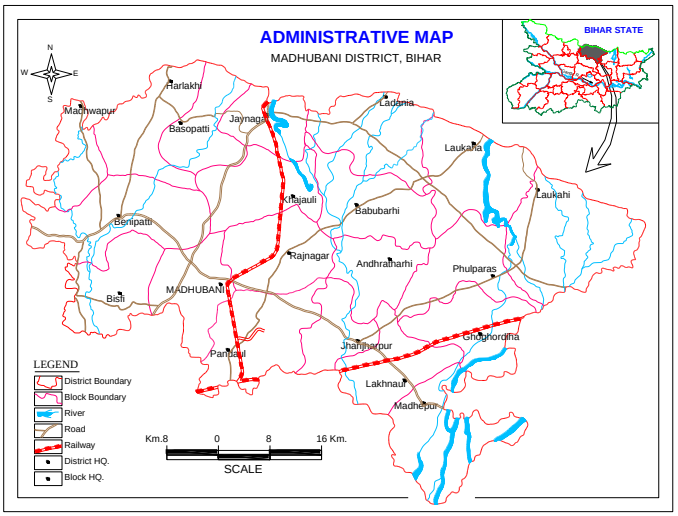
भूजल सूचना पुस्तिका

मधुबनी जिला, बिहार

Ground Water Information Booklet

Madhubani 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

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GROUNDWATER INFORMATION BOOKLET
MADHUBANI DISTRICT

DISTRICT AT A GLANCE

Sl. No.		Statistics
1.	GENERAL INFORMATION	
	District Headquarter	Madubani
	Location	26^0 03' to 26^0 40' N 85^0 45' to 86^0 45' E
	Geographical Area (Sq. Km.)	3501 sq.km
	Administrative Divisions	Madhubani, Benipatti, Jhanjharpur, Phulparas, Jaynagar
	No. of Blocks	20
	No. of Panchayats/Villages	Na/ 1032
	Population (As per 2011 Census)	4476043
2.	CLIMATE AND RAINFALL	
	Average Annual Rainfall (mm)	1289 mm
	Maximum Temparature	42 ^{0}C
	Minimum temparature	13 ^{0}C
3.	GEOMORPHOLOGY	
	Major Physiographic Units	Alluvium
	Major Drainages	Kosi Dhar, Bhitahi Balan, Kamla Balan, Dhaus Nadi
4.	LAND USE	
	a) Forest Area	Nil
	b) Net Area Sown	2251.13 sq.km
	c) Cultivable Area	3170.83 sq.km
	d) Multi- crop area	919.70 sq. km
5.	MAJOR SOIL TYPES	Younger and Older Alluvium
6.	AREA UNDER PRINCIPAL CROPS	
7.	IRRIGATION BY DIFFERENT SOURCES (Areas and Number of Structures)	
	Tube wells irrigation	411.13 sq.km
	Other Sources	974.38 sq. km
	Net Irrigated Area	1385.51 sq.km
	Gross Irrigated Area	1000 sq.km
8.	NUMBER OF GROUND WATER MONITERING WELLS OF CGWB (2011)	
	No. of Dug wells	10
9.	PREDOMINANT GEOLOGICAL FORMATIONS	Alluvium
10.	HYDROGEOLOGY	
	Major water bearing formations	Alluvium

	Pre-monsoon Depth to water level during 2011	1.16 – 6.0 m bgl
	Post-monsoon Depth to water level during 2011	1.4 – 3.75 m bgl
	Long term water level trend in last 10 yrs (2002 – 2011) in m/yr	No significant decline
11.	GROUND WATER EXPLORATION BY CGWB (As on 31-03-2013)	
	No. of well drilled (EW,OW, PZ, SH, Total)	EW-8, PZ-4, OW-11, Total= 23
	Max. Depth Drilled (m bgl)	398.5
	Max. Depth of Well Construction	351
	Min. Depth of Well Construction	112
	Discharge (m/s)	40 – 180 m^3/hour
	Storativity (s)	1.0×10^{-3} to 1.8×10^{-4}
	Transmissitivity (m^2/day)	215 – 1736 m^2/day 9.6 – 18 m3/hour (autoflow discharge)
12.	GROUND WATER QUALITY	
	Presence of Chemical constituents more than the permissible limit (e.g.EC, F, As, F)	Fresh & Potable with little higher Iron concentration at places in shallow aquifer
	Type of Water	
13.	DYNAMIC GROUND WATER RESOURCES (as on 31st March 2009) In ha.m	
	Annual Replenishible Ground Water Resources	90844
	Net Annual Ground Water Draft	33828
	Projected Demand for Domestic and Industrial Uses up to 2025	10006
	Stage of Ground Water Development	37.2%
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	No major groundwater related problem

