केंद्रीय भूमि जल बोर्ड

जल संसाधन, नदी विकास और गंगा संरक्षण

विभाग, जल शक्ति मंत्रालय

भारत सरकार

Central Ground Water Board

Department of Water Resources, River Development and Ganga Rejuvenation,
Ministry of Jal Shakti
Government of India

AQUIFER MAPPING AND MANAGEMENT OF GROUND WATER RESOURCES

KARIMGANJ DISTRICT, ASSAM

उत्तर पूर्वी क्षेत्र, गुवाहाटी

North Eastern Region, Guwahati

AQUIFER MAPPING AND MANAGEMENT PLAN OF KARIMGANJ DISTRICT, ASSAM

ANNUAL ACTION PLAN, 2022-23

By

ARIJIT MITRA, Scientist-C (Hg.)

CENTRAL GROUND WATER BOARD
North Eastern Region
Guwahati

&

Ms. Rinku Rani Das, Scientist-B (Hg.)

CENTRAL GROUND WATER BOARD
State Unit Office, Shillong
Meghalaya

CONTENTS

1. Introduction

1.1 Objectives

The objective of the study is to prepare aquifer map of the area in 1:50,000 scale, identify the aquifer system of the study area and prepare a groundwater management plan.

1.2 Scope of the study

Karimganj district has vast groundwater and surface water resources. However, the Agro based economy of the area has very less irrigation facility and the stage of ground water extraction is very low. Proper hydrogeological knowledge of the area can be helpful to prepare a sustainable management plan for groundwater utilization.

1.3 Approach and methodology

The approach is to identify the major aquifers and to conceptualize the aquifer system. This will help to formulate an aquifer management plan. Finally, the scientific knowledge will be disseminated to farmers, state government and stake holders.

The methodology can be illustrated as follows:

1. Data compilation and data gap analysis: The preliminary works consisted of collection and review of all existing hydrogeological and exploration data of CGWB, PHED, Agriculture department, Irrigation department, Water resource department. All data were plotted in base map on GIS Platform. On the basis of available data, Data Gaps were identified.

2. Data Generation: Efforts were made to fill the data gaps by multiple activities such as exploratory drilling, hydro-geochemical analysis, besides detailed hydrogeological surveys.

3. Aquifer Map Preparation: On the basis of integration of data generated from various studies of hydrogeology & geophysics, aquifers have been delineated and characterized in terms of quality and potential. Various maps have been prepared bringing out Characterization of Aquifers, which can be termed as Aquifer maps providing spatial variation (lateral & vertical) in reference aquifer extremities, quality, water level, potential and vulnerability (quality & quantity).

4. Aquifer Management Plan Formulation: Based on aquifer map and conceptual model a sustainable development plan of the aquifer is formulated.

1.4 Area Details

The study area for aquifer mapping falls under Survey of India Toposheet No. 83D/2, 83D/3, 83D/5, 83D/6, 83D/7, 83D/8, 83D/9, 83D/10, 83D/11 bounded by 24.9168°N, 92.2976°E in northern side and 24.9168°N, 92.2976°E in southern side while 24.9168°N, 92.2976°E in western side and 24.9168°N, 92.2976°E in eastern side covering an area of 1809 sq. km of

Karimganj district of Assam. The demographic details have been furnished in Table 1.1 and the Base Map is attached as Figure 1.1.

Figure 1.1 – Base Map of Karimganj District, Assam.

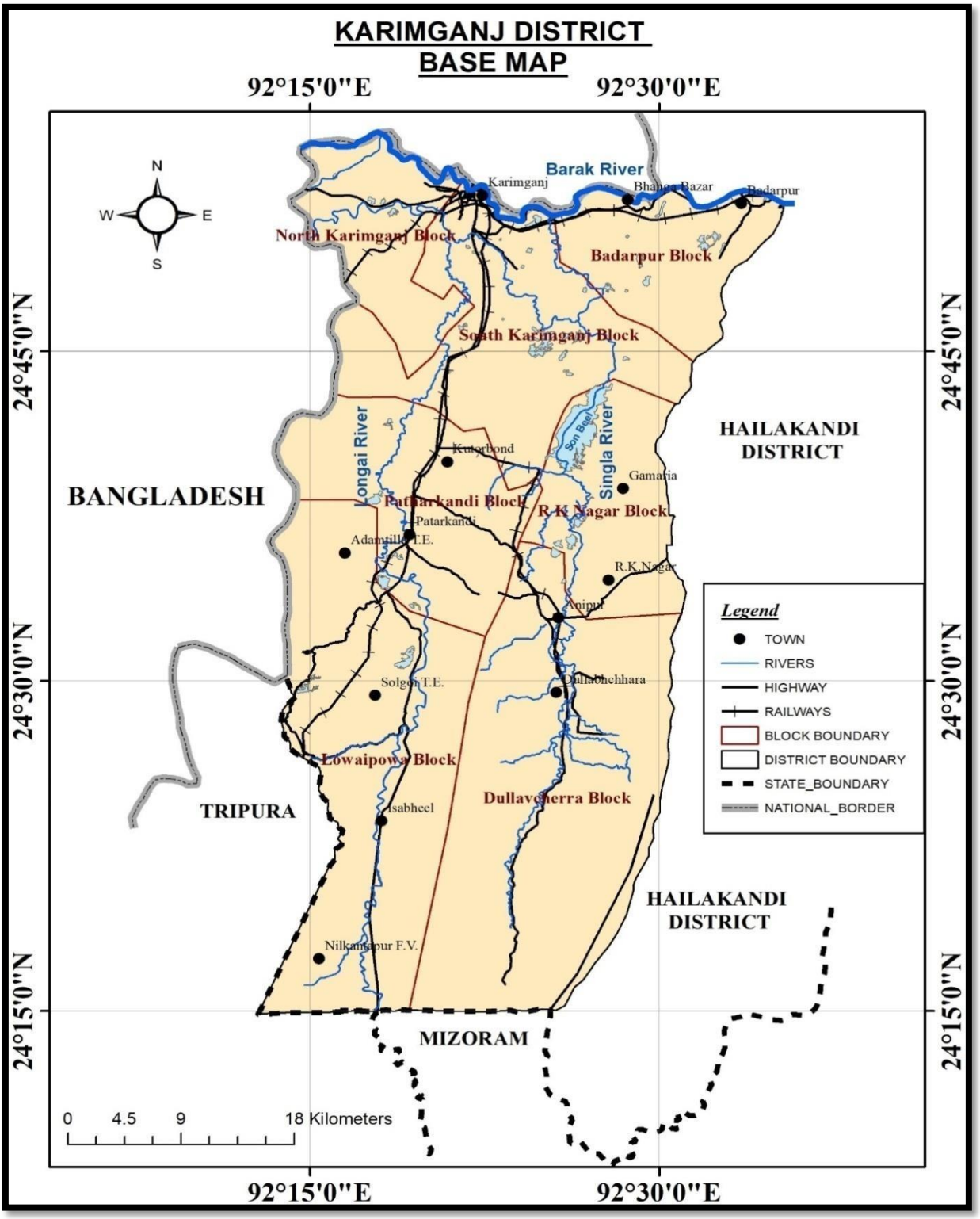


Table 1.1 – Block wise demographic details, Karimganj district, Assam.

STATE	DISTRICT	BLOCK	AREA (sq. Km)	G. P	VILLAGES	POPULATION
Assam	Karimganj	Badarpur	13506	12	83	164703
		N. Karimganj	14565	12	127	140869
		S. Karimganj	22041	21	206	325288
		Patharkandi	35031	13	122	168726
		R.K. Nagar	32675	12	129	113992
		Dullabcherra	32160	14	161	167872
		Lowaipowa	30922	12	112	147236

1.5 Data availability, data adequacy, data gap analysis and data generation

The preliminary works consisted of collection and review of all existing hydrogeological and exploration data of CGWB. All data were plotted in base map on Arc GIS Platform. The available data, data gap and data generation work are tabulated in Table: 1.2 and shown in Figure 1.2 and 1.3.

Table 1.2 – Exploration and monitoring database, Karimganj district, Assam.

Sr No.	Theme	Type	Data available	Data gap	Data generation	Total	Remark
1	Borehole Lithology Data		8	2	2	10	
2	Geophysical Data		7	2	Nil	7	
3	Groundwater Level Data	Dug Well	9	3	51	60	
4	Groundwater Quality Data	Dug Well	9	0	107	116	
5	Specific Yield		Nil	Nil	Nil	Nil	
6	Soil Infiltration Test		Nil	7	3	3	

Figure 1.2 – Key Wells Data Gap, Karimganj District, Assam.

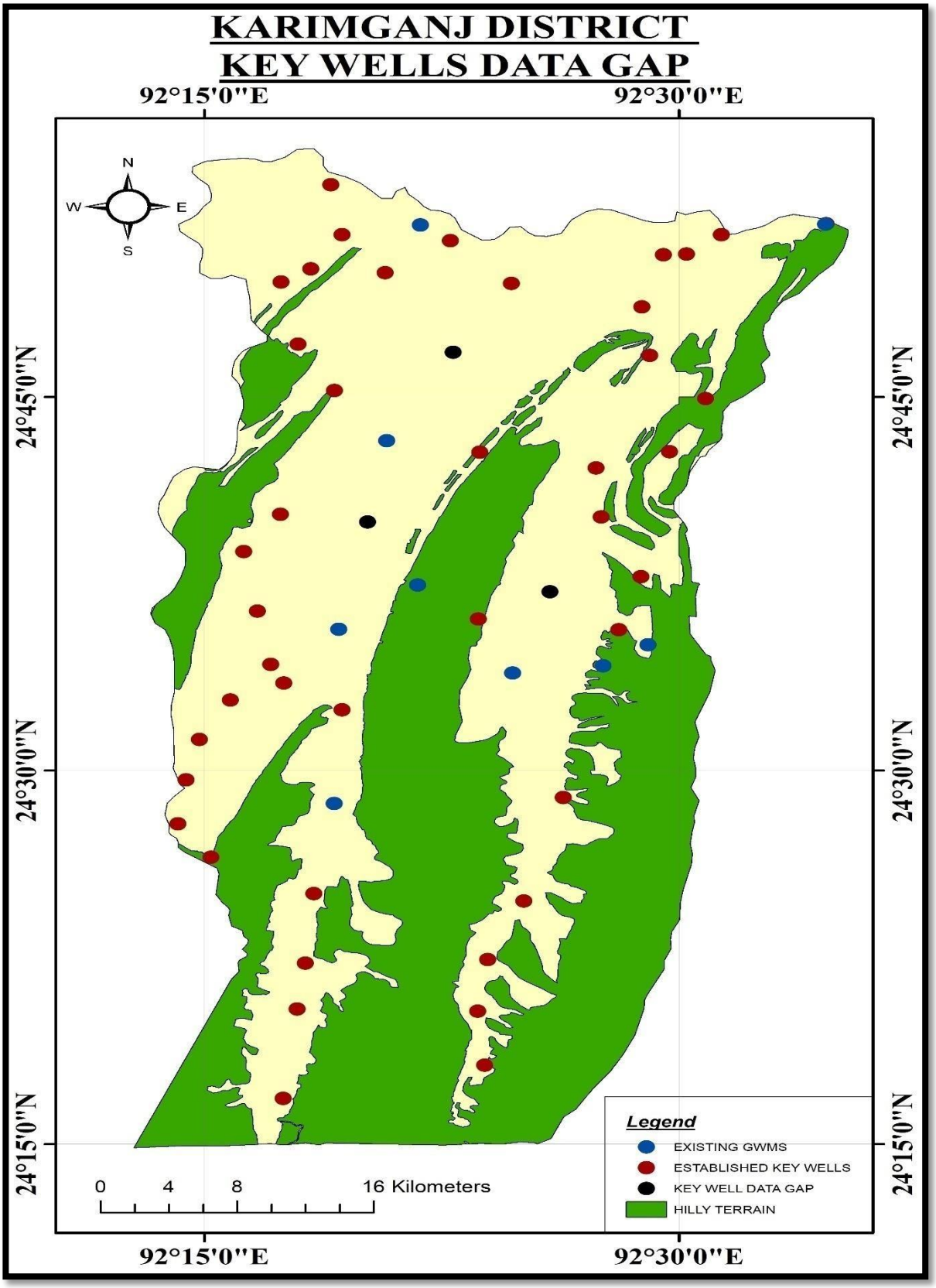
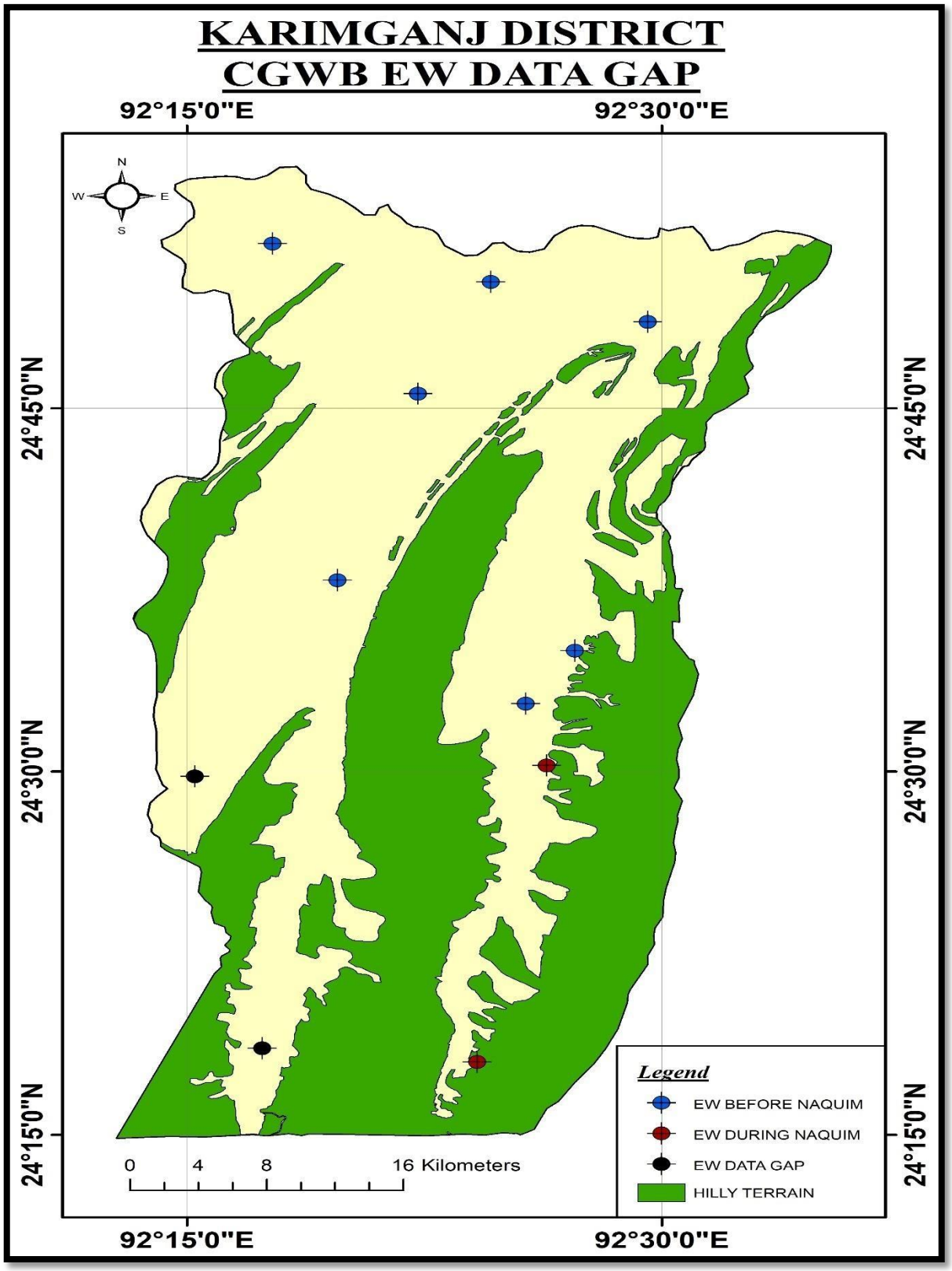


Figure 1.3 – CGWB EW Data Gap, Karimganj District, Assam.



1.6 Hydrometeorology

The area enjoys a sub-tropical warm climate with short dry season (Am type of climate). This climate is characterized by a hot humid summer and a dry cool winter with heavy rainfall during May to September. Rainfall is received from the South -West Monsoon, which normally breaks in the month of May. The hydrometeorogical details have been furnished in Table 1.3 and the graphical illustration of the rainfall data is shown in Figure 1.4 respectively.

(Source- IMD)

Table 1.3 – Hydrometeorogical data, Karimganj district, Assam.

Parameter	Details
Average Monsoon rainfall	2772.7 mm
Average Non-Monsoon rainfall	862.9 mm
Average annual rainfall	3635.70 mm
Maximum rainfall	June (698.2 mm)
Minimum rainfall	January (5.6 mm)
Average annual temperature	27 ° C
Maximum temperature	April (38 °C)
Minimum temperature	January (13 °C)

Figure 1.4 - Graphical illustration of Average monthly rainfall and yearly rainfall variations

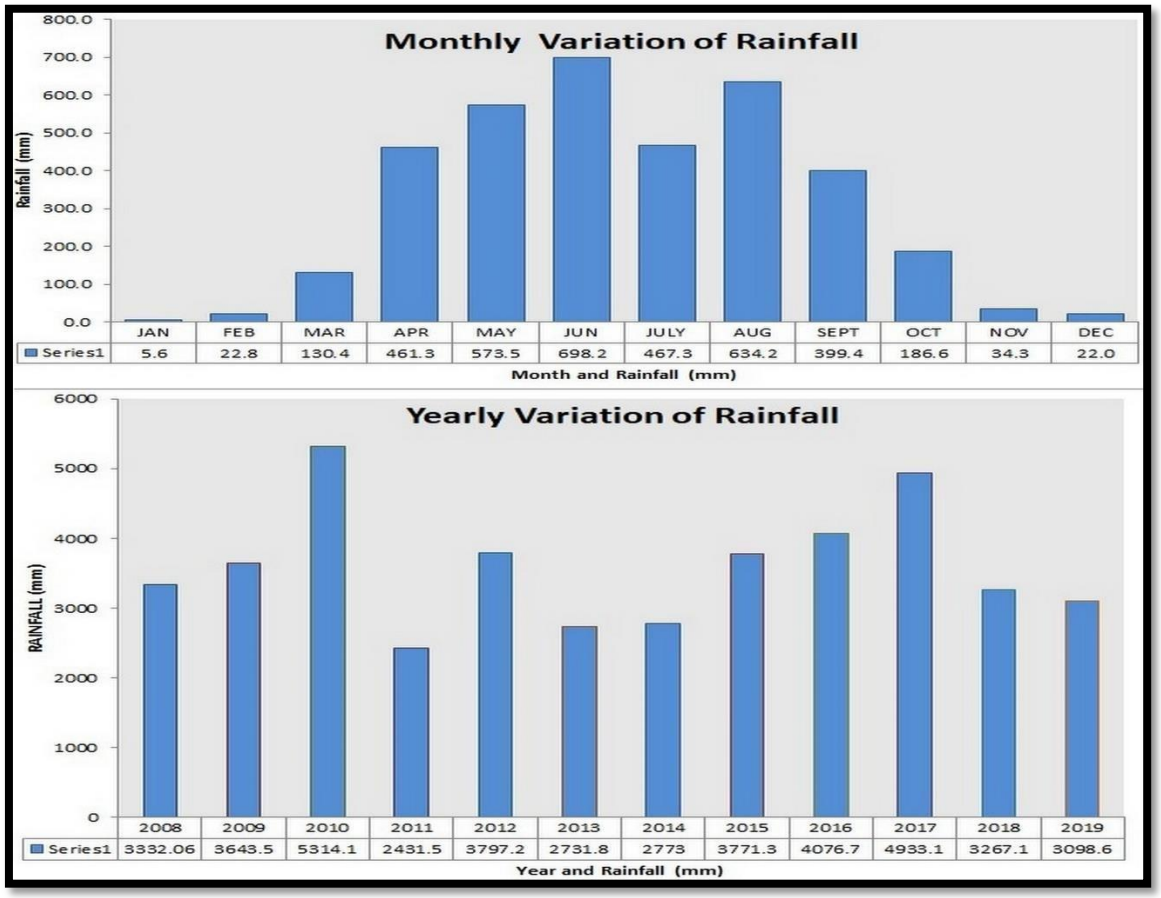


Table 1.4 – Annual variation of Temperature, Karimganj district, Assam.

