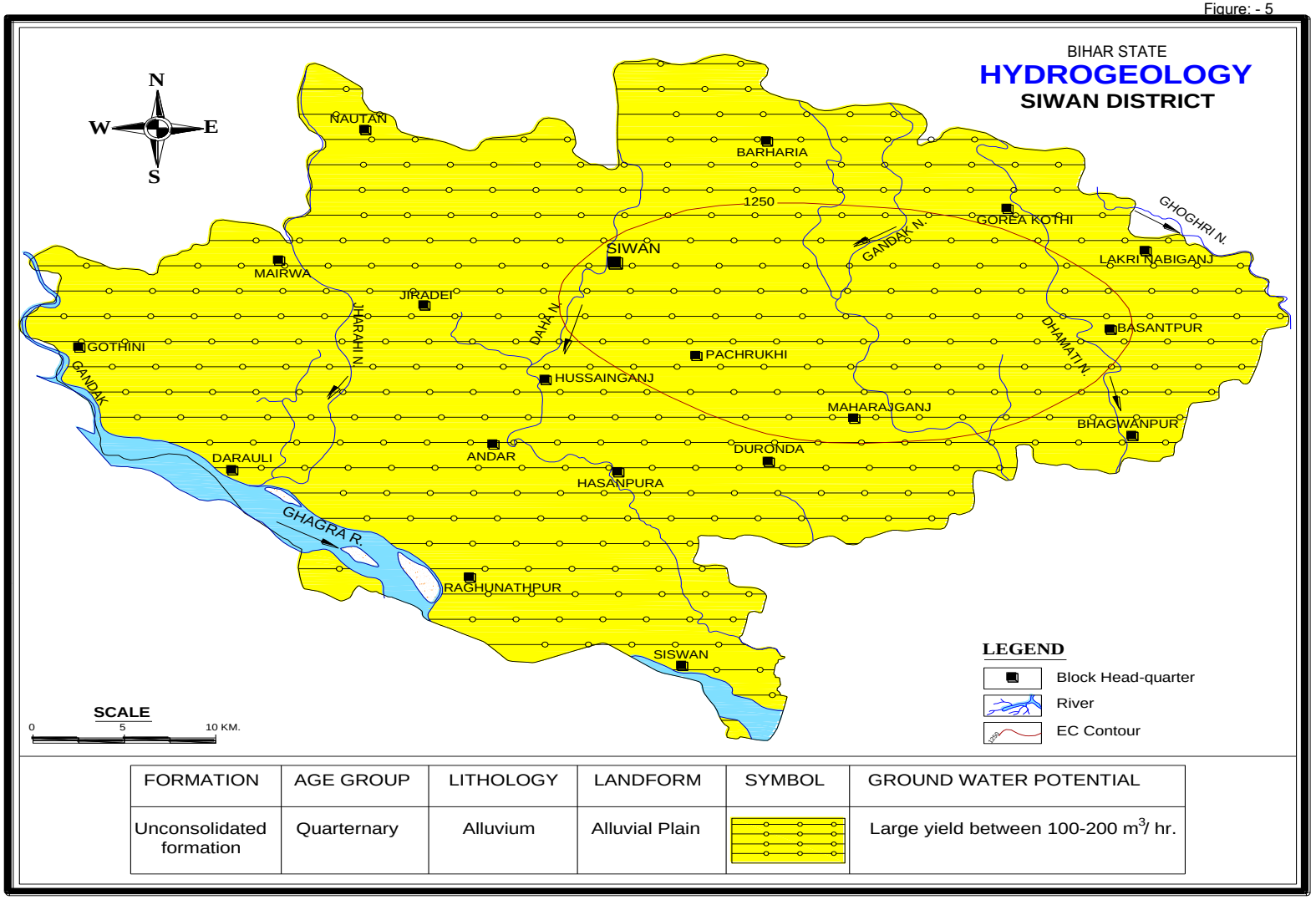


Fig. 5 Blockwise stage of ground water development

Figure: - 5



FORMATION	AGE GROUP	LITHOLOGY	LANDFORM	SYMBOL	GROUND WATER POTENTIAL
Unconsolidated formation	Quarternary	Alluvium	Alluvial Plain		Large yield between 100-200 m^3/ hr.

Fig. 5