1.0 INTRODUCTION

1.2 Location, Area and Population

The district Madhubani lies between the north latitudes of $26^0$03' to $26^0$40' and east longitudes of $85^0$45' and $86^0$44'. It occupies a total geographical area of 3501 sq km. It is bounded by Darbhanga district in the south, Sitamarhi district in the west, Kosi river in the east and Nepal in the north. The is at Madhubani town is the district headquarter of the district and it is well connected by roads to its other towns like Jainagar, Jhanjhapur, Khutauna, Benipatti, Phulparasa etc.

As per the latest 2011 census, the total population of the district stands at 4476043 including rural and urban populations of 4311466 and 164577 respectively. Madhubani has five Sub-divisions, namely, Madhubani, Jaynagar, Benipatti, Jhanjharpur and Phul Paraas. As on 31st March 2004, the district has twenty blocks namely Madhubani, Jainagar, Pandaul, Bisfi, Benipatti, Basopatti, Babubarhi, Rajnagar, Madhepur, Khutauna, Khajauli, Jhanjharpur, Ghoghardiha, Ladania, Madhwapur, Harlakhi, Laukahi, Andharatharhi, Lakhnaur and Phulparas. Paddy is the key crop of the district. Pisciculture is known to be one of the main sources of revenue in the district. Sugar factories are also present in the district, which help in income generation. Madhubani is popular world over for its art and crafts. Madhubani Paintings claim a distinct identity because of their unique design and top quality texture. The district, intersected by Kamala and Bhutahi Balan rivers, is flourishing every year with its farming endeavours and artistic richness.

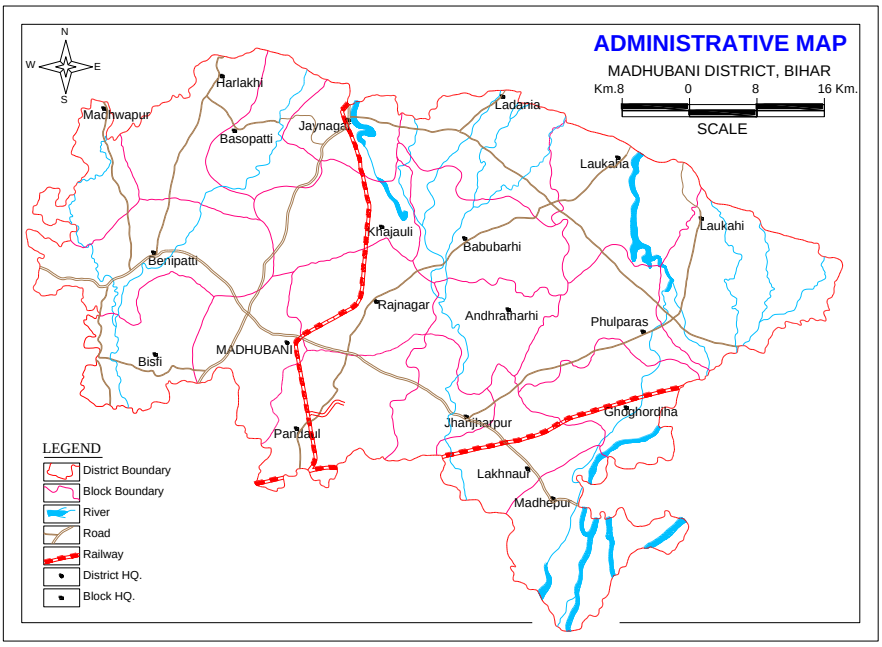

Figure 1: Administrative map of Madhubani district, Bihar with block boundaries road (rail) networks

1.2 Basin/Sub-Basin and Drainage

The district Madhubani forms a part of Mid-Ganga basin with Kamla Balan sub-basin (Figure 1). The district is situated just to the south of Tarai region of Nepal. The rivers originating from the Tarai zone with their tributaries are flowing towards south and meeting major rivers in India. The principal rivers in Madhubani district from east to west are Kosi Dhar, Bhutahi Balan, Kamla Balan and Dhaus Nadi (Table 1).