ANNUAL VARIATION IN TEMPERATURE OF KARIMGANJ DISTRICT												
MONTH	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JULY**	**AUG**	**SEPT**	**OCT**	**NOV**	**DEC**
MIN TEMP °C	13	16	20	24	26	28	27	27	26	22	18	15
MAX TEMP °C	25	29	35	38	37	36	33	33	33	31	29	26
AVG TEMP °C	19	22.5	27.5	31	31.5	32	30	30	30	26.5	23.5	20.5

1.7 Geomorphology

The area can be divided into three parts:

a. Highly dissected hill range - The general trend of the anticlinal hill range is NE-SW and occasionally varies to N-S. The height of the hill ranges decreases from south to north. The highest elevation is 636m above MSL at Chhatachura in the south eastern part, along the border with Hailakandi district. The lowest part of the hills in north is known as the Badarpur hills with average height of about 150 m. The Chhatachura range is about 80 km from north to south and at some parts 20 km in breadth. The Adamil or Patharia range marks the western border of the Karimganj district forming the international border with Bangladesh. This hill range trends N – S. Its length is about 45 km and breadth is about 13 km. The highest point of the range is about 244 m above mean sea level. The third hilly range present in the study area is the Duhalia range, also called the Pratapgarh range. This hill range also trends N – S. The highest peak of this range about 457 m above mean sea level.

b. Pediment- pediplain complex – A broad, gently sloping expanse of rock debris extending outwards from the foot of a dissected hill slope is found. This zone is found significantly in the western and eastern sides between the dissected hills and alluvial plains.

c. Alluvial Plain- The alluvial plain is found over the synclinal flat bottom valleys. This broad synclinal valley occurs in the study area is the Karimganj valley and Anipur valley. The average elevation of the Karimganj valley is 15m above MSL. The valley becomes narrow and constricted towards the south and widens towards the north. The master slope of the valley is towards north. Some isolated hillocks are present in the plains of the study area. In the alluvial plains, the flood plains of river Longai, Singla Kusiara and Barak is present. The Geomorphological Map of the district is shown in Figure 1.5.

   Owing to this physiographical setting, out of 1809 km² of the district, 722 km² of the area has slope more than 20%. The slope map of the district is shown in Figure 1.6.

Figure 1.5 – Geomorphological Map, Karimganj District, Assam.

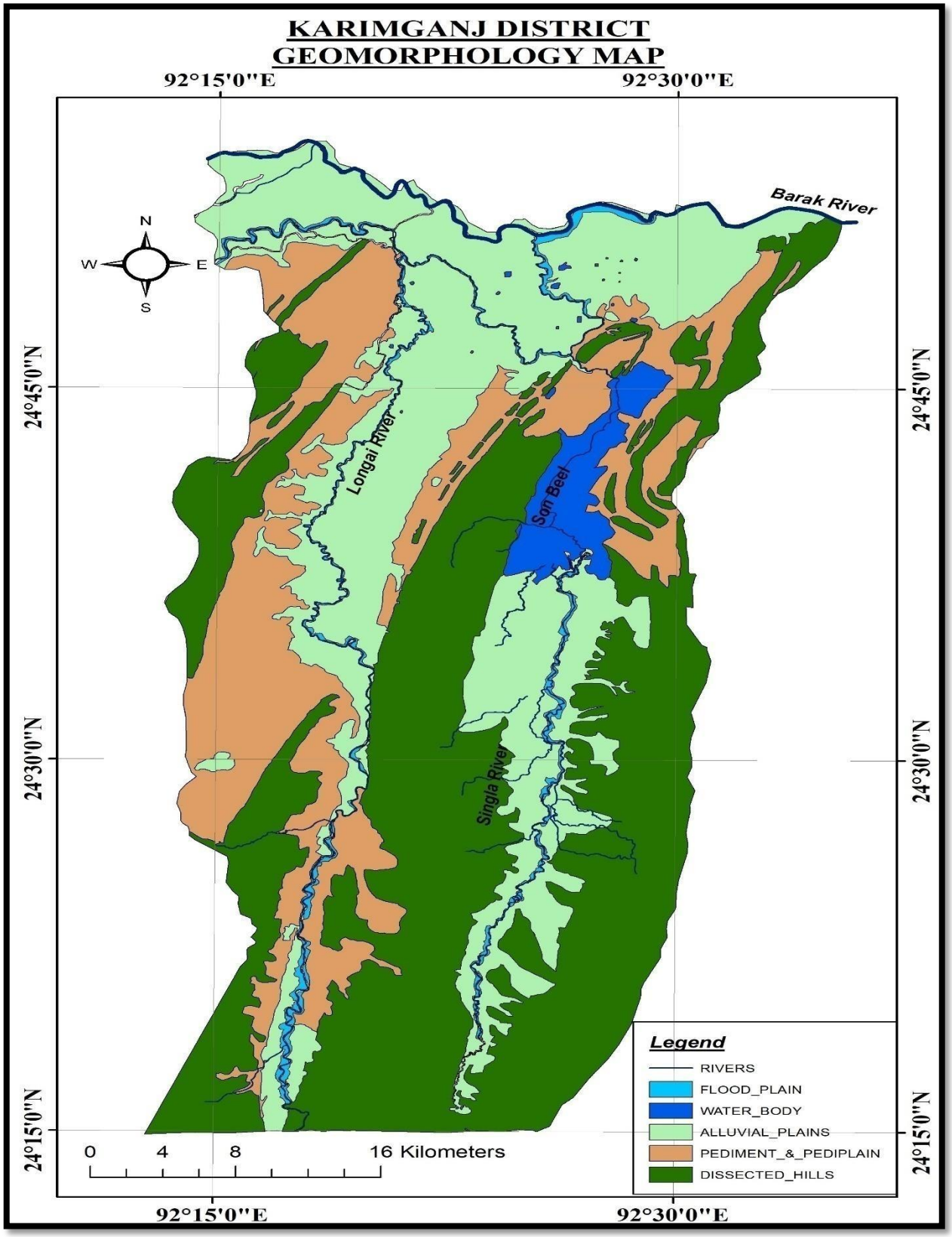
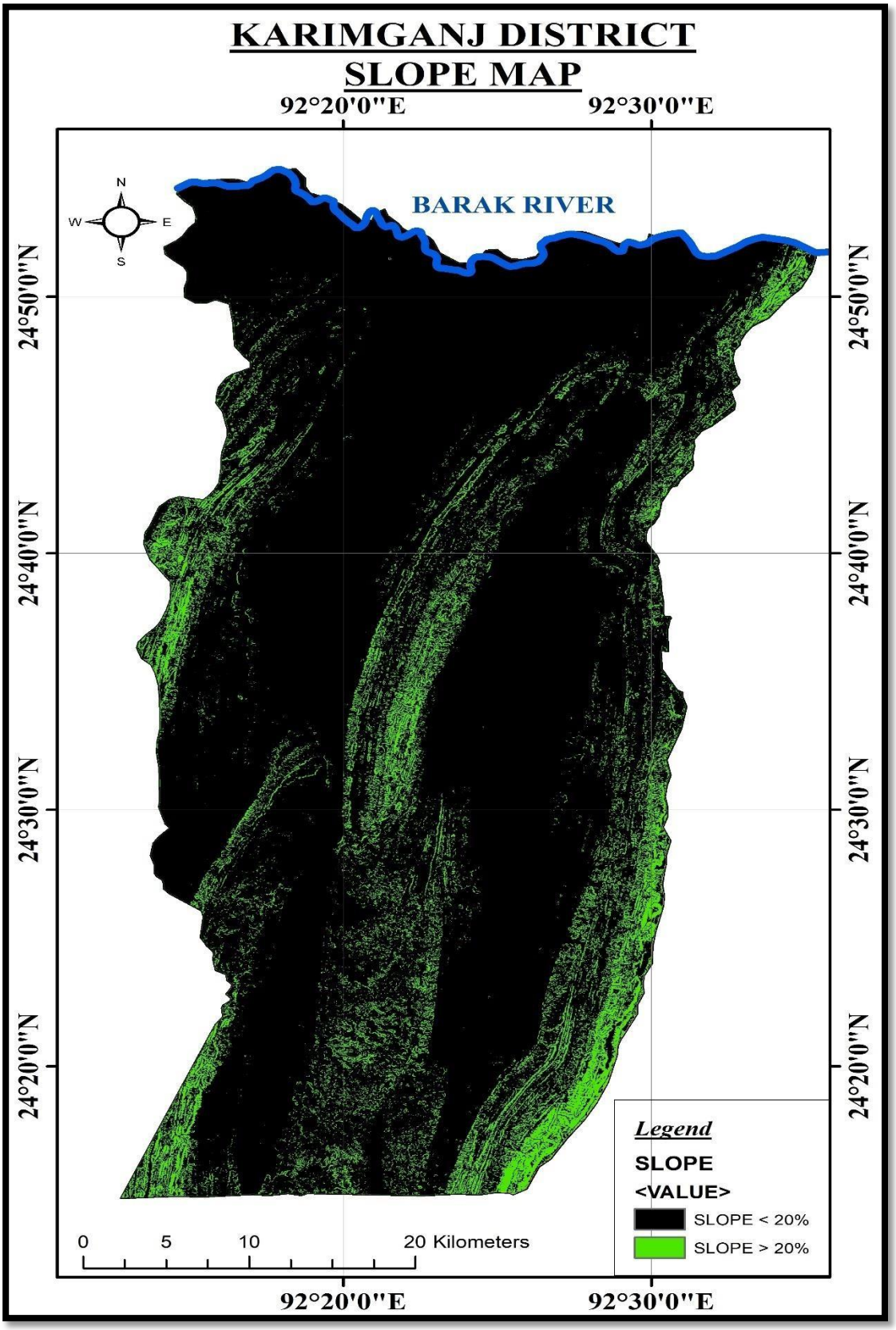


Figure 1.6 – Slope Map, Karimganj District, Assam.



1.8 Geology

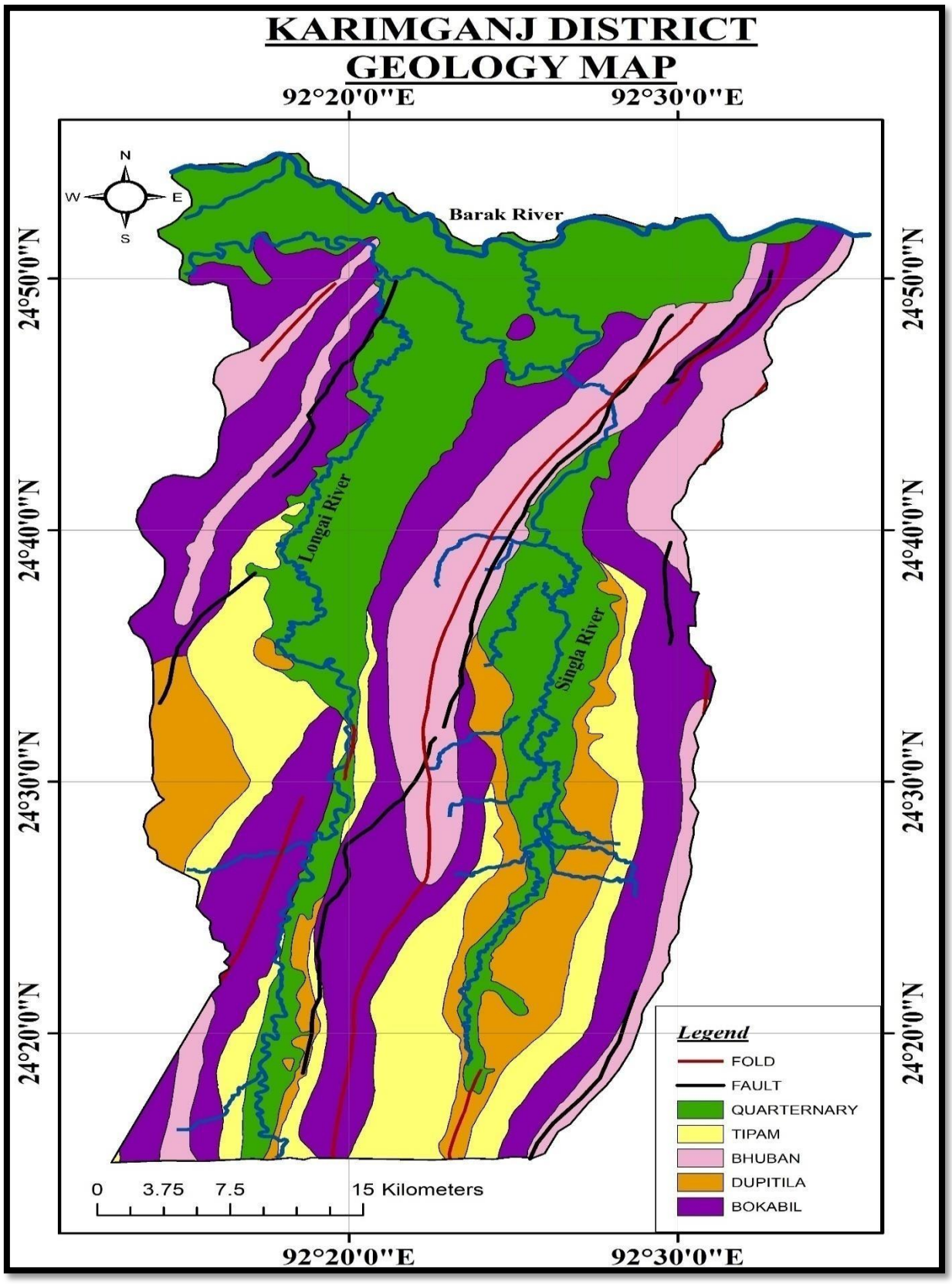
The study area is situated in the Barak Valley of Assam. It is occupied by the folded sedimentary formations of Surma, Tipam, Dupitila, Alluvium groups ranging in age from Lower Miocene (Tertiary) to Holocene (Quarternary). The regional strike of the folded geosynclinal facies sequences is NNE-SSW. The geological succession of the area is shown in Table 1.5.

Table 1.5 – Geological Succession, Karimganj district, Assam.

SYSTEM	SERIES	GROUP	FORMATION	LITHOLOGY
Quarternary	Holocene to Pleistocene	Recent	Alluvium	Alluvium, represented by unconsolidated pale to dirty grey silt, sand, clay , silty clay ,sandy clay, yellowish brown coarse river sand, gravel and concretions.
	UNCONFORMITY			
Upper Tertiary	Miocene to Pliocene	Dupitila	Dupitila	Sandstone, mottled clay, grit, conglomerate, poorly consolidated sand with layers and packets of pebbles, clayey sandstone with ferruginous material and laterites.
	UNCONFORMITY			
	Miocene	Tipam Group	Tipam	Fairly bedded fine to medium grained sub arkosic sandstone with sandy shale and siltstone
	UNCONFORMITY			
	Miocene	Surma Group	Bokabil	Shale, sandy shale, siltstone, mudstone and lenticular coarse ferruginous sandstone.
			Bhuban	Alternation of sandstone, sandy shale, thin conglomerate shaly in the middle part

The Geology map of the district is shown in Figure 1.7

Figure 1.7 – Geology Map, Karimganj District, Assam.



1.9 River and Drainage

The anticlinal hill ranges form the watershed from which various drainage channel emerged. The common drainage pattern is sub parallel to parallel and dendritic. In general, drainage pattern of the area is in conformity with the topography, which area structurally controlled.

The major river in the study area is Barak River and its tributaries are Longai and Singla. All of them are perennial rivers. The Barak River and its tributaries control the entire drainage system in the area. The river Barak originating from the southern slopes of north Manipur hill ranges and enter the study area through its north eastern corner near Badarpur Ghat and after travelling a length of 11 km up to a place called Haritikar near Bhanga is bifurcated into the Kushiara and the Surma. From the point of bifurcation, the Kushiara flows westwards to Bangladesh forming the northern boundary of Karimganj district. The Longai river originates in the Jampai hills of Tripura state and traveling a course of northerly direction, turns south-west near Longai Railway station near Karimganj town. Near Latu village, it enters Bangladesh. The Singla river originates from Mizoram state and taking a northward direction, it enters Son beel (lake) wherefrom the stream emerges bifurcated forming two rivulets, viz, Kachua and Kakra. The drainage map of the district is shown in Figure 1.8.

1.10 Hydrology

The major rivers in the district are Barak, Kushiara, Longai, Singla. All the rivers are rain fed and drain the major valley in the area. There is no major or medium irrigation project present in the district. A few minor irrigation projects are available such as river lift irrigation system. There are many small ponds available in the district area. These ponds are mainly used for fish cultivation and also for domestic purpose. These ponds are rarely used for irrigation purpose as they don’t have sufficient water during dry period.

Total natural area in the form of beels, hawars, and rivers is 4420 Ha.
Artificial area in the form of ponds, tanks, lakes is 3247 Ha.
Total water spread area in Karimganj district is 25779.50 Ha

There are natural depressions and water-logged area scattered in the district. These are confined to flat/plain/low lying areas in the central part of the valley and found near the river.

Figure 1.8 – Drainage Map, Karimganj District, Assam.

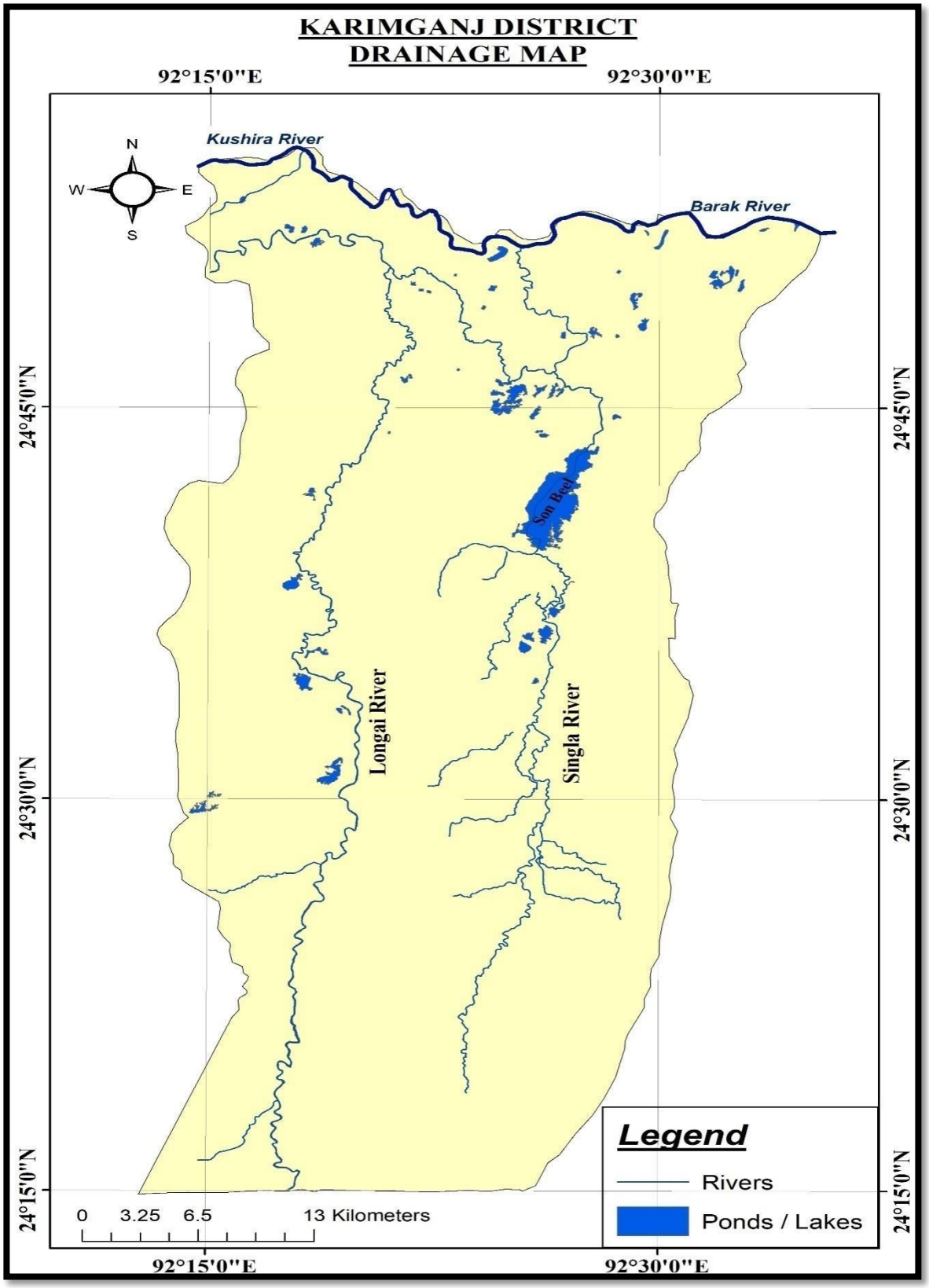
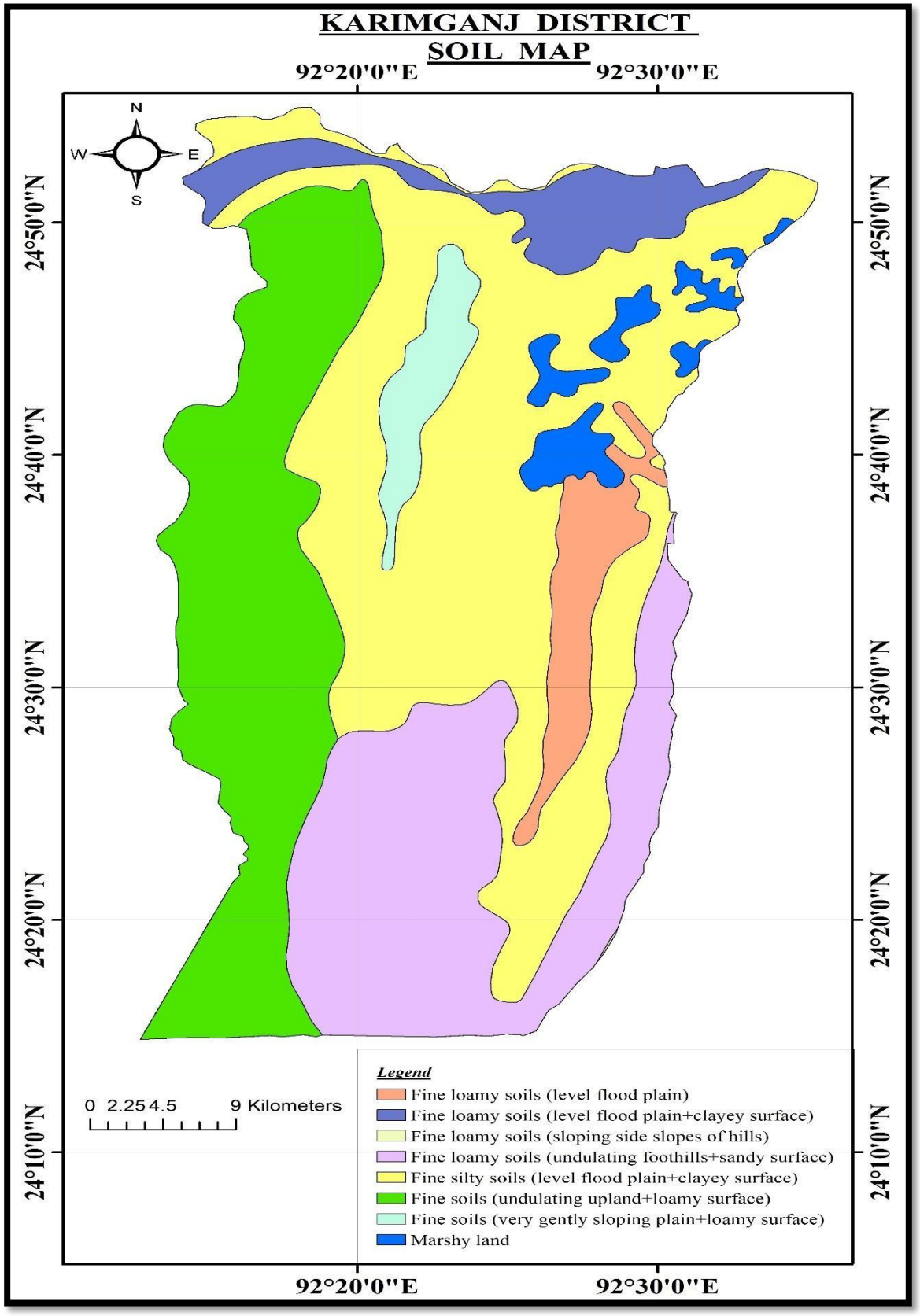


Figure 1.9 – Soil Map, Karimganj District, Assam.



1.11 Soil

Both residual and transported soils are found in the study area. Alluvial soil is developed almost entirely in the area and its brown in color. This is practically unaltered alluvium representing a broad spectrum of sand, silt and humus rich bog clay depending on landform component. The alluvial soil which is light grey to brown in color is at places sandy and has localized occurrence. The soils are mainly clay to clay-loam except riverine tracts and hilly tracts. The lateritic soil is found in tillas (hilly area), younger soils are found along all major river courses and clayey soils are found in paddy fields.

The soil map of the district is shown in Figure 1.9.

1.12 Agriculture

Karimganj district with geographical area of 1809 sq. Km occupies 26.26 % area of the Barak Valley Agro Climatic zone of Assam. Majority of the population depend on cultivation. In the study area, agriculture is rain fed and paddy is the principal crop. The pre monsoon rain (February-April) helps for growing Autumn Paddy and Kharif vegetable, normal monsoon (May – September) helps for growing winter paddy and in case of excess rainfall it causes damage to crops and livestock. The post monsoon (October – November) shower helps in panicle initiation stage of paddy crop. If sufficient shower is not received then it causes little dry spell condition in October on the other hand excess shower sometimes delays the cultivation of Rabi crops. Winter months (December – January) remains generally dry with scanty rainfall. Double cropping pattern is not observed in all the parts mainly due to lack of irrigation facility. There are 23 tea gardens in the district. Some of the important crops are Paddy, Black Gram, Green Gram, Pea, French, Bean, Arhar, Rape & Mustard, Linseed Sesamum, Kharif Vegetable, Rabi Vegetable, Sweet Potato, Potato, Chilli, Turmeric, Zinger, Black Pepper, Areca nut, Coconut, Pineapple, Litchi, Banana, Mango, Guava, Jack fruit, Assam Lemon, Orange, Papaya, Cashew nut, Other Indigenous fruit crops. Cropped area details are as follows:

Gross cropped area	Net cropped area	Area under Mono crop	Area under Double crop	Triple cropped area	Cropping Intensity
96290 Ha	68550 Ha	59842 Ha	69357 Ha.	35475 Ha	140 %

1.13 Land use pattern

The block wise land use pattern of the district is given in Table No 1.6. (Area in Hectare)

Table 1.6 – Block wise land use pattern, Karimganj district, Assam.

Name of Block	Badarpur	North Karimganj	South Karimganj	Patharkandi	Lowaipowa	R.K. Nagar	Dullabcherra
Geographical area	13506	14565	22041	35031	30922	32675	32160
Cultivable area	8402	9104	12079	16868	14992	15836	15925
Cultivated area	6774	7564	9422	10778	11550	11550	11911
Cultivable waste	525	438	1580	1660	1800	375	416
Current fallow	103	102	153	130	142	111	298
Forest	20	12	2510	607	39	1940	4012
Pasture	20	12	40	120	25	40	218
Land in non-Agricultural use	533	620	2133	520	775	550	1786
Misc. Plantation	1176	1212	1020	300	156	322	130
Barren (Waste Land)	-	264	422	50	20	93	1235

2. Data Collection

Data collection includes collection of rainfall data from state government, tea estates, compilation of CGWB's earlier survey data, exploration, and geophysical data. Population and agricultural data are collected from Census of India website.

2.1 Hydrogeological data

The entire study area is covered by regular monitoring of existing 09 GWMS (NHNS) and another 51 Key wells have been established. All these wells are monitored after establishment. Table 2.1 shows the existing ground water monitoring stations (GWMS) under NHNS and Table **2.2** shows the details of the Key wells established in Karimganj district in AAP 2020-2021.

2.2 Water Quality

To understand the chemical quality of groundwater in the study area and its suitability for domestic, drinking and agricultural utilization, pre monsoon and post monsoon water samples were collected from the existing 09 GWMS under NHNS, newly established 51 Key wells under NAQUIM and additional 47 wells under special studies for Arsenic concentration in ground water. The samples collected were for analyzed for base, iron, heavy metals and arsenic.

2.3 Geophysical survey

During AAP 2019-20, no geophysical survey had been conducted in Karimganj district.

Table 2.1 - Details of GW monitoring stations under NHNS in Karimganj District, Assam

Village	Latitude	Longitude	Well Type	MP (m)	RL (m)	Depth (m)	Dia (m)
Badarpur	24.87439	92.58333	Dug Well	0.74	8	6.3	1.7
Dhaulia	24.62406	92.36228	Dug Well	0.6	41	4.2	1.2
Hatikira	24.47789	92.31828	Dug Well	0.9	36	5.9	1.2
Karimganj	24.86498	92.36376	Dug Well	0.9	24	4.7	1.2
Kayasthagram	24.72069	92.34611	Dug Well	0.9	30	4.7	1.6
Patharkandi	24.59450	92.32078	Dug Well	1.0	20	6.7	1.0
R.K. Nagar	24.56658	92.46083	Dug Well	0.8	37	6.5	1.3
Sarkaribari	24.56525	92.41242	Dug Well	0.8	32	7.9	1.1
Kalinagar	24.58417	92.48375	Dug Well	0.8	12	4.4	1.1

Table 2.2 - Details of Key Wells established in Karimganj District, Assam

LOCATION	LATITUDE	LONGITUDE	TYPE	RL (m)	DIA (m)	DEPTH (m)	MP (m)	AQUIFER GROUP
Badarpur	24.87439	92.58333	Dug Well	31	1.0	4.6	0.7	Unconsolidated
Chandrapur	24.77789	92.48478	Dug Well	31	1.0	4.4	0.9	Unconsolidated
Mahakal	24.84510	92.49191	Dug Well	30	1.0	7.0	0.9	Unconsolidated
Marjatkandi	24.81033	92.48056	Dug Well	31	1.0	5.1	0.9	Unconsolidated
Srigouri	24.85853	92.52248	Dug Well	31	1.3	5.4	0.6	Unconsolidated
West Hassanpur	24.84563	92.50403	Dug Well	30	0.8	13.7	1.1	Unconsolidated
Birozapur	24.33888	92.39395	Dug Well	84	1.0	8.0	0.8	Unconsolidated
Durlabchera	24.48192	92.43913	Dug Well	9	1.2	8.1	0.5	Unconsolidated
Hemp Kali Mandir	24.37349	92.39935	Dug Well	5	0.8	5.0	0.9	Unconsolidated
Rangpur	24.30271	92.39774	Dug Well	85	1.0	6.2	0.4	Unconsolidated
Sarkaribari	24.56525	92.41242	Dug Well	7	0.8	4.2	0.8	Unconsolidated
Wangirbond	24.41271	92.41832	Dug Well	10	1.0	4.5	0.6	Unconsolidated
Adamtilla	24.60665	92.27783	Dug Well	49	1.0	3.5	0.6	Unconsolidated
Bagaon	24.46431	92.23594	Dug Well	8	1.0	4.8	0.9	Unconsolidated
Charaibari	24.44193	92.25346	Dug Well	12	1.0	5.4	0.5	Unconsolidated
Dengarbond	24.54066	92.32253	Dug Well	33	1.8	5.0	0.9	Unconsolidated
Hathikira	24.47789	92.31828	Dug Well	8	0.9	5.6	0.6	Unconsolidated
Hatyarbond	24.34034	92.29892	Dug Well	29	1.0	5.0	0.9	Unconsolidated
Isabhil TE	24.41758	92.30758	Dug Well	31	1.0	5.0	0.7	Unconsolidated
Kacharigaon	24.49381	92.24026	Dug Well	6	0.8	3.6	0.6	Unconsolidated
Kotamani	24.37114	92.30315	Dug Well	29	1.1	6.0	0.6	Unconsolidated
Kukitol	24.52083	92.24734	Dug Well	6	1.0	4.0	0.7	Unconsolidated
Longai TE	24.57103	92.28493	Dug Well	12	1.0	4.0	0.9	Unconsolidated
Piplagool	24.54717	92.26362	Dug Well	8	1.5	5.6	0.7	Unconsolidated
Rangamati	24.28054	92.29144	Dug Well	36	1.0	4.5	0.7	Unconsolidated
Sashan Kali Mandir	24.55858	92.29173	Dug Well	11	1.0	5.5	0.5	Unconsolidated
Akbarpur	24.85853	92.32248	Dug Well	21	1.2	8.2	0.5	Unconsolidated
Mahisashan	24.82693	92.29034	Dug Well	26	1.0	6.4	0.8	Unconsolidated
Maijgaon	24.83578	92.30602	Dug Well	32	1.0	4.9	0.7	Unconsolidated
Nawagram	24.78531	92.29932	Dug Well	37	1.0	5.1	0.9	Unconsolidated
Sadarasi	24.89200	92.31667	Dug Well	25	1.1	5.5	0.9	Unconsolidated
Tangabari	24.75425	92.31849	Dug Well	30	1.0	6.2	0.8	Unconsolidated
Bazarghat	24.60148	92.39429	Dug Well	25	1.0	5.2	0.6	Unconsolidated
Dhaulia	24.62406	92.36228	Dug Well	44	1.0	5.2	0.6	Unconsolidated
Lakhipur	24.64648	92.27069	Dug Well	39	0.8	4.7	0.9	Unconsolidated
Patharkandi	24.59450	92.32078	Dug Well	31	1.0	3.8	1.0	Unconsolidated
Sunatula	24.67153	92.2901	Dug Well	31	0.8	3.4	0.6	Unconsolidated
Chandkhani	24.59413	92.46840	Dug Well	32	1.0	6.0	0.9	Unconsolidated
Debodargaon	24.70249	92.45643	Dug Well	32	1.0	6.0	0.9	Unconsolidated
Kalingar	24.58417	92.48375	Dug Well	31	0.8	3.8	0.8	Unconsolidated
Netajinagar	24.62979	92.48003	Dug Well	31	1.0	7.0	0.9	Unconsolidated
R.k nagar	24.57000	92.46000	Dug Well	12	0.8	4.4	0.8	Unconsolidated

LOCATION	LATITUDE	LONGITUDE	TYPE	RL (m)	DIA (m)	DEPTH (m)	MP (m)	AQUIFER GROUP
Samridhipur	24.66965	92.45904	Dug Well	25	1.0	6.0	0.8	Unconsolidated
Taturgul	24.71344	92.49510	Dug Well	48	1.1	6.2	1.1	Unconsolidated
Adarkona	24.74891	92.51410	Dug Well	54	1.0	7.3	0.9	Unconsolidated
Bazarghat	24.83317	92.34525	Dug Well	32	1.0	6.9	0.9	Unconsolidated
Karimganj	24.86519	92.36375	Dug Well	32	1.0	3.9	0.9	Unconsolidated
Kayasthagram	24.72069	92.34611	Dug Well	30	1.0	3.6	0.9	Unconsolidated
Nathupur	24.82603	92.41173	Dug Well	30	1.0	7.2	0.9	Unconsolidated
Nilambazar	24.71308	92.39506	Dug Well	31	1.1	6.0	0.9	Unconsolidated
Sarisa	24.85461	92.37958	Dug Well	32	1.0	4.0	1.0	Unconsolidated

2.4 Groundwater Exploration

During AAP 2020-21, CGWB took up GW exploration in the study area by in-house drilling. Details of the exploration activity in Karimganj district is given in Table 2.3.

Table 2.3: Details of exploration wells constructed by CGWB in Karimganj District, Assam

Location	Longitude	Latitude	Topo sheet	Year of const.	Depth of Drilled (mbgl)	Depth of constr. (mbgl)	Source
FAKIRA BAZAR EW	92.29500	24.86333	83/D/5	Feb-79	297.25	151.0	CGWB
NAIRGRAM EW	92.41000	24.83700	83/D/5	Mar-79	293.55	100.0	CGWB
HASIMGANJ EW	92.32917	24.63167	83/D/5	Apr-79	294.30	144.0	CGWB
LOHARPARA EW	92.37167	24.76000	83/D/5	Apr-79	281.20	178.0	CGWB
ANIPUR EW	92.42833	24.54667	83/D/6	May-79	287.60	109.0	CGWB
CHANDPUR SH	92.38000	24.83667	83/D/5	May-79	299.50	-	CGWB
MAHAKAL EW	92.49263	24.80943	83/D/6	Mar-10	200.00	171.0	CGWB
R.K. NAGAR EW	92.45431	24.58319	83/D/6	Mar-11	182.30	176.0	CGWB
MUKAMCHERRA EW	92.439378	24.504122	83/D/6	Dec-20	142.10	129.0	CGWB
BARUATILLA EW	92.402802	24.300054	83/D/6	Mar-21	114.00	-	CGWB

The preliminary yield test have been conducted on the exploratory well and the observatory well at Mukamcherra in AAP 2020-21. The PYT reports of the EW and OW have been furnished in the Annexure 2.1 and 2.2 respectively. The EW at Baruatilla was abandoned due to lack of granular zones and no discharge.

2.5 Soil Infiltration Test

Three soil infiltration tests have been performed in the Karimganj district at Mukamcherra, Baruatilla and Nayabari. The soil infiltration reports have been furnished in Annexure 2.3, 2.4, 2.5.

3. Data Interpretation, Integration and Aquifer Mapping

3.1 Data Interpretation

I. Geophysics and Aquifer Characterization

During AAP 2020-21, no geophysical logging was conducted at the exploratory drilling sites. However, in the previous exploratory work conducted by CGWB in Karimganj district, electrical logging has been done where after a comparative study of self-potential curve and resistivity curve, the permeable granular zones have been delineated. The details of the granular zones delineated by electrical logging have been furnished in Table 3.1 attached as Annexure 3.1.

II. Aquifer Geometry

The Karimganj district is surrounded by dissected hills on both western and eastern sides as well as in the central portion, due to which two narrow valleys - Karimganj valley and Anipur valley are formed which tapper down towards the south and gradually opens up towards the Barak River in the northern side. The general slope is from South to North direction. CGWB has constructed ten exploratory wells across the Karimganj district with depth ranging from 50.0 m to 300.0 m. The major aquifers of the district have been delineated based on the litholog of these exploratory wells. In the district, two principal aquifers have been delineated.

- **Alluvial aquifer of Quaternary age** - The alluvial aquifer consists of clay, sand and clayey sand. The clay is yellowish brown in color.
- **Sandstone aquifer of Tertiary age** - The sandstone aquifer is composed of friable sandstone with clay. Sandstone occurs as lenses and the color of clay is grey.

Based on the litholog of the exploratory wells, three sections have been prepared to show the 2D disposition of the aquifers along the East-West direction (Figure 3.1), North-South direction (Figure 3.2, 3.3). From the section, it is observed that the southern part of the district is argillaceous dominant and the northern part near the Barak River is arenaceous dominant. A thin layer of alluvial cover of average thickness of 12 m spreads across the valley area of the district. The alluvium thickness encountered in the EW range between 3.0 m to 23.0 m. Underneath the alluvial aquifer, six granular zones have been encountered in both the valleys.

Anipur Valley

- The first and second granular zones encountered are within 50m depth between 18-28 m and 40-50 m. The zones are extensive in the valley up to Mukamcherra, beyond which the second zone pinch out before Baruatilla.
- The third granular zone is encountered around 100m depth is between 71-106 m. The zone is extensive in the valley up to Mukamcherra, beyond which the zone pinches out before Baruatilla.
- The fourth granular zone encountered up to 200m depth is between 146-175 m. The zone is extensive in the valley up to Anipur.

- The fifth and sixth granular zone encountered over 200m depth is in between 206-231 m and 237-248 m. The zone is extensive in the valley up to Anipur.
- Information regarding the fourth, fifth and sixth granular zone south of Anipur is not available as drilling in Mukamcherra and Baruatilla are restricted to 142m and 114m respectively.

Karimganj Valley

- The first granular zones encountered is within 50m depth between 23-57 m. The zone is extensive in the valley.
- The second and third granular zone is encountered around 100m depth is between 67-96 m and 128-138 m. These zones are extensive across the valley.
- The fourth granular zone encountered up to 200m depth is between 150-175 m. The zone is extensive in the valley from Nairgram to Hasimganj.
- The fifth and sixth granular zone encountered over 200m depth is in between 214-235 m and 250-256 m. These zones are extensive around Nairgram and pinch out near Loharpara.

A brief summary of the depth ranges of the zones is furnished in Table 3.2.

Table 3.2 – Granular zones of Karimganj District

	Anipur Valley	**Karimganj Valley**
Granular Zones (Depth in m)	18-28, 40-50, 71-106, 146-175, 206-231, 237-248	23-57, 67-96, 128-138, 150-175, 214-265, 250-256
Description	Six granular zones up to 250 m. The aquifers zones are uniformly extensive with minor lithofacies variation. Clayey soil is thicker (19m) in northern part than in southern part (3m). Grain size is medium to fine.	Six granular zones up to 260 m. The aquifers zones are uniformly extensive with minor lithofacies variation. Clayey soil is thicker (23m) in northern part than in southern part (3m). Grain size is medium to fine.

During hydrogeological studies during Tipaimukh project canal command area during 1990-1993, CGWB has drilled 2 shallow tube wells (TW) and 4 observation wells (OW) upto 50 m depth in Karimganj district. Details of tube wells drilled and shallow aquifer parameters computes from CGWB wells in Karimganj district furnished in Table 3.2 a. and 3.2 b.