Table 1 Principal Rivers and their Tributaries in Madhubani District

Principal rivers	Tributaries
Kosi Dhar	1. Kosi Dhar 2. Kajra 3. Kharag
Bhutahi Balan	1. Bihul Nadi 2. Bhutahi Nadi 3. Sugarwe Nadi
Kamla Balan	1. Sonia Nadi 2. Kamla Nadi 3. Ziwach Nadi
Dhaus Nadi	1. Dhaus Nadi 2. Thomana Nadi

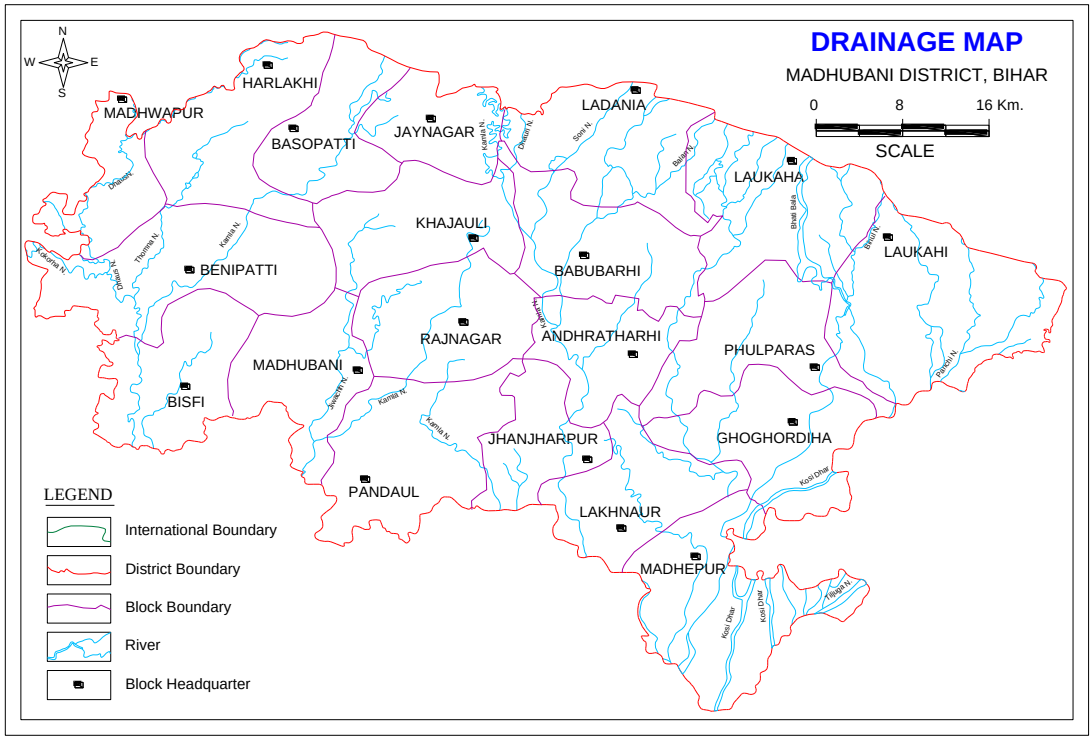

Figure 2: Drainage map of Madhubani district, Bihar.

1.4 Landuse Pattern, Agriculture and Irrigation Practices

Out of the total geographical area of the district, nearly 65 % (2251 sq.km) is culturable and the rest constitute non-culturable wasteland and land put to non-agricultural uses. There are mainly two harvesting seasons in the district in a year known as Rabi and Kharif. The area under paddy cultivation stands at 36.85 % of the total agricultural land in the district. During the Rabi season (October to April), the crops like wheat, barley and pulses etc are sown, while the main crops during Kharif season (June to October) are paddy, maize, Jawar and pulses. Sugarcane is sown during both the seasons.

The main sources of irrigation in the district are shallow tube wells, tanks and canals. Tanks and canals are basically rain-fed and dry up during the Rabi season.