Table 3.2 a: Details of Shallow tube well drilled in Karimganj district under Tipaimukh Project

Location	Depth drilled (m bgl)	Depth of construction (m bgl)	Aquifer tapped (m)
Mahakal	50	12	7-9
Badarpur	50	50	43-46
Rakesh Nagar (Test well)	50	24	12-21
Rakesh Nagar (Observation well-I)	27.9	24	15-18
Rakesh Nagar (Observation well-II	28.9	24	15-18

Table 3.2 b: Shallow aquifer parameters in Karimganj district

SI No.	Location	Thickness of aquifer (m)	Discharge (m^3/h)	Draw down (m)	Specific capacity (Lpm/m)	Transmissivity (m^2/day)		Storativity (S)	K (m/day)
						Jacob method	Theis method		
1	Anipur TW	9	9.6	3.43	46.65	120.48	64.87	_	11.14
	Anipur OW-I	6	_	1.677	_	64.87	62.99	2.67×10^{-4}	
	Anipur OW-II	6	_	1.505	_	70.28	84.33	2.74×10^{-4}	
2	Rakesh Nagar TW	9	3.08	3.34	15.39	26.06	22.58	_	13.2
	Rakesh Nagar OW-I	3	_	0.613	_	54.21	45.17	4.51×10^{-4}	
	Rakesh Nagar OW-II	3	_	0.36	_	67.76	54.21	8.4×10^{-4}	

The study show that specific capacity in shallow aquifer varies from 15 to 46 lpm/m of drawdown, transmissivity ranges from 26 to 120 m2/day and Storativity ranges from 2.67×10^{-4} to 8.4×10^{-4}. Transmissivity values show that shallow aquifers are having moderate groundwater potentiality and S values show that it is semi-confined in nature.

The Aquifer property delineated from CGWB's deeper exploratory wells in Karimganj district have been furnished in Annexure 3.2.

Fig 3.1- 2D section showing Aquifer disposition along (A-A') West-East direction of Karimganj district

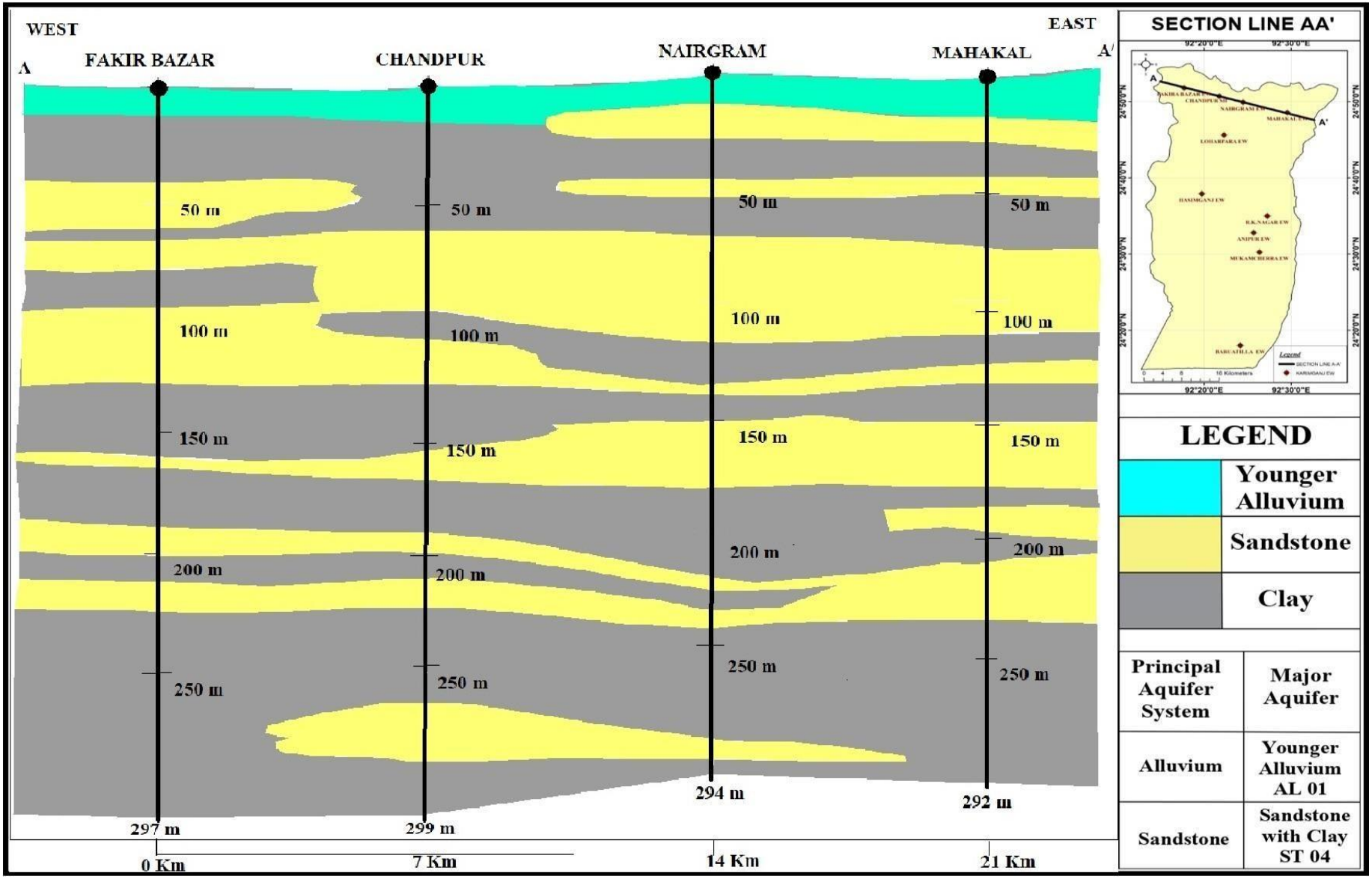


Fig 3.2- 2D section showing Aquifer disposition along (B-B') North-South direction of Karimganj district

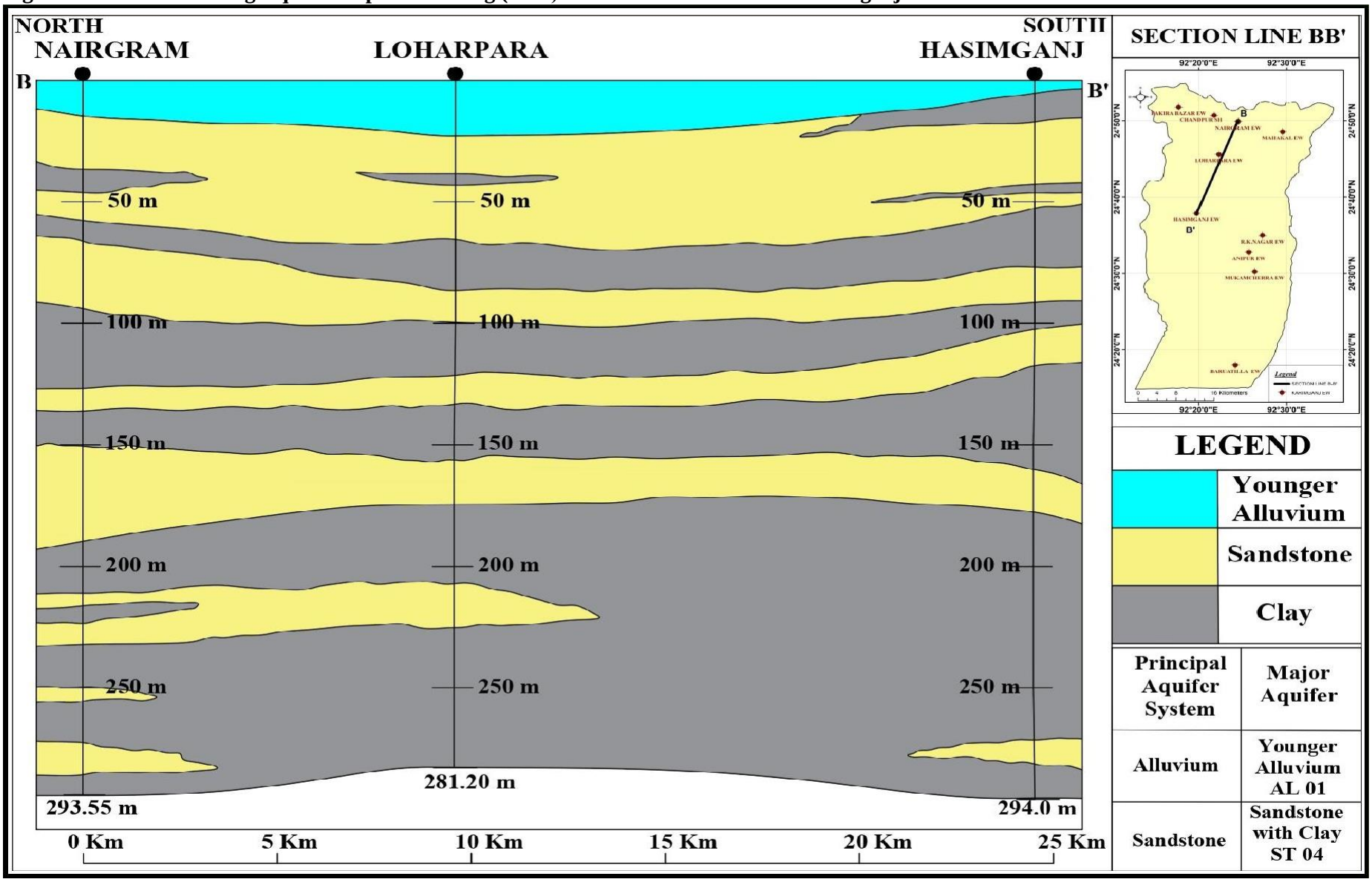
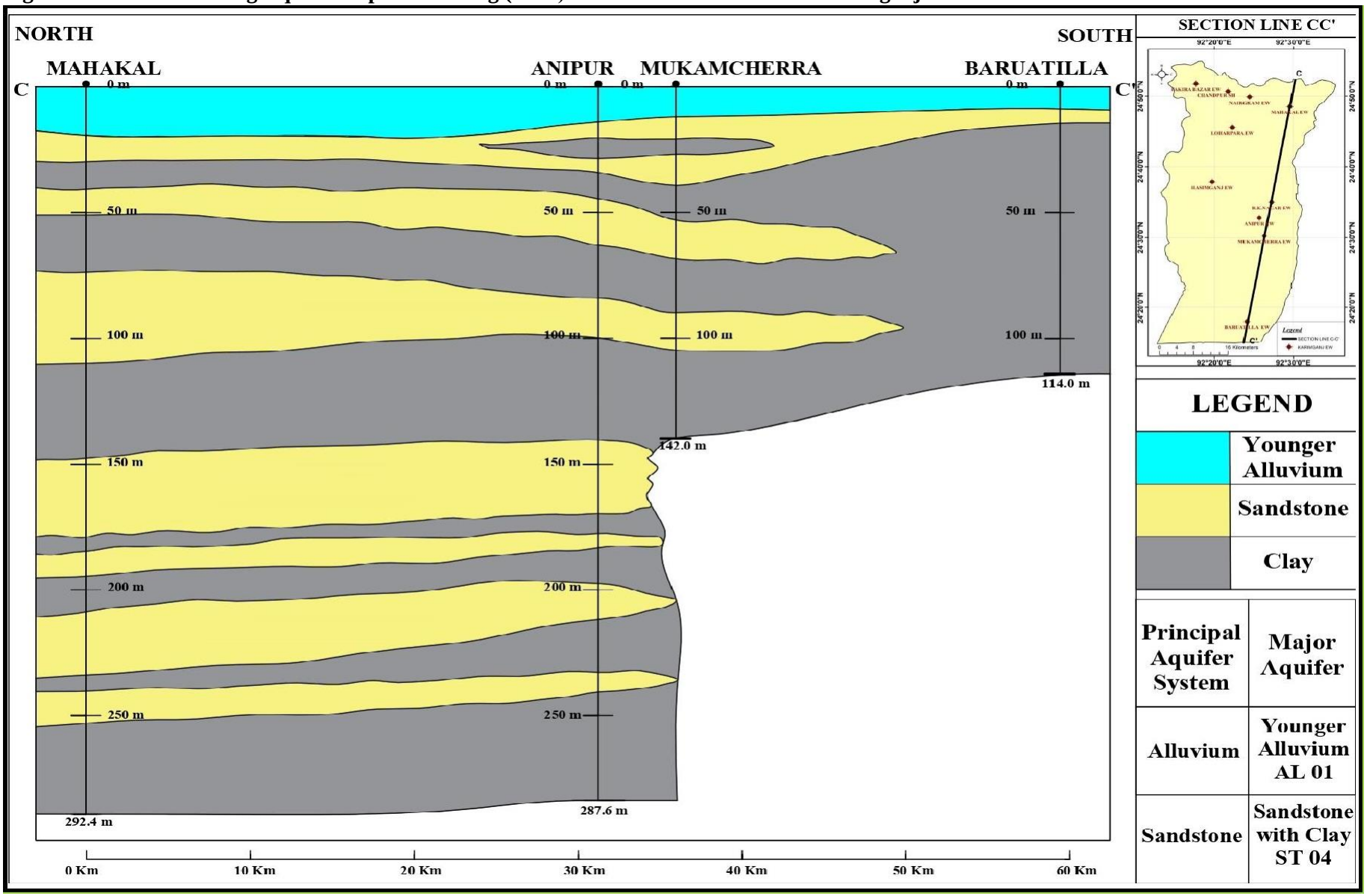


Fig 3.3- 2D section showing Aquifer disposition along (C-C') North - South direction of Karimganj district



3.2 Ground Water Level

To study ground water regime, depth to water level from 09 monitoring stations under NHNS are measured seasonally. The pre monsoon and post monsoon depth to water level as well as the fluctuation are shown in Table 3.4.

Table 3.4: Pre & Post Monsoon DTWL and fluctuation data of NHNS monitored wells

NHNS Wells	Pre-Monsoon DTWL (m)	Post Monsoon DTWL (m)	Fluctuation (m)
Badarpur	2.7	0.9	1.8
Dhaulia	0.4	0.1	0.3
Hatikira	1.7	1.6	0.1
Karimganj	1.5	0.5	1.0
Kayasthagram	1.4	0.8	0.6
Patharkandi	1.6	0.9	0.7
R.K. Nagar	4.0	2.9	1.1
Sarkaribari	1.6	1.2	0.4
Kalinagar	2.3	1.7	0.6

Apart from these 09 NHNS wells, 51 key wells have been established all over the district to monitor the depth to water level and its seasonal fluctuation whose details are given in Table 3.5 attached as Annexure 3.3.

Based on the pre & post monsoon depth to water level data collected from monitoring of the key wells, DTWL maps have been drawn and shown in Fig 3.4, 3.5.

In the pre monsoon season, the depth to water level in the study area ranges between 0.2 m bgl to 6.2 m bgl. The area in and around Karimganj town and area close to the hills in the south eastern parts of the valley has water level up to 6.2 m bgl while in the central portion of the valley, the depth to water level is very shallow below 2.0 m bgl.

In the post monsoon season, the depth to water level in the study area ranges between 0.0 m bgl to 4.4 m bgl. The area in and around Karimganj town and area close to the hills in the south eastern parts of the valley has water level up to 4.4 m bgl while in the central portion of the valley, the depth to water level is very shallow below 1.0 m bgl.

Area with DTWL below 2.0 m is 513.39 Km^2, while area with DTWL between 2.0 to 3.0 m is 401 Km^2.

3.3 Ground Water Movement

The water table contour has been prepared based on the water level of ground water monitoring stations. Regionally the ground water flow direction is from the higher elevation of the southern side towards the valley portion which ultimately flows north towards the Barak River. The water table contour map is shown in Fig 3.6.

The water table map show that the WT in the southern side is at 40m and it gradually decreases to 5m in the northern part. The WT contours forms a V shape as the study area is a synclinal valley which tappers towards the southern side and widens up in the northern side. The flow direction is from south to north. The hydraulic gradient is varies between 0.34 m/Km in the north to 0.93 m/Km in the south.

Fig 3.4 : Pre monsoon DTWL map of Karimganj district

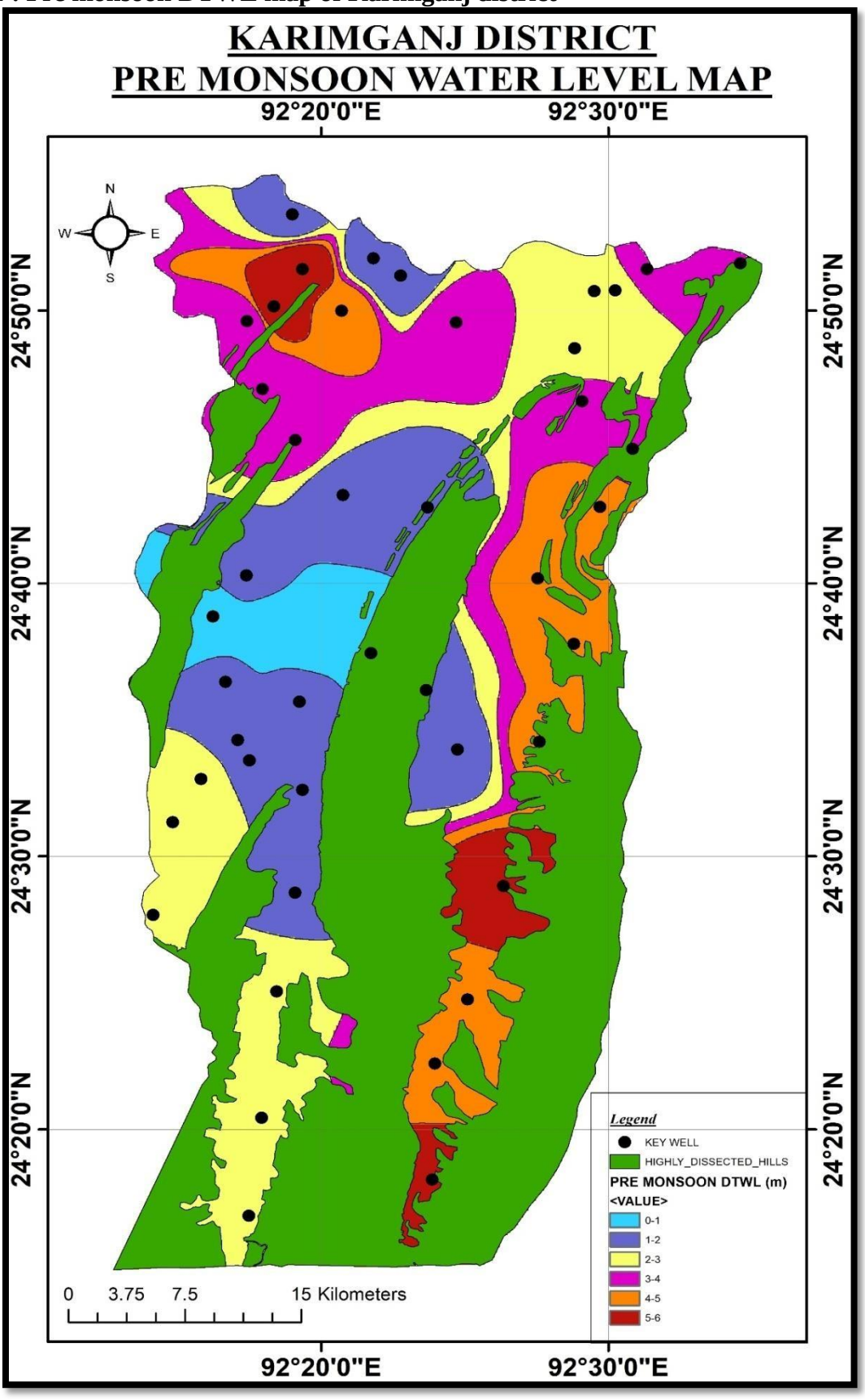


Fig 3.5 : Post monsoon DTWL map of Karimganj district

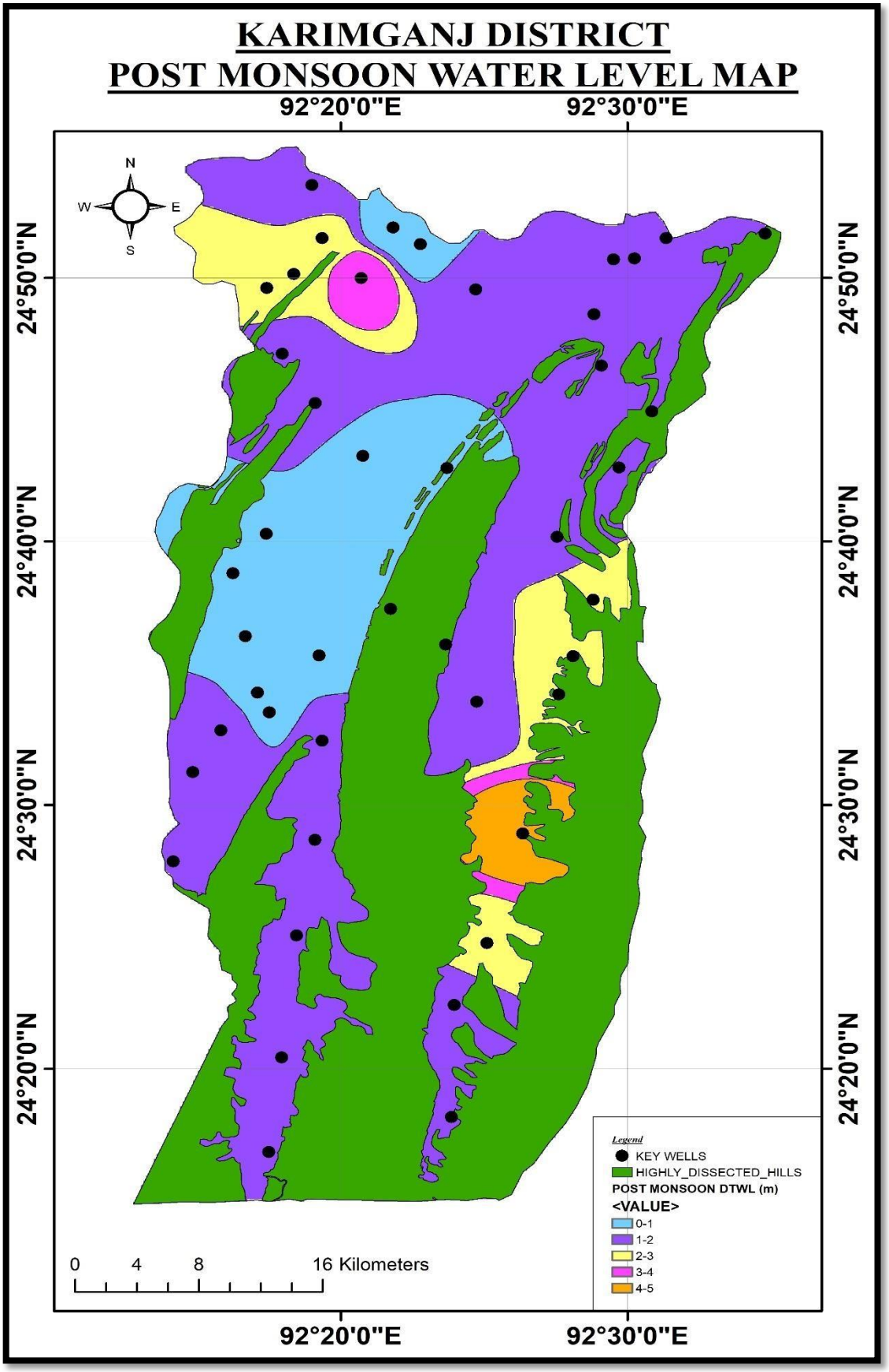
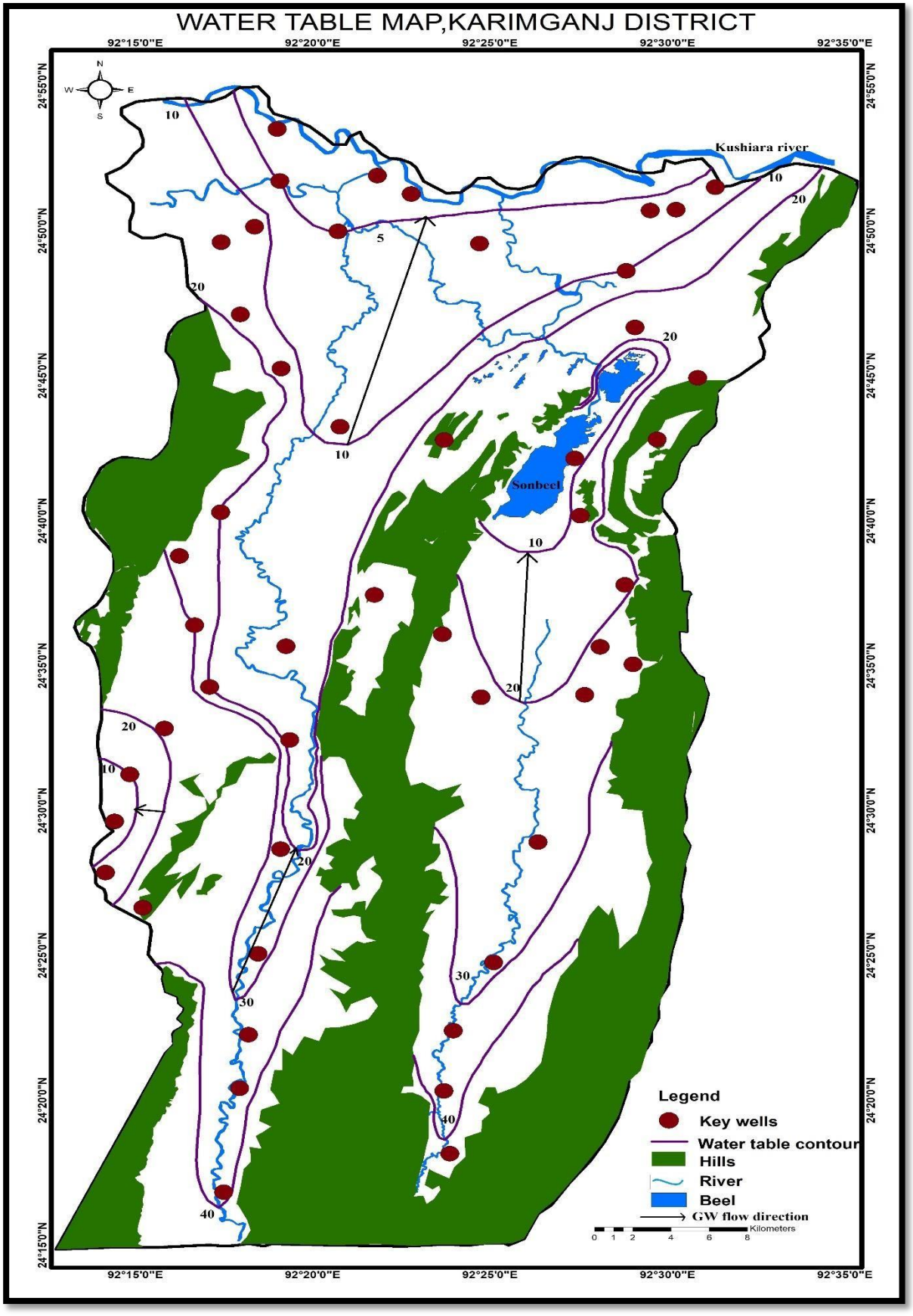


Fig 3.6 : Water table map of Karimganj district



4. Ground Water Quality

To study the ground water quality of the study area water samples from dug wells and tube wells were collected during pre-monsoon and post monsoon seasons. A total of 107 samples were collected during pre-monsoon. Out of which 29 samples from dug well and 78 samples from tube well. Similarly 41 samples were collected during post monsoon, 28 samples from dug well and 13 samples from tube well. Chemical analysis of ground water samples is carried out by regional chemical laboratory of Central Ground Water Board, North Eastern Region, Guwahati. Samples were analyzed for the parameters like pH, EC, Turbidity, TDS, CO3, Cl, SO4, Na, K, HCO3, NO3, F, Ca, Mg, As and Fe. The chemical analysis data of groundwater samples from Karimganj district during pre-monsoon and post-monsoon season are given in the Table 4.1 and 4.2 as Annexure 4.1 and 4.2 respectively. Table 4.3 and 4.4 summarizes the results of chemical analysis

Table 4.1 : Chemical quality of water samples from dug well and tube well in Karimganj district during pre-monsoon

SI.NO.	Chemical constituents (Concentrations in mg/l except pH, EC and As)	Maximum	Minimum
1	pH	8.721	6.176
2	EC (µs/cm) 25°C	574.1	15.78
3	Turbidity (NTU)	0.3	BDL
4	TDS	332.5	9.17
5	CO_3^{-2}	48	BDL
6	HCO_3^{-1}	476.18	36.63
7	TA (as $CaCO_3$)	476.18	36.63
8	Cl^-	326.14	10.64
9	SO_4^{-2}	80.07	0.01
10	NO_3^{-1}	13.57	BDL
11	F^-	1.2	0.07
12	Ca^{+2}	114.09	4
13	Mg^{+2}	139.53	1.2
14	TH (as $CaCO_3$)	750	35
15	Na	86.88	2.55
16	K	34.75	1.32
17	Fe	81.647	0.157
18	As (µg/L)	48.718	BDL

Table 4.2 - Chemical quality of water samples from dug well and tube well in Karimganj district during post-monsoon

SI.NO.	Chemical constituents (Concentrations in mg/l except pH, EC and As)	Maximum	Minimum
1	pH	8.194	7.262
2	EC (µs/cm) 25°C	470.7	111.5
3	Turbidity (NTU)	0.4	BDL
4	TDS	276.7	65.83
5	CO_3^{-2}	BDL	BDL
6	HCO_3^{-1}	366.29	12.21
7	TA (as $CaCO_3$)	366.29	12.21
8	Cl^-	67.35	7.09
9	SO_4^{-2}	75.42	0.37
10	NO_3^{-1}	7.96	0.27
11	F^-	0.38	0.07
12	Ca^{+2}	70.06	10.01
13	Mg^{+2}	44.66	6.05
14	TH (as $CaCO_3$)	310	65
15	Na	48.01	5.27
16	K	41.11	0.87
17	Fe	15.275	0.204
18	As (µg/L)	109.452	0.458

Table 4.3: Concentration of Fe, As and pH value in ground water during pre-monsoon

Type of Structure	No. of Sample analysed	Conc. of Iron (mg/l)			Conc. of Arsenic (µg/L)	pH value	
		<0.3	0.3 to 1	>1	>10	<6.5	6.5 to 8.7
Dug well	29	3	15	11	4	0	29
Tube well	78	6	10	62	17	3	75

Table 4.4: Concentration of Fe, As and pH value in ground water during post-monsoon

Type of Structure	No. of Sample analysed	Conc. of Iron (mg/l)			Conc. of Arsenic (µg/L)	pH value	
		<0.3	0.3 to 1	>1	>10	<6.5	6.5 to 8.7
Dug well	28	1	4	23	2	0	28
Tube well	13	0	3	10	2	3	10

4.1 Ground Water Quality of Shallow Aquifer

A total of 29 and 28 ground water samples were collected from dug wells during pre-monsoon and post monsoon studies respectively. The range of concentrations of different chemical constituents present in the ground water samples are given in table 4.3 and 4.4.

It is deciphered from table 4.3 and 4.4 that the all the dug wells samples have pH values in the range from 6.5 to 8.7 during pre-monsoon and post monsoon season. No dug wells sample has pH value less than 6.5. So it can be inferred that the nature of ground water in the dug wells in both the seasons is neutral to slightly alkaline. The concentration of Fe in 11 dug wells during pre-monsoon and 23 dug wells during post monsoon are beyond the permissible limit of WHO i.e >1mg/L. The As concentration in water samples in 4 dug wells collected during pre-monsoon and 2 dug wells samples collected during post monsoon season are beyond the permissible limit of 10µg/L as given by WHO.

4.2 Ground water quality of Deeper Aquifer

A total of 78 and 13 ground water samples were collected from tube wells during pre-monsoon and post monsoon studies respectively. The range of concentrations of different chemical constituents present in the ground water samples are given in table 4.3 and 4.4.

It is deciphered from table 4.3 and 4.4 that the 3 tube wells from pre monsoon and 3 tube wells from post monsoon have pH less than 6.5, which indicates slightly acidic in nature. The rest of the tube wells from both pre and post monsoon have pH values in the range 6.5 to 8.7, which indicates neutral to slightly alkaline nature of the ground water. The concentration of Fe in 62 tube wells during pre-monsoon and 10 tube wells during post monsoon are beyond the permissible limit of WHO i.e >1mg/L. The As concentration in water samples in 17 tube wells collected during pre-monsoon and 2 tube wells sample collected during post monsoon season are beyond the permissible limit of 10µg/L as given by WHO.

The pre & post monsoon pH map are shown in Figure no. 4.4 and 4.5 respectively. The pre & post monsoon Iron conc. map are shown in Figure no. 4.6 and 4.7 respectively. The Arsenic conc. Map is shown in Figure no. 4.8 and the Electrical conductivity map is shown in Figure no. 4.9.

4.3 Assessment of ground water quality with various chemical diagram

Ground water quality has been assessed with the help of various chemical diagram such as Piper diagram, Wilcox diagram and Stiff diagram prepared with the help of Aquachem 9 software.

Piper diagram

In order to understand water composition and chemical relationship between dissolved ions, Pipers trilinear diagram for graphical analysis (Figure 4.1) is used. This diagram reveals similarities and differences among water samples. Most of the water samples analyzed fall within the no dominant type in case of cations with few samples fall under calcium type and Na-K type. In case of anions, most of the samples are under bicarbonate type and few other samples under no dominant type and chloride type. These trends are reflected in the central diamond of the diagram where most of the samples fall under the category of alkaline dominant field in case of cations within which around 53% of the samples falls under Magnesium bicarbonate (Mg-HCO3) type ,37% of the samples falls under mixed type and 5% both under calcium chloride (CaCl) type and sodium chloride (NaCl) type. In case of anions, most of samples are within weak acids (HCO3 - CO3) dominant field with few samples under strong acids (Cl-SO4) dominant type. The results suggest that Magnesium bicarbonate and mixed type are the dominant hydro chemical facies for the studied groundwater samples.

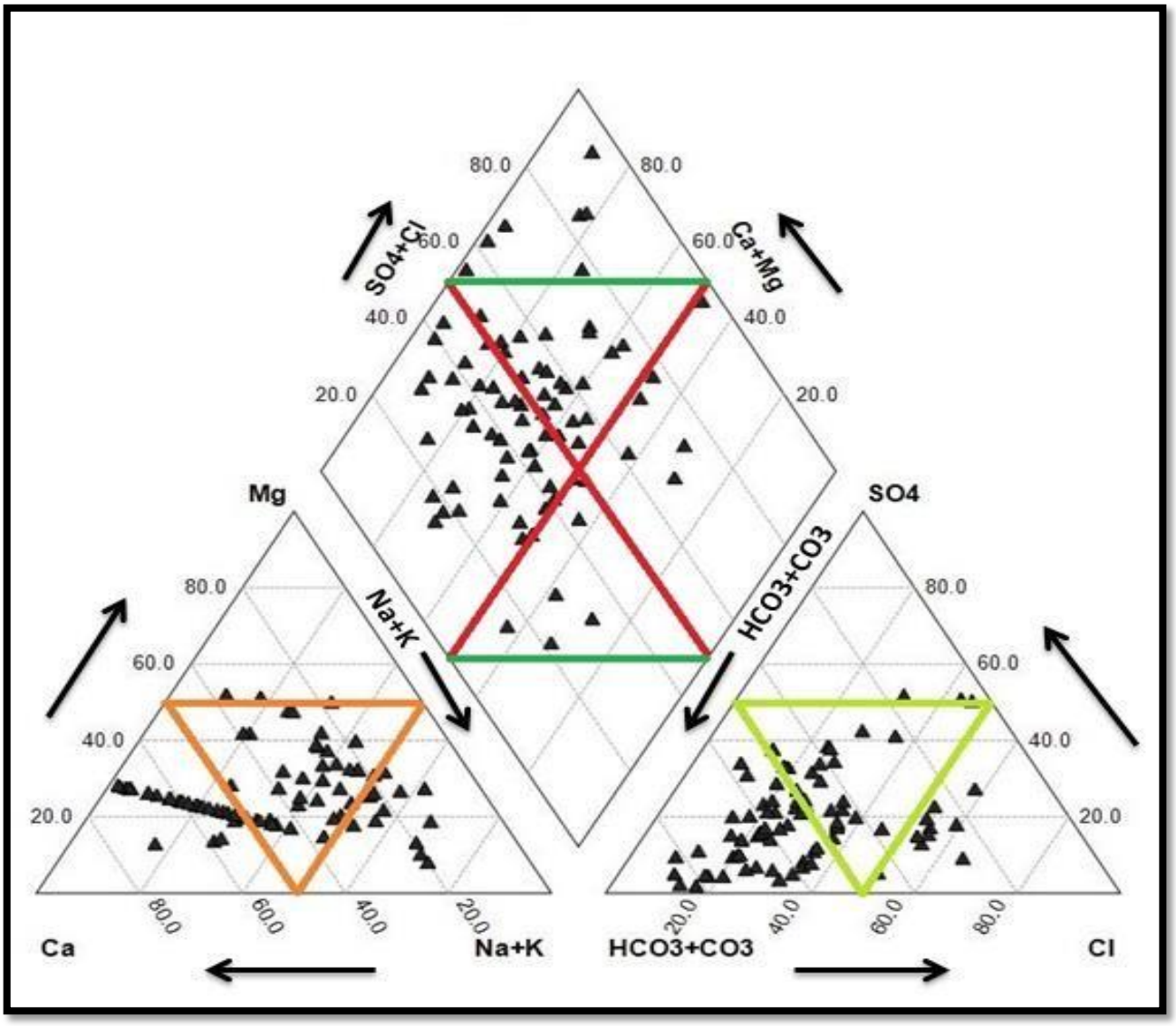


Figure 4.1 - Piper diagram for representing the analysis of ground water

Wilcox diagram

According to Wilcox diagram (US Salinity Laboratory's diagram) in Figure 4.2, salinity and alkalinity hazard class of water samples were C1–S1 (83 %) and C2–S1 (16 %). The result shows that a majority of the ground water samples possess low salinity with low sodium (C1–S1). Such water can be used directly for irrigation purpose. However, water samples falling in medium salinity and low sodium class(C2-S1) should be treated before using for irrigation purposes.

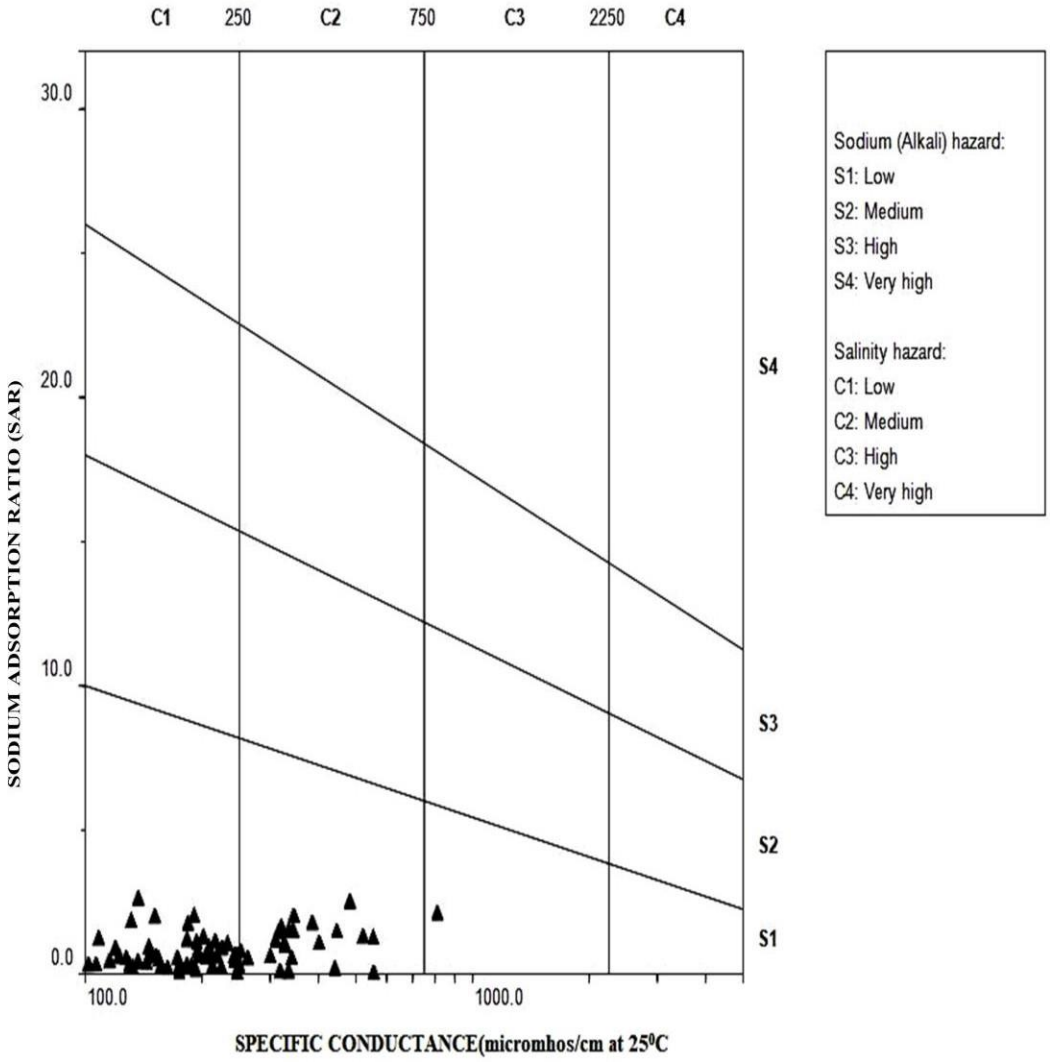


Figure 4.2 - Wilcox diagram to analyze the quality of water in relationship to salinity & sodium hazard.

Stiff diagram

In the Figure 4.3 it can be seen that the ground water present in the study area shows a higher concentration of Calcium (Ca) in comparison to Sodium (Na) and Magnesium (Mg). In terms of anions the ground water of the study area has a higher concentration of Carbonate and Bicarbonate ions (CO3+HCO3) in comparison to Chloride ions (Cl) and Sulphate ions (SO4).