1.5 Activities Carried out by CGWB

A systematic hydrogeological survey was carried out by CGWB in the district during 1975-76. Again the potential ground water areas in the district were delineated in 1981 through systematic survey. Later on in 1994-95, a hydrogeological reappraisal survey was carried out in order to evaluate the status of ground water development in the district. During 1993-95, a total 23 bore holes were drilled in the district including 8 exploratory wells, 11 observation wells and 4 piezometers, in order to demarcate the auto-flow zone in the district, to decipher the aquifer geometry and their potentiality. The bore hole have been drilled to a maximum depth of 398.5 m. Besides, all these, Central Ground Water Board has a set up of dug wells in the district as Hydrograph Network Stations from which water level data are collected four times in a year in order to study the general ground water trend in the district.

2.0 CLIMATE AND RAINFALL

The district experiences a sub-tropical climate, characterized by tolerable summer (March to November) and pleasant winter (November to February). The maximum and minimum daily temperatures during May are around 36^0C and 24^0C respectively. In rare cases, the summer maximum temperature reaches 43^0C. In winter the temperature varies within 24^0C and 10^0C. The maximum humidity in the region is felt during rainy season and minimum in summer.

The normal annual rainfall in the district varies stands at 1257.81 mm, of which monsoon rainfall constitutes about 83.14 % (1045.71 mm). The rain usually starts in the middle of June. The maximum rainfall occurs between the second half of July and first half of August.

Table 2 Rainfall Pattern in the Madhubani district during 1997-98

Duration	Rainfall (mm)
June – September 1997	1114.4
October – December 1997	15.60
January – February 1998	16.70
March – May 1998	92.00
Annual 1977-98	1338.7

3.0 GEOMORPHOLOGY AND SOIL TYPES

The entire Madhubani district is a plain tract situated just to the south of Nepal. The foothills of Nepal Himalayas, which are running east west, is 30 – 35 km north from the Madhubani district border. The entire Tarai zone lies in Nepal with high relief of 2.95 -3.95 m/km and slopping towards south. The northern parts of Madhubani are in touch with the Tarai zone. From the end of the Tarai zone up to the south of the district, the areas shows 1 m/km gradient with ground elevation of 80 m amsl at the northern boundary and 40 m amsl at the southern boundary. Thus the relief of the area in Nepal is much higher in comparison to the area towards its south in Madhubani district.

The area in Madhubani district can be sub-divided three geomorphological units namely (i) Newer Flood Plain, (ii) Older flood plain and (iii) Older alluvial plain. The flood plains are mainly occurring all along the river courses and consist of sand, silt and clay having largely low-lying water logged areas. The old flood plains consist of sand, silt and clay and are mostly under paddy cultivation. The older alluvial plains are generally uplands and consist of clayey silt, clay, and occasional kankars.

1.3 Soil

The soils found in Madhubani district have been classified into the following three categories:

i) Newer Aluvium (Khadar)

ii) Sandy Alluvium soil having alkaline reaction

iii) Calcareous soil

Newer Alluvium soil is generally found along either side of the river namely Kamla, Bhutahi Balan and Dhaus Nadi.

The soils in Madhubani fall in the class of largely entisols with several variations brought about due to vagaries of fluvial sedimentation. These soils have not got sufficient time for pedogenic changes due to highly dynamic fluvial regimes in the area.

4.0 GROUND WATER SCENARIO

4.1 Hydrogeology

The quaternary alluvium is the main repository of ground water in Madhubani district. Granular and mixed zones are found with different sicknesses starting from the depth of 15 m bgl to the explored depth of 398 m bgl.

The dug wells are sustained within 15 m bgl, of the formations of predominantly clay, silt and sand lenses. Here, the ground water occurs under water table condition.

In the northern part of the district, in Ladania, Padma and Harlakhi section, the first potential aquifer comes within 15 – 50 m bgl (semi-confined to confined). The local farmers mostly exploit this by constructing shallow tube wells. The next important aquifers come at depth ranges of 129 - 146 m bgl, 185-197 m bgl and 305-311 m bgl respectively. All these three aquifers are auto-flowing in nature (Figure 3) with an average discharge of 9.6 m^3/hr (free flow discharge). This auto-flow nature of the aquifers has developed due to the thick (50 – 129 m bgl) confining clay layer, which overlies them. The piezometric head of the wells constructed in this zone lies at 1.34 – 2.77 m AGL with the highest free flow discharge of 18 m^3/hr.

In the remaining parts of the district, the hydrogeological scenario has been quite modified by the fluvial regimes of the rivers in the district. Places close to the rivers show silty and fine sand layers up to a depth of 20 m bgl. Here, water occurs under water table condition. In general a thick clay bed from 10 – 60 m bgl with silt and fine sand bed partings, covers the underlying major aquifers within 60 -110 m bgl as per the state tube well drilling data. These aquifers are under confined condition.

As per the ground water exploration work conducted in the northern part of the district by CGWB, the yield of the wells constructed in this part can be up to 180 m^3/hr with a safe drawdown of 6 – 12 m. The aquifer test conducted in this part indicates that the transmissvity value of the aquifers varies between 1.01×10^{-3} to 1.8×10^{-4} (confined condition).

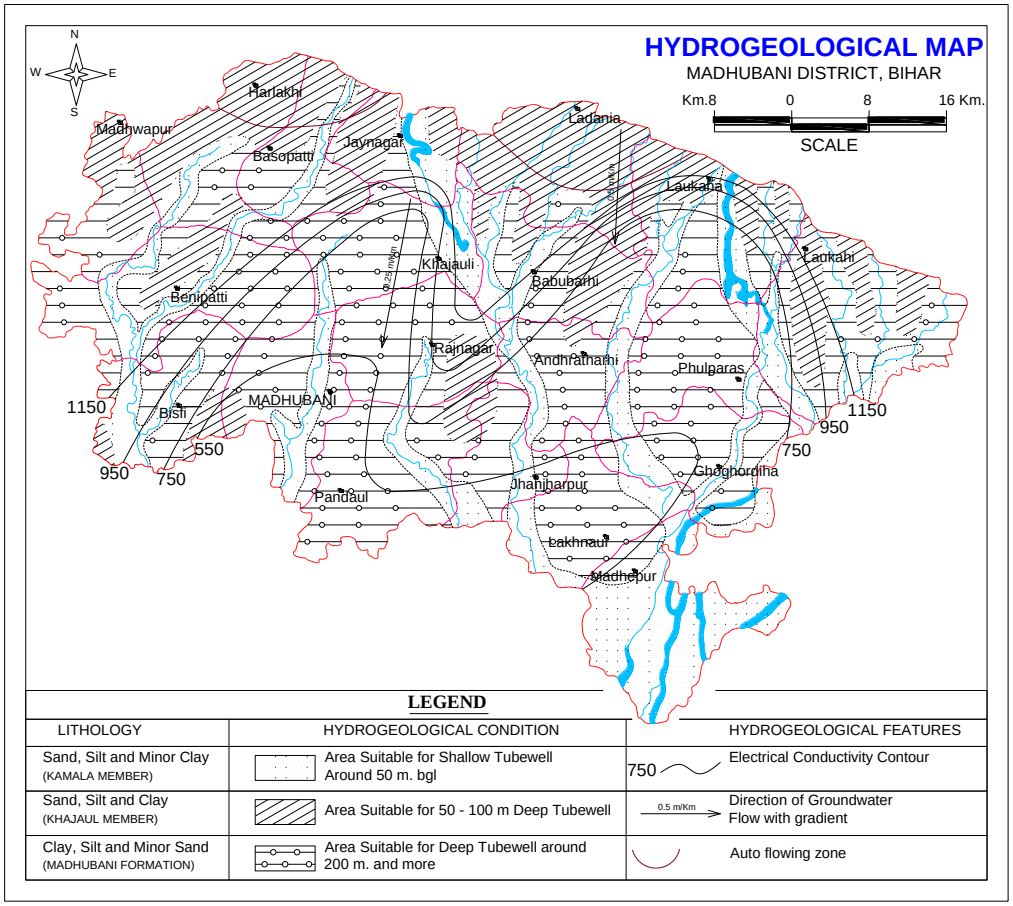

Figure 3: Hydrogeological map of Madhubani district, Bihar showing Quaternary Alluvium with their yield potential. Auto- flowing zone has been demarcated by curves around Harlakhi and Ladania. Electrical conductivity of groundwater has been represented by contours.

4.2 Depth to Water Level

In pre-monsoon 2011 depth to water level in the district ranges from 1.16 to 6 m bgl (Fig.4). Northern and southern part of the area show the < 2 m bgl and on patches in north-wester part of the study area show the > 5 m bgl. In post-monsoon 2011 depth to water level ranges from 1.40 to 3.75 m bgl. In south-western part of the area depth to water level are < 2 m bgl (Fig 5).