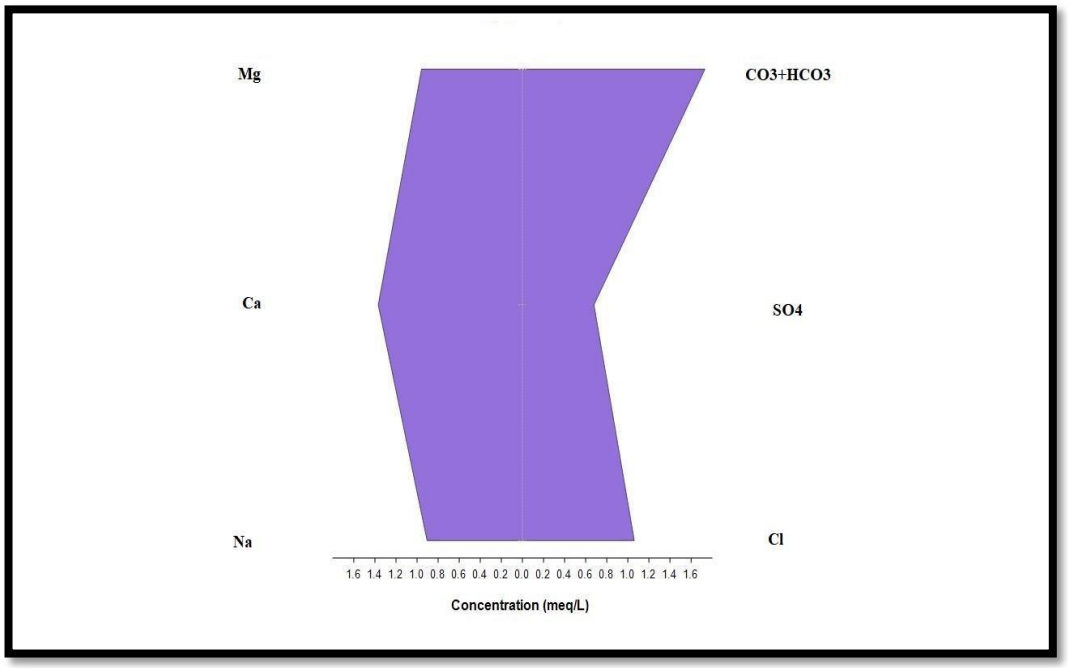


Figure 4.3- Stiff diagram to analyze the concentration of various cations and anions present in the ground water

4.4 Water Quality Evaluation for Irrigation Purpose

To study the water quality for irrigation purpose, 107 water samples (both DW and TW) are collected during pre-monsoon and 28 water samples during post monsoon. Different chemical parameters like pH, electrical conductivity(EC), total dissolved solids (TDS), Ca2+, Mg2+, Na+, K+, Cl-, HCO3,CO3, SO4, F- and various chemical index such as sodium absorption ratio (SAR), sodium percentage(SP), residual sodium carbonate (RSC), Kelly's ratio and magnesium ratio were analyzed by adopting the standard procedures of water analysis. The feasibility check of ground water for irrigation purpose is given in Table No. 4.7.

Suitability of the groundwater for irrigation purpose was discussed by the following basic criteria.

pH

The pH of the water samples ranges from 6.176-8.721 during the pre-monsoon and from 7.262- 8.194 during the post monsoon in the study area. All the water samples fall in the safe limit of pH standard (6–8.5) for irrigation purpose.

Salinity Hazard

Determination of salinity hazard is very important in irrigation water, as high salt content renders the soil saline. This also affects the salt intake capacity of the plants through the roots. In the present study, the salinity hazard was evaluated by EC and TDS. EC varies from 15.78 to 574.10µS/cm during pre-monsoon and 111.50-470.7 µS/cm during post monsoon. TDS varies from 9.17- 332.50 mg/L during pe monsoon and 65.83- 276.7 mg/L during post monsoon. Based on the classification of TDS as suggested by USSL, all the water samples both from pre and post monsoon are classified as non-saline. According to the EC grading standards as suggested by Wilcox, 68% of from pre monsoon and 36% of post monsoon samples are classified as excellent category and 32% of pre monsoon and 64% of post monsoon samples as good category. Therefore, the use of this excellent- good quality ground water for irrigation in the study area may not cause any salinity hazard.

Alkalinity Hazard (SAR)

Irrigation water is classified on the basis of SAR. Hence, the assessment of sodium hazard is necessary while considering the suitability for irrigation. The SAR values of the groundwater samples from pre monsoon and post monsoon varies from 0.1-4 and 0.2-1.6 respectively. The SAR values of the water samples of the study area less than 10 and are classified as excellent for irrigation. To determine the hazardous effect of sodium on water quality for irrigation, Percent Sodium (%Na) and Kelly's Index are calculated. The percent sodium (%Na) of pre monsoon samples varies from 4.4- 73% and the post monsoon samples varies from 9.8-50%. Around 90% of the pre monsoon samples are categorized as excellent- permissible while 10% of the samples as doubtful and all the post monsoon samples are categorized as excellent- permissible for irrigation purpose. Around 82% of the pre monsoon samples and 100% of the post monsoon samples has Kellys Index less than 1 and is classified as suitable for irrigation.

Magnesium Ratio

In the study area, nearly 50% of the pre monsoon water samples and 79% of the post monsoon samples has Mg ratio less than 50 % which is suitable for irrigation, as magnesium ratio of more than 50% indicate that the soil is more alkaline which adversely effects the crop yield.

Residual Sodium Carbonate (RSC)

The RSC values varies from -9.9 to 5.91ppm and -1.49 to 0.9ppm for pre monsoon and post monsoon water samples respectively.84% of the pre monsoon water samples are suitable for irrigation, 14% are marginally suitable and 2% are unsuitable for irrigation. All the post monsoon

water samples are suitable for irrigation. The water with high RSC has high pH and land irrigated by such water becomes infertile owing to deposition of sodium carbonate as indicated by the black colour of the soil.

Table 4.7 - Feasibility check of ground water for irrigation purpose

Parameters	Range	Classification	Pre monsoon (No. samples)	Post monsoon (No. samples)
Total Dissolved Solid(TDS) (mg/L)	<1000	Non-saline	107	28
	1000-3000	Slightly saline	0	0
	3000-10000	Moderately saline	0	0
	>10000	Very saline	0	0
Salinity Hazard(EC) (µS/cm)	<250	Excellent	73	10
	250-750	Good	34	18
	750-2000	Permissible	0	0
	2000-3000	Doubtful	0	0
	>3000	Unsuitable	0	0
Alkalinity Hazard (SAR)	<10	Excellent	107	28
	10-18	Good	0	0
	18-26	Doubtful	0	0
	>26	Unsuitable	0	0
Percent Sodium (%Na)	<20	Excellent	17	11
	20-40	Good	40	11
	40-60	Permissible	39	6
	60-80	Doubtful	11	0
	>80	Unsuitable	0	0
Kelly's Index (KI)	<1	Suitable	87	28
	>1	Unsuitable	20	0
Magnesium Ratio (MR)	>50%	Unsuitable	53	6
	<50%	Suitable	54	22
Residual Sodium Carbonate (RSC)	<1.25	Suitable	90	28
	1.25-2.5	Marginally suitable	15	0
	>2.5	Unsuitable	2	0