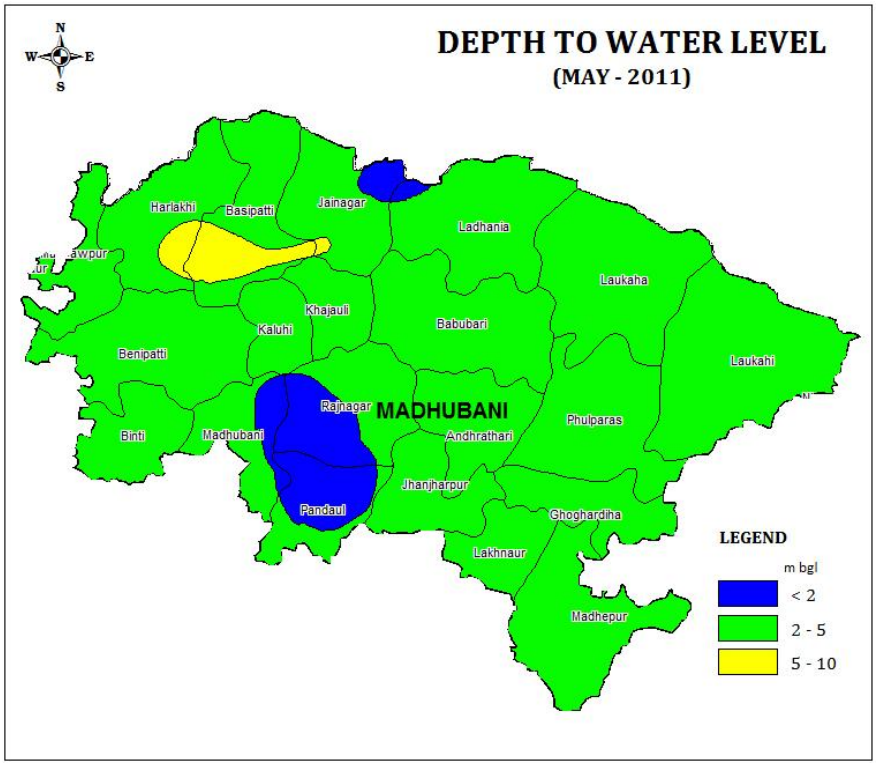

Figure 4: Pre- monsoon 2011 depth to water level contours in Madhubani district, Bihar.

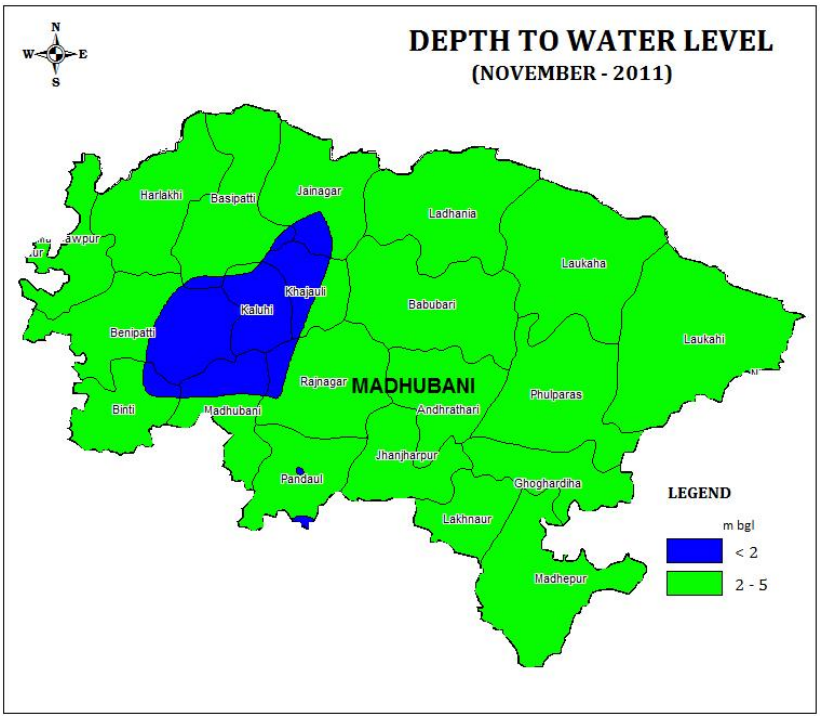

Figure 5: Post- monsoon 2011depth to water level contours in Madhubani district, Bihar.