Figure 4.4- Pre monsoon pH map of Karimganj District

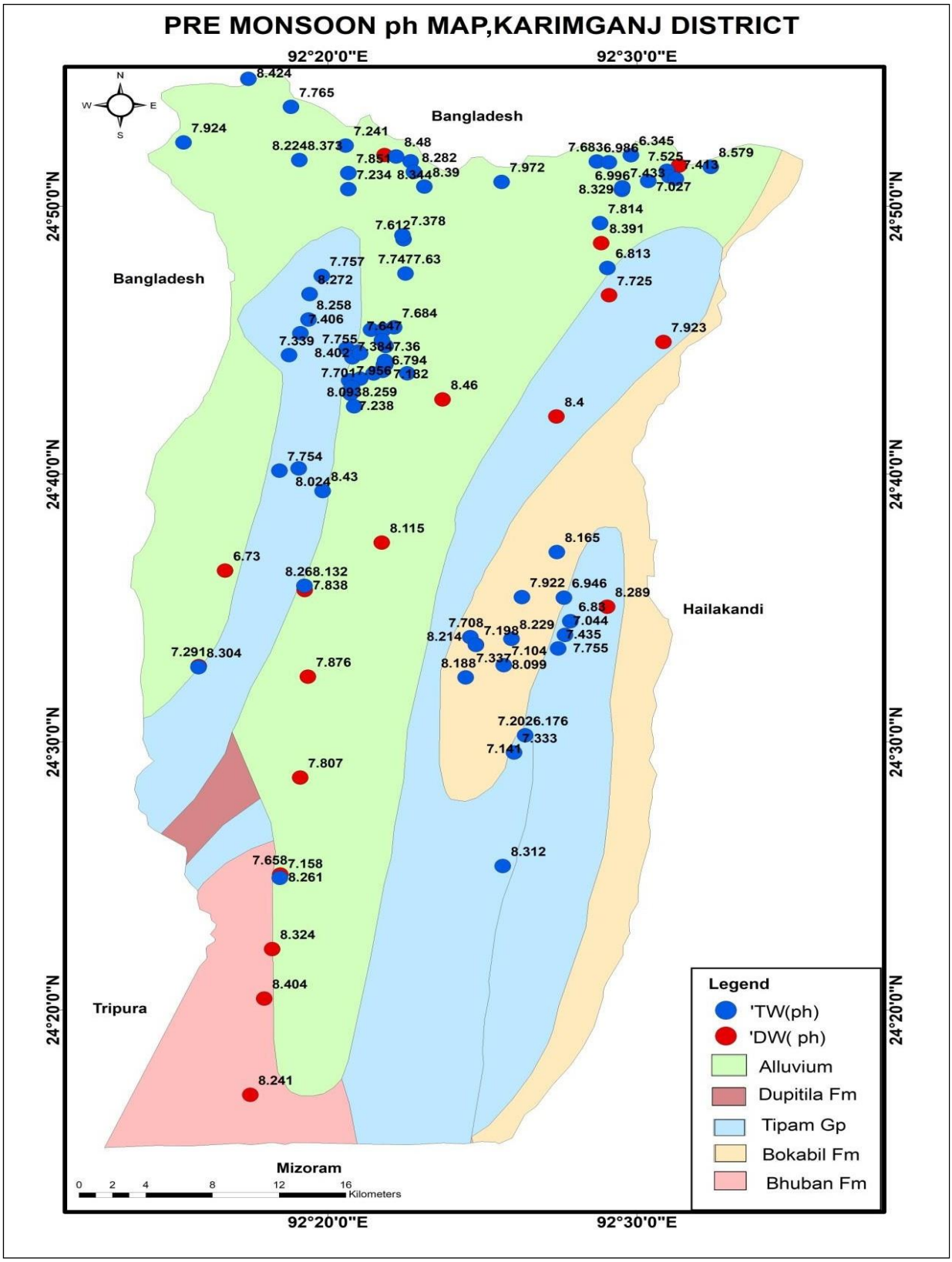


Figure 4.5- Post monsoon pH map of Karimganj District

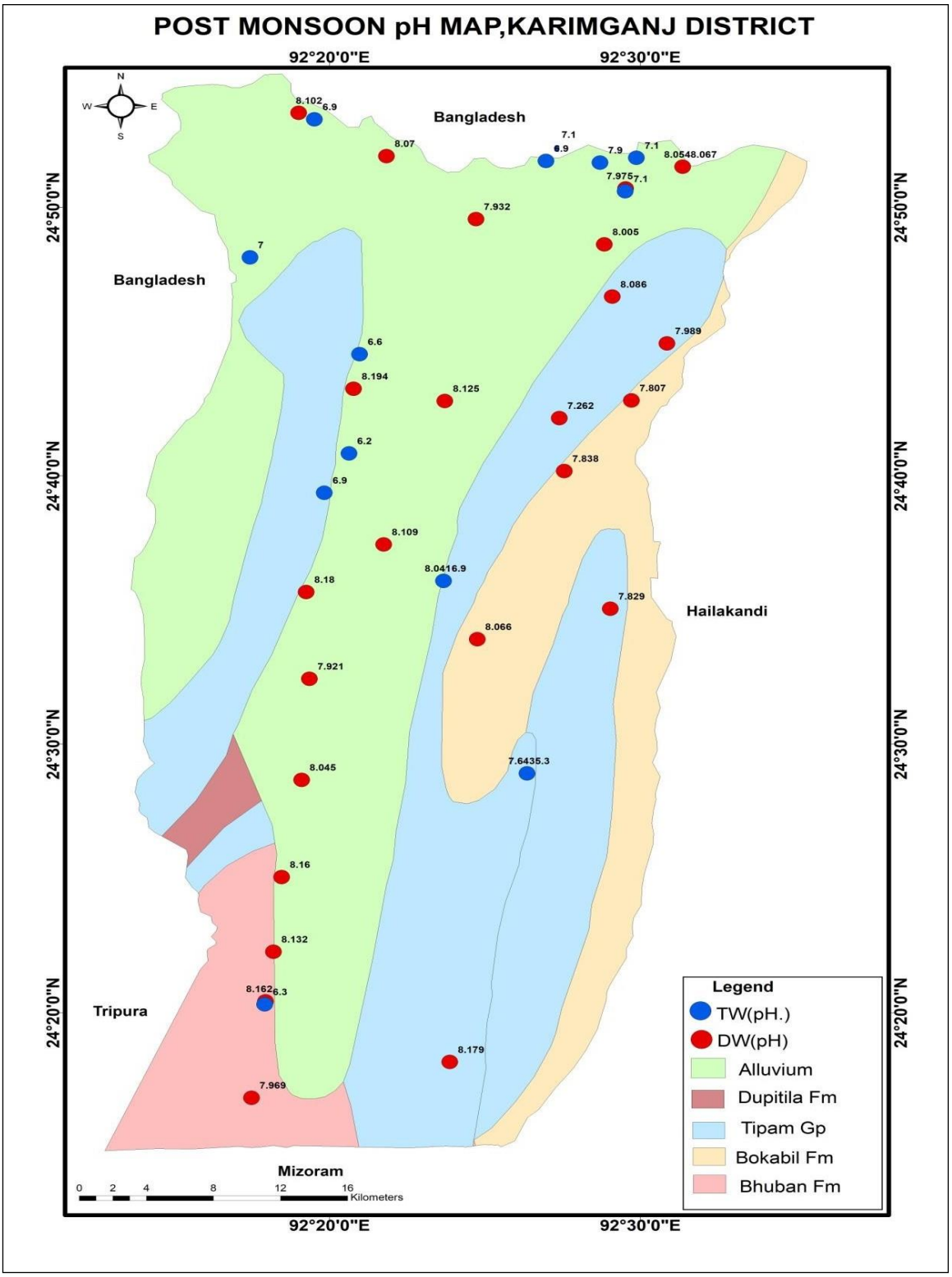


Figure 4.6 Pre monsoon Iron conc. map of Karimganj District

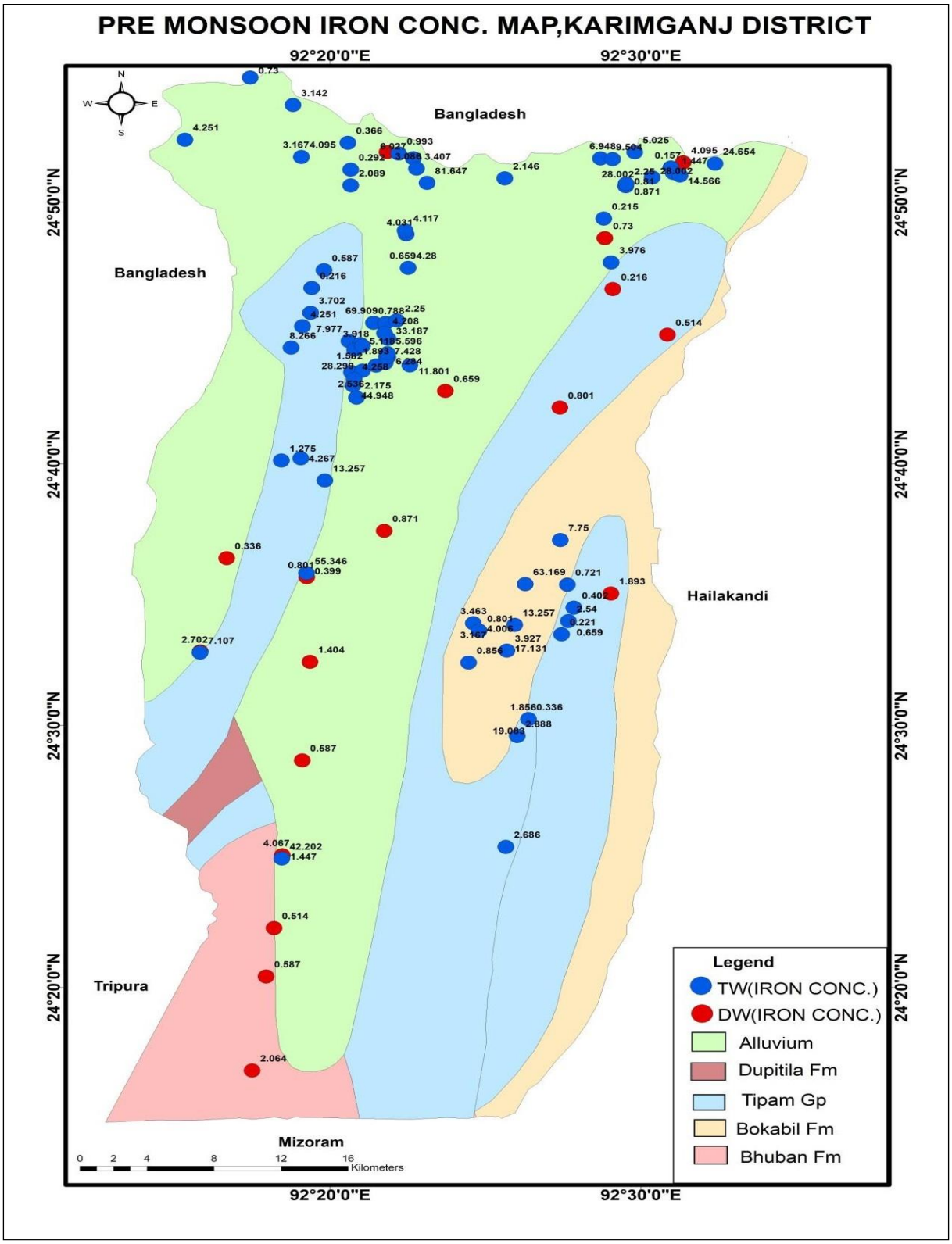


Figure 4.7- Post monsoon Iron conc. map of Karimganj District

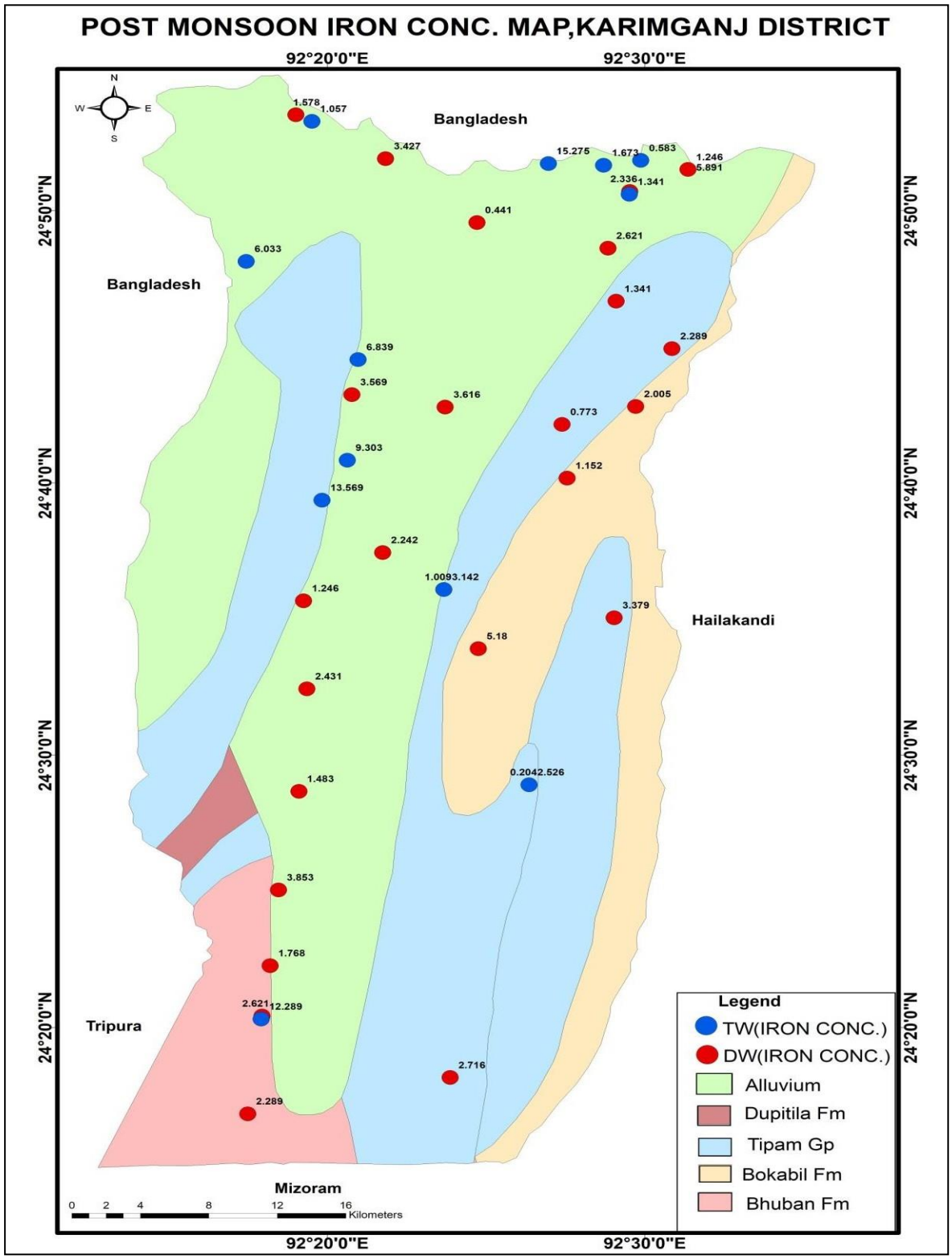


Figure 4.8- Arsenic conc. map of Karimganj District

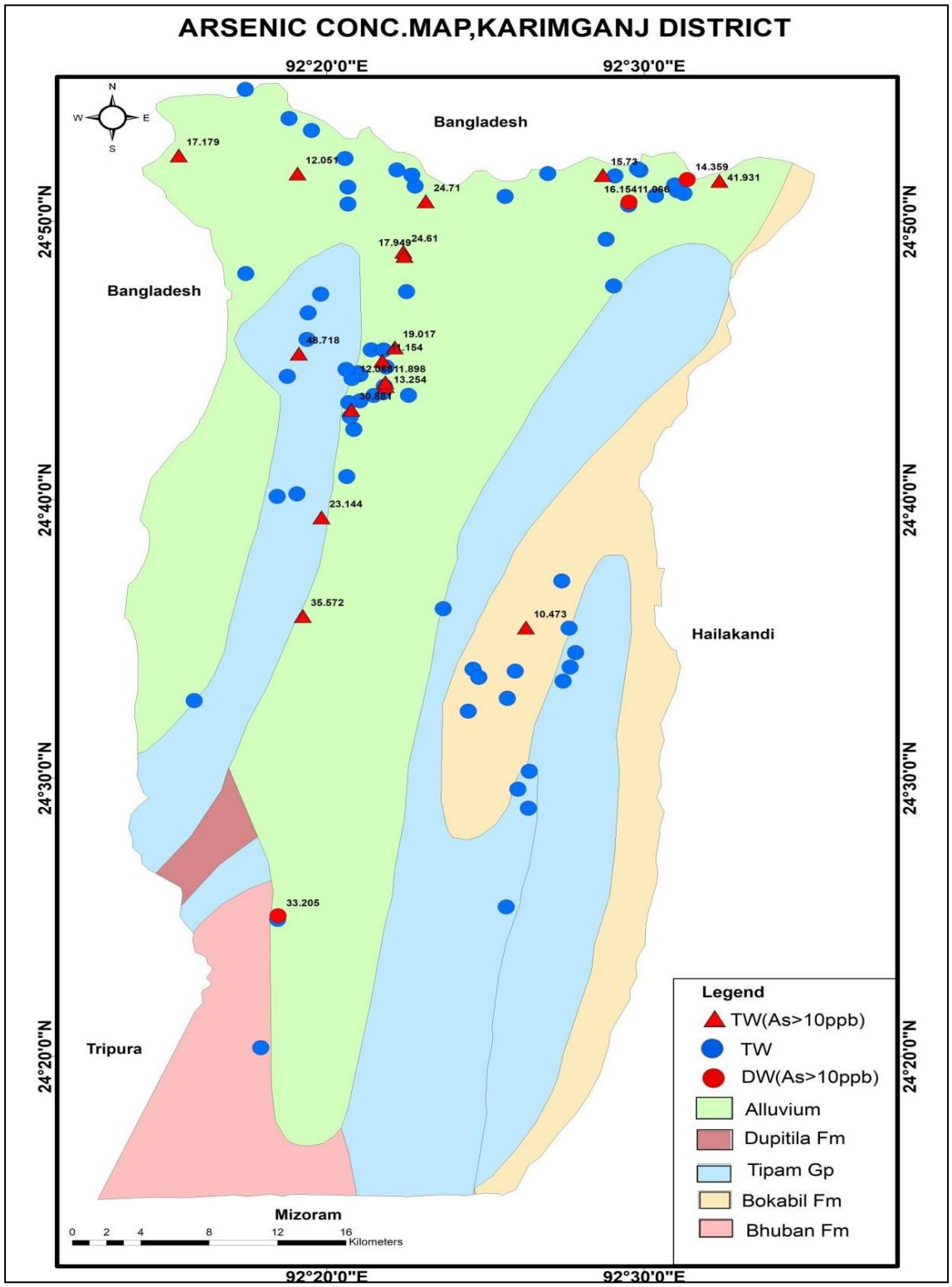
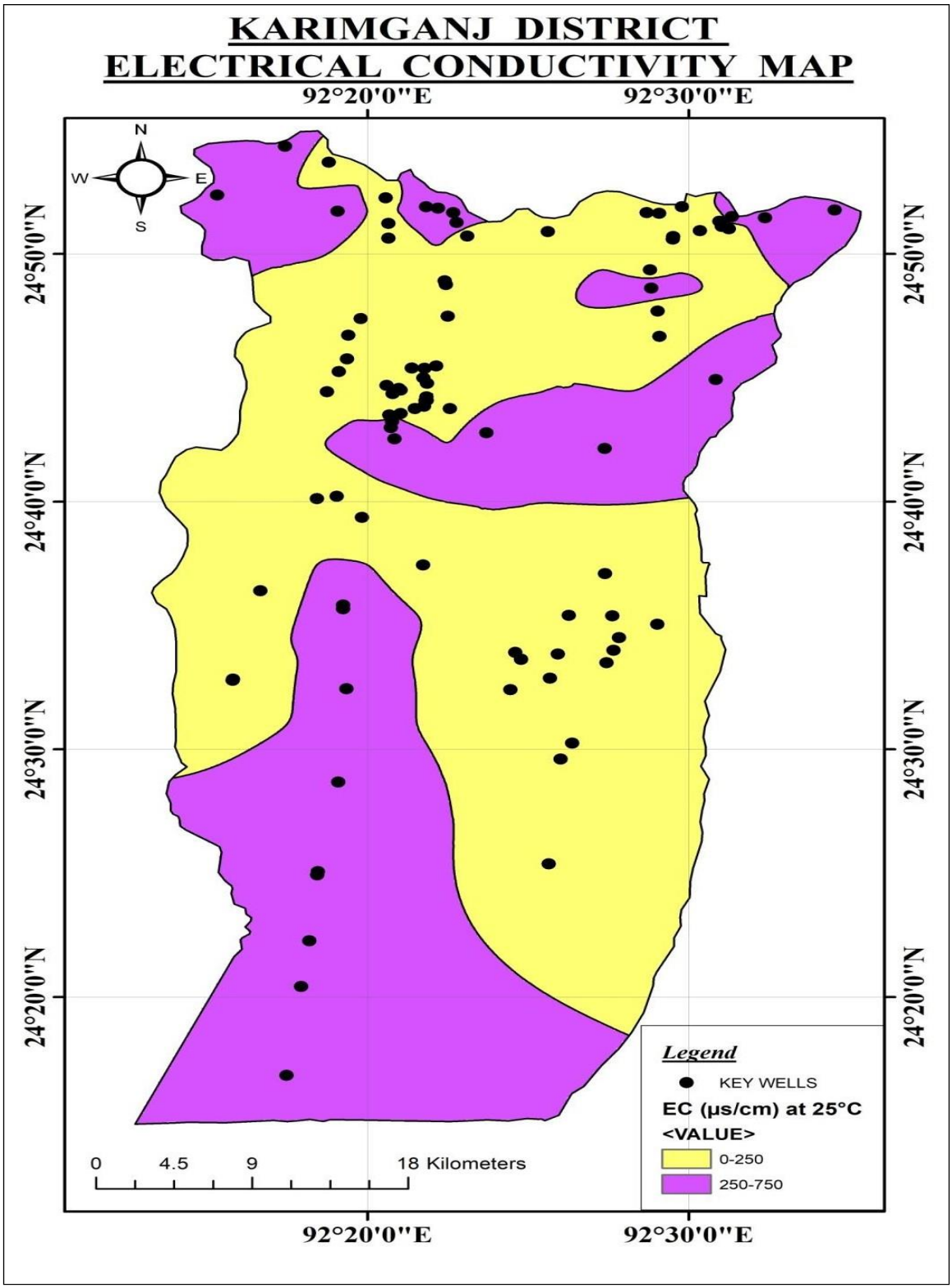


Figure 4.9- Electrical conductivity map of Karimganj District



Water samples were collected from exploratory well, observation well and Tara pump at the same location to analyze the chemical constituents in groundwater at different depths. The comparative chemical data have been furnished in the Table 4.8.

Table 4.8: Chemical data of EW, OW, Tara pump at Mukamcherra, Karimganj district

Latitude	24.50414	24.50414	24.50414
Longitude	92.43953	92.43953	92.43953
Source	EW	OW	Tara pump
Depth	**129**	**63**	**10**
Date of collection	03.01.2021	31.01.2021	22.01.2021
Temp (ºC)	25.7	25.9	25.4
pH	7.1	7.2	6.2
EC (µs/cm) @ 25°C	41.76	59.63	145.70
Turbidity (NTU)	0.00	0.00	0.00
TDS	23.82	32.14	79.84
CO_3^{-2}	0.00	0.00	0.00
HCO_3^{-1}	42.73	61.05	42.73
TA (as CaCO3)	42.73	61.05	42.73
Cl^-	10.64	10.64	39.00
SO_4^{-2}	35.81	75.63	3.68
NO_3^{-1}	1.53	3.73	5.38
F^{-1}	0.17	0.31	0.12
Ca^{+2}	8.01	34.03	10.01
Mg^{+2}	7.28	1.20	4.85
TH (as CaCO3)	50.00	90.00	45.00
Na	13.24	14.90	18.09
K	2.23	4.14	7.05
Fe	1.86	19.083	0.336
As (in ppb)	0	BDL	BDL

5. Groundwater Resources

Dynamic Groundwater Resources of Karimganj district has been estimated based on the methodology recommended by Groundwater Estimation Committee (GEC'2015). The present methodology used for resources assessment is known as Ground Water Resource Estimation Methodology – 2015 (GEC'2015). GEC 2015 recommends estimation of Replenishable and in-storage ground water resources for both unconfined and confined aquifers. In GEC'2015, two approaches are recommended – water level fluctuation method and norms of rainfall infiltration method. The resources computed for the groundwater year 2019-20. The following sub-units are recommended for the computation of various figures in the methodology and these are considered in details below:

Hilly Area: Area with more than 20% slope has been excluded for the recharge computation. As per NESAC, total recharge worthy area in the district is 167648 Ha

Command and Non-Command Area- The methodology envisages computation of various figures separately for command & non-command area. In the district, there is no major or medium canal irrigation scheme and thus the entire rechargeable area has been considered as a non-command area.

Recharge from Rainfall- has been computed separately for monsoon and non-monsoon periods for the entire district. The recharge from rainfall during monsoon season has not been computed using water level fluctuation method (WLFM) as Ground Water Monitoring Wells (GWMW) in the district is very few. The rainfall recharge estimated for non-command area of the entire district and the details are shown in Annexure 5.1.

Recharge from All Sources- Total recharge to groundwater has several components, rainfall being the major one. The other components include seepage from canals, return flow from surface water irrigation, return flow from groundwater irrigation, seepage from tanks/ ponds etc.

Recharge from various sources has been calculated for monsoon as well as non-monsoon periods and details have been shown in Table 5.1.

Table 5.1- Groundwater recharge from various sources (Ham).

Assessment Unit/ District	Command/ Non-Command/ Total	Recharge from rainfall during monsoon season	Recharge from other sources during monsoon season	Recharge from rainfall during non-monsoon season	Recharge from other sources during non-monsoon season	Total Annual Ground Water Recharge	Provision for Natural Discharges	Annual Extractable Ground Water
Karimganj	Non-command	37175.6	1632.9	24199.65	226.25	63234.40	6323	47345.78
	Total	37175.6	1632.9	24199.65	226.25	63234.40	6323	47345.78

5.1 Groundwater extraction for Various Purposes

Groundwater extraction for domestic use has been estimated based on number of households using groundwater (Census 2011 data). Groundwater draft for domestic purpose is 1106.79 ham, for irrigation 80.64 ham and for industrial use 0.58 ham. It was found that groundwater draft for all uses in the district is 1188.01 ham.

5.2 Stage of Groundwater extraction & Categorization of the Blocks

The district falls under "SAFE" category. The stage of GW extraction is 2.51%. Summary of groundwater resources, stages of development and categorization are given in Annexure 5.1.

5.3 Summarized results of dynamic ground water resources of Karimganj district as on March 2020

The summarized results of dynamic ground water resources estimation of Karimganj district as on March 2020 is shown in the Table 5.2.

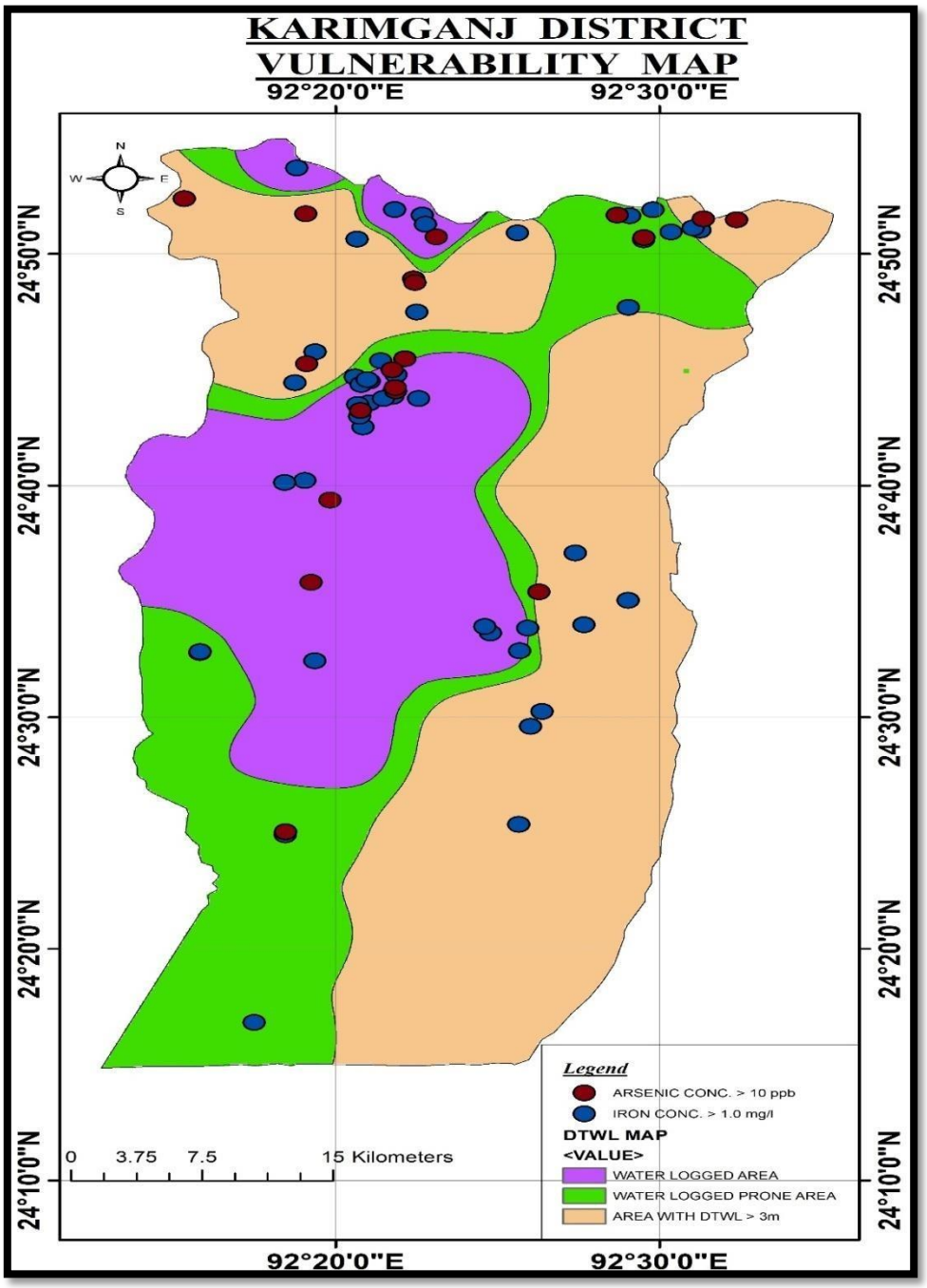
Table 5.2: Summarized results of dynamic ground water resources of Karimganj district as on March 2020

Sl. No.	ITEM	Year, 2019-20
	Methodology	**GEC 2015 (in ham)**
1	Total Annual Ground Water Recharge	63234.40
2	Total Natural Discharges	6323.4
3	Annual Extractable Ground Water Resource	47345.78
4	Total annual Ground water extraction	1188.01
5	Annual GW Allocation for for Domestic Use as on 2025	1266.18
6	Net Ground Water Availability for future use	45998.39
7	Stage of GW Development (%)	2.51

6. Ground Water Related Issues

The main groundwater issues in the study area are its vulnerability issue. These include areas vulnerable to water logging as well as prone to water logging conditions along with high Iron and Arsenic concentration in ground water above the WHO permissible limit. The vulnerability map of Karimganj district has been shown in Figure 5.1.

Fig 5.1: Vulnerability map of Karimganj District.



6.1 Low stage of ground water development

As per ground water resource estimation 2020, the stage of ground water extraction is just 2.51 % and there is no utilization of ground water for irrigation in this area. All the irrigation schemes in the district are dependent upon the surface water resources. Therefore, there is enough scope for future development of ground water in the study area to bring more area under irrigation practice. At present the irrigation department is constructing shallow tube wells (<50m depth) in the district. The work is still under progress. However according to the exploration data of CGWB some area in the district has clay layer up to a depth of 50m. So, construction of shallow tube wells in those areas will be a failure.

6.2 High Iron Concentration

As per water quality analysis data, 68% of the water samples collected during pre monsoon and 88% of the post monsoon samples from both dug well and tube well shows high concentration of Iron (i.e., >1ppm), which is above the permissible limit set by WHO for drinking water.

6.3 High Arsenic Concentration

As per water quality analysis data, 19.63% of water samples collected from both dug wells and tube wells shows high concentration of Arsenic (i.e., >10ppb), which is above the permissible limit set by WHO for drinking water. Most of the samples showing As values more than 10ppb in the study area tapped shallow aquifer, i.e. less 50m depth.

6.4 Water logging

As per the pre monsoon water level data 513.39 Km^2 of the study area has depth to water level less than 2m. As a result, this portion of the study area remains water logged. In the Fig 5.1 it can be seen that the most of the water-logged area is spread in the western part of the study area. The alluvium cover in the area is mainly clayey in nature which prevents the water to percolate downward. High rainfall and low stage of ground water development also results in water logging in the area. Around 400 Km2 of the study area is prone to water logging condition. Such area has pre monsoon depth to water level of 2-3m.

6.5 Water borne diseases

A large population of the district living in the villages mostly in the eastern and the southern part of the district do not get potable water during the lean season. As a result, a large population living in those areas suffers from many water borne diseases during that season.

7. Management Strategies

Low Stage of Groundwater Extraction and Water Logging

As per dynamic ground water resource estimation of Karimganj district for 2019-20, annual extractable ground water is 47362 Ham and stage of ground water extraction is only 2.51%. The district is having balance net ground water availability for future development in the tune of 46015 Ham. If an irrigation plan is made to develop 60% of the balance dynamic ground water resources available, then 27609 Ham of groundwater resources is available in the district for the future irrigation uses. From this available resource (planned for future development) 11503 nos. of shallow tube wells (considering a unit draft of 2.4 Ham/year) can be constructed in the district. Again 51300 ha area is water logged and 40100 ha area is prone to be water logged. Therefore, there is enough scope for future development of ground water in the study area to bring more area under irrigation practice.