4.2 Ground water Resources

The replenishable groundwater resouece estimated (as on 31st March-2009) for the district Madhubani is given in Table 3. As per this data, except the block Khajauli (79.2%), all blocks in the district come under safe category (refer table 4 & figure 5); i. e. the stage of ground water development is below 70 % of the total replenishable (dynamic) resource. The Madhepura block has the lowest status (only 16.7 %) of development of its total resource. The net annual groundwater availability is 90844 ha m and existing gross groundwater draft from all users is 33828 & stage of ground water development of the district is about 37.2 % (Table 3)

Table 3 Replenishable ground water resources in the district 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 (9-10-13)	Stage of Ground Water Development (12/9)*100 (%)
1	2	9	10	11	12	13	14	15
1	Andaratharhi	3142	716	257	973	399	2027	31.0
2	Babubarahi	4627	1267	304	1571	472	2888	34.0
3	Basopatti	4286	1389	236	1625	367	2530	37.9
4	Benipatti	7958	1461	501	1961	777	5720	24.6
5	Bisfi	4150	1756	458	2214	711	1683	53.4
6	Ghoghardiha	3884	1939	332	2271	505	1440	58.5
7	Harlakhi	3448	1056	265	1322	412	1980	38.3
8	Jainagar	3554	931	345	1276	521	2102	35.9
9	Jhanjharpur	3250	1146	380	1526	572	1532	47.0
10	Khajauli	3391	2490	194	2684	301	599	79.2
11	Kaluahi	2224	706	169	875	263	1255	39.4
12	Ladania	4493	1901	240	2141	373	2219	47.7
13	Lakhnaur	2555	749	235	984	364	1442	38.5
14	Laukaha	6129	865	293	1158	455	4809	18.9
15	Laukahi	8206	1619	284	1903	441	6146	23.2
16	Madhepura	6869	770	380	1150	590	5509	16.7
17	Madhubani	3564	651	450	1102	684	2228	30.9
18	Madhwapur	3447	678	199	877	308	2460	25.4
19	Pandaul	3854	1822	383	2205	594	1438	57.2
20	Phulparas	3600	1382	228	1610	353	1865	44.7
21	Rajnagar	4212	2051	349	2400	541	1620	57.0
	Total	**90844**	**27345**	**6483**	**33828**	**10006**	**53494**	37.2

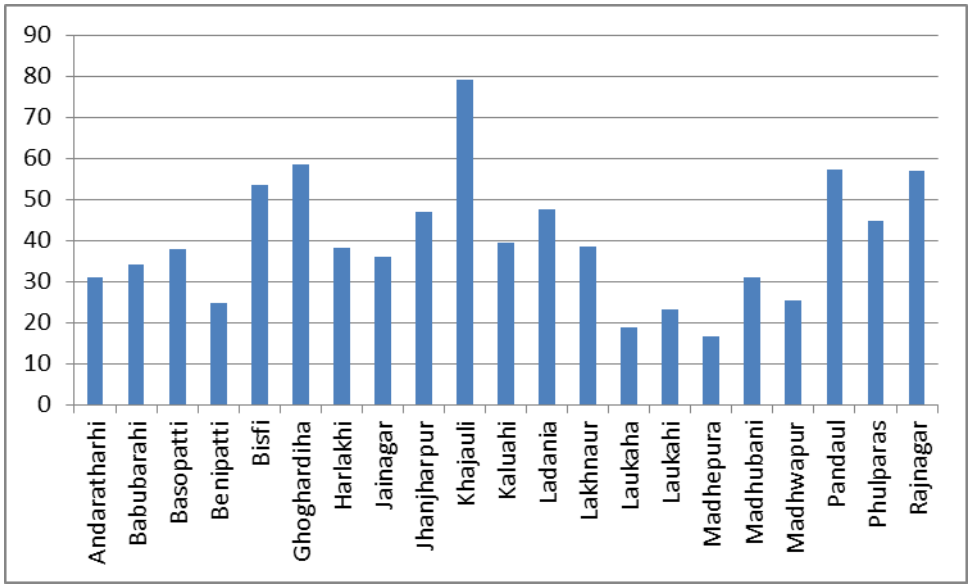

Figure 5: Map showing the stage of ground water development of Madhubani district, Bihar.

4.3 Status of Ground Water development

The utilisation of ground water for irrigatuion in the district can be vidualised from the fact that only 38.01 % of the total irrigated area is served by ground water structures based on minor irrigation system.

There are 868 deep tube wells in the district out of which more than 90 % are non-operational due to non-availability of electricity. As per 1992-93 MI census, the district is possessing 13685 shallow tube wells, most of which are diesel engine operated. Though there are 6 canals in the district, those are capable of irrigating hardly 686 hactares because these canals are rainfed in character.

4.4 Ground Water Quality

It has been found that the ground water in the area falls under the permissible limit for both drinking as well as irrigation purposes. Only the iron concentration is found to be crossing the permissible limit (0.3 mg/l) (Table 5). Shallower aquifers contain higher concentration of iron than the deeper aquifers. The following table depicts the extent of the presence of various chemical parameters in ground water of both shallow as well as deeper aquifers in Madhubani district.

Table 5 Ground water quality (refer figure 3 for contour of EC values in groundwater)

Chemical constituents (mg/l)	Deeper Aquifer	Shallow Aquifer	Drinking Water Standard (As per BIS norms)	
			Highest Desirable	Maximum Permissible
pH	7.0	7.42 – 8.91	6.5 – 8.5	No relaxation
E.C (Micro-siemens/cm at 25^0C	564 - 734	500 - 2000	500	2000
Total Hardness ($CaCO_3$)	235 - 280	110 - 380	300	600
Bicarbonate	378 - 445	177 - 476	200	600
Calcium	52 - 80	12 - 44	75	200
Magnesium	16 - 35	12 - 66	30	100
Chloride	3.55 – 10.60	14 - 263	250	1000
Sulphate	< 1.0	-	200	Up to 400 if Mg is <30
Nitrate	< 1.0	-	45	100
Fluoride	0.2 – 0.25	0.41 – 0.76	0.6 – 1.2	1.5
Iron	<0.1 – 3.20	-	0.30	1.0
Sodium	22 - 45	75 - 246		
Potasium	1.40	2.70	1.90 - 50	

5.0 GROUND WATER MANAGEMENT STRATEGY

5.1 Ground Water development

The average stage of ground water development in the district stands at 30.6 % only showing its great potential for future irrigation. All the ground water abstraction structures present in the district have created an irrigation potential of 25666.8 ha.m leaving a balance of 68406.80 ha.m of ground water resource potential for future irrigation.

5.2 Design of Tube Wells

5.2.1 Sallow Tube Wells

The district is blessed with potential aquifers, which can meet the demand of shallow tube wells (STW) having small command area. The STWs in the depth range of 30 – 50 m bgl and tapping granular zones between 15 - 25 m bgl and 20 – 50 m bgl can yield 25 to 30 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.

5.2.2 Deep Tube Wells

Table 5 Proposed Model of Deep Tube Wells

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	25
			153 – slotted pipe	24
			153 – blank pipe	51
2	150	150	357 – casing pipe	30
			204 – slotted pipe	30
			204 – blank pipe	90
3	290	190	357 – casing pipe	35
			204 – slotted pipe	35
			204 – blank pipe	120

The slot size should be recommended depending on the grain size of the granular zones as given below;

Table 6 Slot opening size in different size of formation sands

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 – 3 – 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 recharge structure has been constructed in the district.

6.0 GROUND WATER RELATED ISSUES AND RELATED PROBLE

No such major ground water problem exists in the district.

7.0 MASS AWARENESS AND TRAINING PROGRAMME:

One Mass Awareness Programme has been organised at Madhubani district head quarter. The numbers of participants were near around 500 including school children, school staff, general public, invited dignitaries, NGOs and media people.

8.0 AREA NOTIFIED BY CENTRAL GROUND WATER AUTHORITY/ STATE GROUND WATER AUTHORITY

Since all blocks of the district come under safe category from ground water development point of view, hence no area is notified either by Central ground water authority or State ground water authority till date.

9.0 RECOMMENDATION

- To have a detailed account of the aquifer characteristics in the study area, deep drilling along with pump test for estimation of aquifer parameter needs to be taken up.
- There is ample scope of large scale ground water development in the area to meet the requirement for agriculture sector. Exploitation of ground water can be done through Shallow tube wells and bamboo boring to meet the requirement of small and marginal farmers while deeptubewells can be operated through formers cooperative.
- Energisation of pump needs to be taken which can help in increasing irrigation potential and cropping intensity.