Total cultivable area in the district is 93,206 ha, whereas present area under cultivation is 74000 ha. Present land under irrigation is only 3360 ha which only 2.53% of area under cultivation. During Kharif season 69,525 ha area is cultivated for paddy and another 2500 ha is under vegetables. During dry season, summer paddy and autumn paddy and Rabi vegetables cultivated in 6895, 1550 and 5446 ha respectively. These paddies and vegetables are cultivated in areas near to beels and haors, especially in Sonbeel area, which remain inundated for 6-7 months during rainy season. Irrigation from both surface and ground water is negligible. Hence, there is ample scope for ground water development for irrigation purpose which will bring prosperity to the society and help the district in achieving self-reliance on food grain. To use the groundwater for irrigation purpose a cropping plan has been designed for the district by using CROPWAT model developed by FAO. Cropping pattern data for the district is presented in Table 7.1.

During Kharif season, 69525 ha area is cultivated for paddy and after that major part of this area remains fallow in want of irrigation facilities. District irrigation Action plan prepared under PMKSY schemes by NABCON, aims to bring 15976 ha under surface water irrigation and 1807 ha underground water irrigation. AES data show that 7% of alluvial (cultivable) area is flood prone and 9% area is under beels and haors. Apart from this, Northern Central part of Karimganj valley is having Arsenic contamination in groundwater from shallow aquifer. Considering all these facts, a plan is formulated to bring this fallow land of about 25,000 ha under assured irrigation during Rabi season and increase cropping intensity up to 200%. In rice fallow, pulses, potato, mustard and rabi vegetables can be grown with the support of irrigation. Present cropping pattern, proposed cropping pattern, intended increase in cropping intensity were shown in Table 7.2a and 7.2b.

Table 7.1 - Cropping pattern data for Karimganj district

Table 6.1: CROPPING PATTERN DATA
(File: C:\ProgramData\CROPWAT\data\sessions\Karimganj.PAT)

Cropping pattern name: KARIMGANJ

No.	Crop file	Crop name	Planting date	Harvest date	Area %
1	...Data\CROPWAT\data	Rice	04/06	01/10	12
2	...Data\CROPWAT\data	Rice	11/06	08/10	13
3	...Data\CROPWAT\data	Rice	18/06	15/10	13
4	...Data\CROPWAT\data	Rice	25/06	22/10	12
5	...CROPWAT\data\crop	Small Vegetables	15/10	17/01	10
6	...a\CROPWAT\data\cr	Pulses	20/10	06/02	10
7	...\CROPWAT\data\cro	Potato	25/10	03/03	10
8	...a\CROPWAT\data\cr	Pulses	30/10	16/02	5
9	...CROPWAT\data\crop	Small Vegetables	07/11	09/02	5
10	rape___mustard.CRO	Mustard	15/11	29/03	10

Table 7.2a - Cropping pattern, proposed cropping pattern, intended cropping intensity, Karimganj district

Cropping pattern (s)				
1. Rice 2. Rice-Pulses 3. Rice-Mustard 4. Rice-Vegetables 5. Rice-Potato	**Present Cultivated area (Ha)**	**Area to be cultivated (%)**	**Area to be cultivated (Ha)**	**Irrigation requirement (Ham)**
	1	2 (= % of 1)	3	4
Rice (main crop)	25000		25000	3192.2
Pulses	0	30	7500	1148.0
Mustard	0	20	5000	729.0
Potato	0	20	5000	949.5
Vegetables	0	30	7500	990.0
Net cultivated area	25000		**25000**	
Gross cultivated area (1+potato/+mustard/+Veg)	25000		**50000**	
Net irrigation requirement				7728.7
Gross irrigation requirement (considering 70% Irrigation Efficiency)				11041.0
Cropping intensity	**100% (Present)**		**200% (Intended)**	

Table 7.2b - Proposed cropping pattern with water deficit months and IWR, Karimganj district

Rice based cropping pattern			
Crop	**Growing period (Months)**	**Periods/months of water deficit**	**Irrigation requirement (Ham)**
Rice	4	1-3	3192.2
Pulses	5	5	1148.0
Mustard	4-5	4	729.0
Potato		4	949.5
Vegetables	4	3-4	990.0

It is planned to utilize rice fallow of 25000 ha for the cultivation of pulses, potato, mustard and vegetables. It is considered to cultivate Vegetables and Pulses in 7500 ha and potato and mustard in 5000 ha each. The peak water requirement for irrigation for rice is in the month of May, for potato, mustard and pulses it is in the month of January and vegetables in December – January.

Crop-wise and month-wise irrigation water requirement (Precipitation deficit) has been taken from CROPWAT after giving necessary meteorological, soil, crop plan inputs and the same has been shown in Table 7.3. Crop-wise and month-wise Irrigation water requirement in Ham has been further calculated in Table 7.4.

Table 7.3: Crop-wise and month-wise precipitation deficit (IWR) from CROPWAT 8, Karimganj District.

Crop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precipitation deficit (mm)												
1. Rice	0	0	0	0	147.2	62.6	0	0	0	3.5	0	0
2. Rice	0	0	0	0	49.6	98	0	0	0	0	0	0
3. Rice	0	0	0	0	49.7	65.9	0	0	0	0	0	0
4. Rice	0	0	0	0	0	147.1	0	0	0	6.5	0	0
5. Small Vegetables	33.7	0	0	0	0	0	0	0	0	0	37.4	51
6. Pulses	63.6	5.1	0	0	0	0	0	0	0	1.4	24.1	56.4
7. Potato	72.9	48.9	0	0	0	0	0	0	0	0	17.8	50.3
8. Pulses	72.2	20.8	0	0	0	0	0	0	0	2.6	13.1	49.3
9. Small Vegetables	65.9	18.2	0	0	0	0	0	0	0	0	24.7	43
10. Mustard	58.6	46.8	0	0	0	0	0	0	0	0	8	32.4

Table 7.4: Irrigation Water Requirement (in Ham), Karimganj District

	% 0f 50000 ha	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1. Rice	12	0.00	0.00	0.00	0.00	883.20	375.60	0.00	0.00	0.00	21.00	0.00	0.00	1279.80
2. Rice	13	0.00	0.00	0.00	0.00	322.40	637.00	0.00	0.00	0.00	0.00	0.00	0.00	959.40
3. Rice	13	0.00	0.00	0.00	0.00	323.05	428.35	0.00	0.00	0.00	0.00	0.00	0.00	751.40
4. Rice	12	0.00	0.00	0.00	0.00	0.00	882.60	0.00	0.00	0.00	39.00	0.00	0.00	921.60
5. Small Vegetables	10	168.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	187.00	255.00	610.50
6. Pulses	10	318.00	25.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.00	120.50	282.00	753.00
7. Potato	10	364.50	244.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	89.00	251.50	949.50
8. Pulses	5	180.50	52.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.50	32.75	123.25	395.00
9. Small Vegetables	5	164.75	45.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	61.75	107.50	379.50
10. Mustard	10	293.00	234.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	40.00	162.00	729.00
Total		1489.25	601.50	0.00	0.00	1528.65	2323.55	0.00	0.00	0.00	73.50	531.00	1181.25	7728.70

Underground water exploration programme, CGWB has drilled 10 nos. of exploratory (including observation wells) tube wells in the district down to the depth of 300 m bgl. It has been established that deeper aquifer in most part of the valleys in the district is having moderate potentiality, having an average discharge of about 80 m³/hr and can be sustainably developed and use for irrigation purpose. CGWB has also constructed 4 nos. of shallow exploratory tube wells within 50 m bgl under Tipaimukh project. Average discharge from a shallow tube well was 6 m³/hr. PHED, Assam has constructed 67 deep tube wells within 85 m bgl for drinking water supply. And average discharge of those wells is 24 m³/hr. Again, under PMKSY GW Irrigation schemes, Assam Govt. has submitted ground water irrigation projects for Karimganj district by constructing shallow tube well within 45 m depth and the considered average discharge is 24 m³/hr.

In the district, shallow tube wells can be designed within a depth of 50m, expected to encounter 10 to 15m of granular zones and discharge of 15 m³/hr. Tube wells can be constructed by using 8// diameter housing pipe and a casing pipe down to 25 m. A shallow tube well having discharge of 15 m³/hr, if runs for 8 hours a day and for 120 days, will create a draft of 1.44 Ham. A deep tube well within a depth of 100m, is expected to provide a discharge of 50 m³/hr. Such a tube well will create a draft of 4.8 Ham.

In the considered area of 25000 ha, 6250 nos. of shallow tube wells can be constructed (considering 200m distance between any two shallow bore well). 6250 nos. of shallow tube wells can extract 9000 Ham of water annually.

Annual irrigation water requirement (IWR) is 11041 Ham while irrigation water requirement during dry season spanning from October to March is 5452 Ham. So, there is a gap of 2041 Ham between annual IWR and expected total discharge from shallow tube wells. However, during Rabi season entire considered area can be covered from ground water irrigation. Therefore, to bring this rice fallow area under double cropping conjunctive use of groundwater and surface water is required. Construction of tube wells for irrigation purposes will also have a positive impact in water logging area by lowering the water levels.

Groundwater Quality

CGWB has confirmed the occurrences of arsenic and iron in the groundwater. However, it is observed that arsenic is detected only from shallow aquifer within 50 m depth. Therefore, tube wells can be constructed down to a depth of 100 m tapping lower 50m granular zones. From the 2D disposition of aquifer diagram it is observed that clay or sandy clay layers are present in many areas. These confining layers can be utilized to separate the arsenic occurrence zone by adopting proper well construction technique. Deep tube well in the flood plain and arsenic affected areas may be constructed by proper cement sealing and clay filling as shown in Fig. 7.1.

In arsenic affected areas, surface water bodies like river, lakes, ponds/tanks should be used for drinking purpose (after suitable treatment/ filtering). If surface water sources are not available then groundwater can be extracted by following the measures described above.

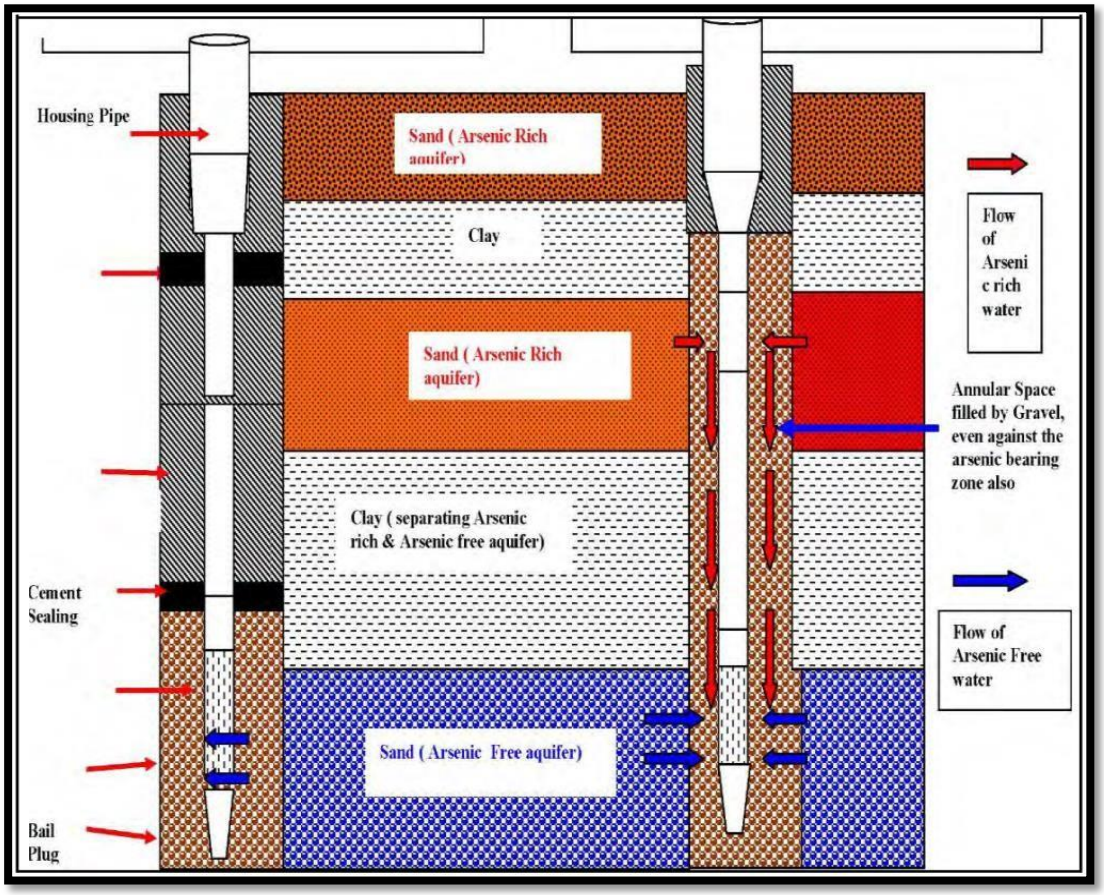


Fig.7.1- Tube-well design of a deep tube well tapping safe deeper aquifer
(Source: Concept note on geogenic contamination of groundwater in India Groundwater from both shallow and deep aquifers is infested with iron.)

So, iron removal plants (compact/ traditional) are should be installed before supplying water.

Annexure 1.1 : PYT Details of Mukamcherra EW, Dullabcherra Block, Karimganj District

Date : 11.12.2020

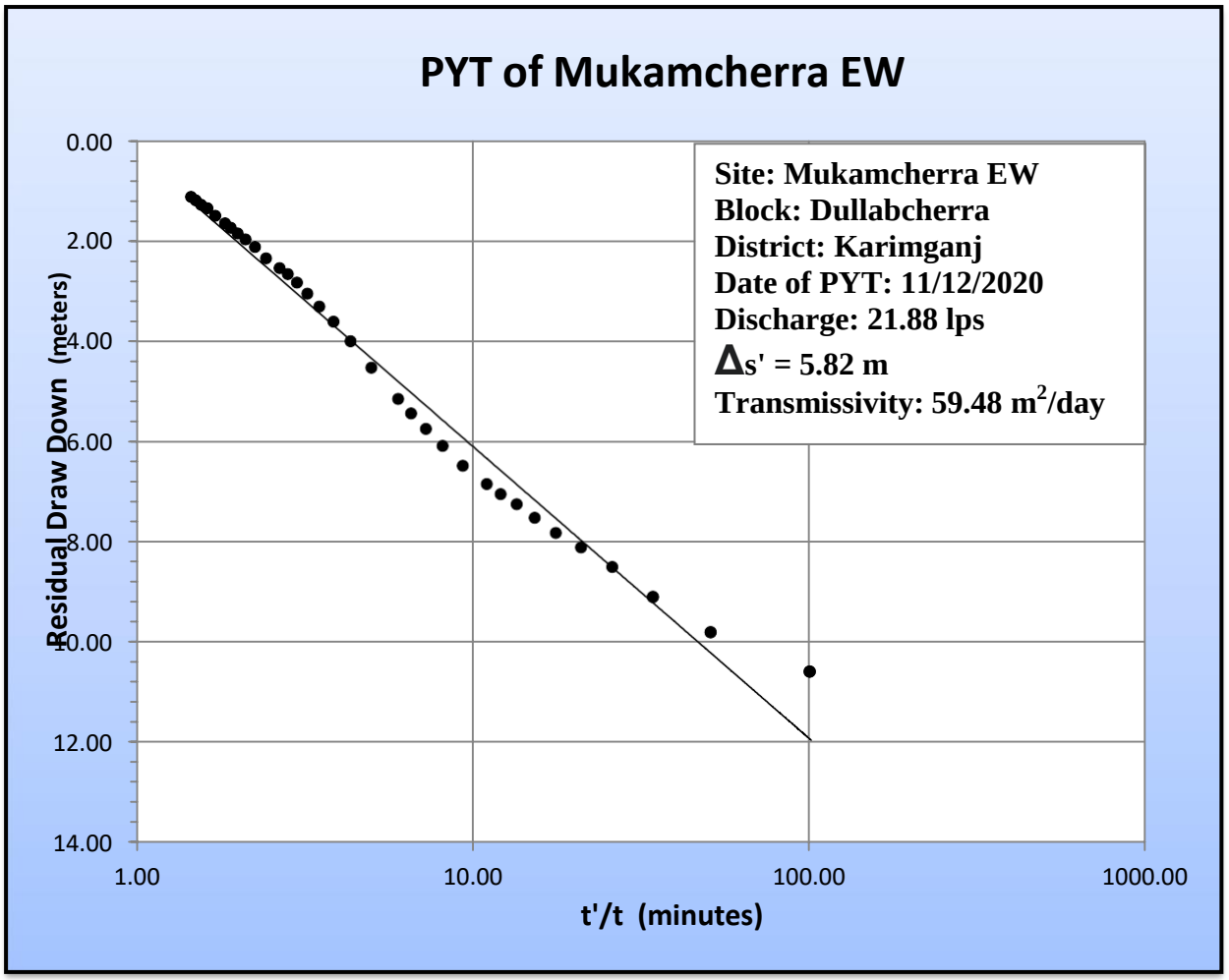
Time : 12.06 PM

SWL (m bmp) : 0.45

SWL :0.15 m agl

MP of Hairline : 0.60 m

Time (t)	SWL	Time since pump stopped t'	Recuperating Water Level (RWL)	t'/t	RDD (m) (RWL-SWL mbmp)
1	0.45	101	11.05	101.00	10.60
2	0.45	102	10.25	51.00	9.80
3	0.45	103	9.55	34.33	9.10
4	0.45	104	8.95	26.00	8.50
5	0.45	105	8.56	21.00	8.11
6	0.45	106	8.27	17.67	7.82
7	0.45	107	7.97	15.29	7.52
8	0.45	108	7.7	13.50	7.25
9	0.45	109	7.5	12.11	7.05
10	0.45	110	7.3	11.00	6.85
12	0.45	112	6.93	9.33	6.48
14	0.45	114	6.54	8.14	6.09
16	0.45	116	6.2	7.25	5.75
18	0.45	118	5.89	6.56	5.44
20	0.45	120	5.6	6.00	5.15
25	0.45	125	4.98	5.00	4.53
30	0.45	130	4.45	4.33	4.00
35	0.45	135	4.06	3.86	3.61
40	0.45	140	3.76	3.50	3.31
45	0.45	145	3.5	3.22	3.05
50	0.45	150	3.28	3.00	2.83
55	0.45	155	3.11	2.82	2.66
60	0.45	160	2.99	2.67	2.54
70	0.45	170	2.8	2.43	2.35
80	0.45	180	2.57	2.25	2.12
90	0.45	190	2.42	2.11	1.97
100	0.45	200	2.3	2.00	1.85
110	0.45	210	2.19	1.91	1.74
120	0.45	220	2.1	1.83	1.65
140	0.45	240	1.95	1.71	1.50
160	0.45	260	1.8	1.63	1.35
180	0.45	280	1.73	1.56	1.28
200	0.45	300	1.64	1.50	1.19
220	0.45	320	1.57	1.45	1.12


PYT of Mukamcherra EW
Site: Mukamcherra EW
Block: Dullabcherra
District: Karimganj
Date of PYT: 11/12/2020
Discharge: 21.88 lps
Δs' = 5.82 m
Transmissivity: 59.48 m2/day
Residual Draw Down (meters)
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
1.00
10.00
100.00
1000.00
t'/t (minutes)

Annexure 1.2 : PYT details of Mukamcherra OW, Dullabcherra Block, Karimganj District

Date : 21.01.2021

Time : 1 PM

SWL (m bmp) : 0.70

SWL :0.20 m agl

MP of Hairline : 0.90 m

Time (t)	SWL	Time since pump stopped t'	Recuperating Water Level (RWL)	t'/t	RDD (m) (RWL-SWL mbmp)		
1	0.70	101	3.53	101.00	2.83		
2	0.70	102	3.13	51.00	2.43		
3	0.70	103	2.9	34.33	2.20		
4	0.70	104	2.74	26.00	2.04		
5	0.70	105	2.62	21.00	1.92		
6	0.70	106	2.48	17.67	1.78		
7	0.70	107	2.4	15.29	1.70		
8	0.70	108	2.32	13.50	1.62		
9	0.70	109	2.24	12.11	1.54		
10	0.70	110	2.2	11.00	1.50		
12	0.70	112	2.09	9.33	1.39		
14	0.70	114	1.99	8.14	1.29		
16	0.70	116	1.9	7.25	1.20		
18	0.70	118	1.83	6.56	1.13		
20	0.70	120	1.77	6.00	1.07		
25	0.70	125	1.64	5.00	0.94		
30	0.70	130	1.55	4.33	0.85		
35	0.70	135	1.49	3.86	0.79		
40	0.70	140	1.42	3.50	0.72		
45	0.70	145	1.38	3.22	0.68		
50	0.70	150	1.34	3.00	0.64		
55	0.70	155	1.3	2.82	0.60		
60	0.70	160	1.28	2.67	0.58		
70	0.70	170	1.22	2.43	0.52		
80	0.70	180	1.18	2.25	0.48		
90	0.70	190	1.14	2.11	0.44		
100	0.70	200	1.11	2.00	0.41		
110	0.70	210	1.08	1.91	0.38		
120	0.70	220	1.05	1.83	0.35		
140	0.70	240	1.02	1.71	0.32		
160	0.70	260	0.98	1.63	0.28		
180	0.70	280	0.96	1.56	0.26		
200	0.70	300	0.94	1.50	0.24		

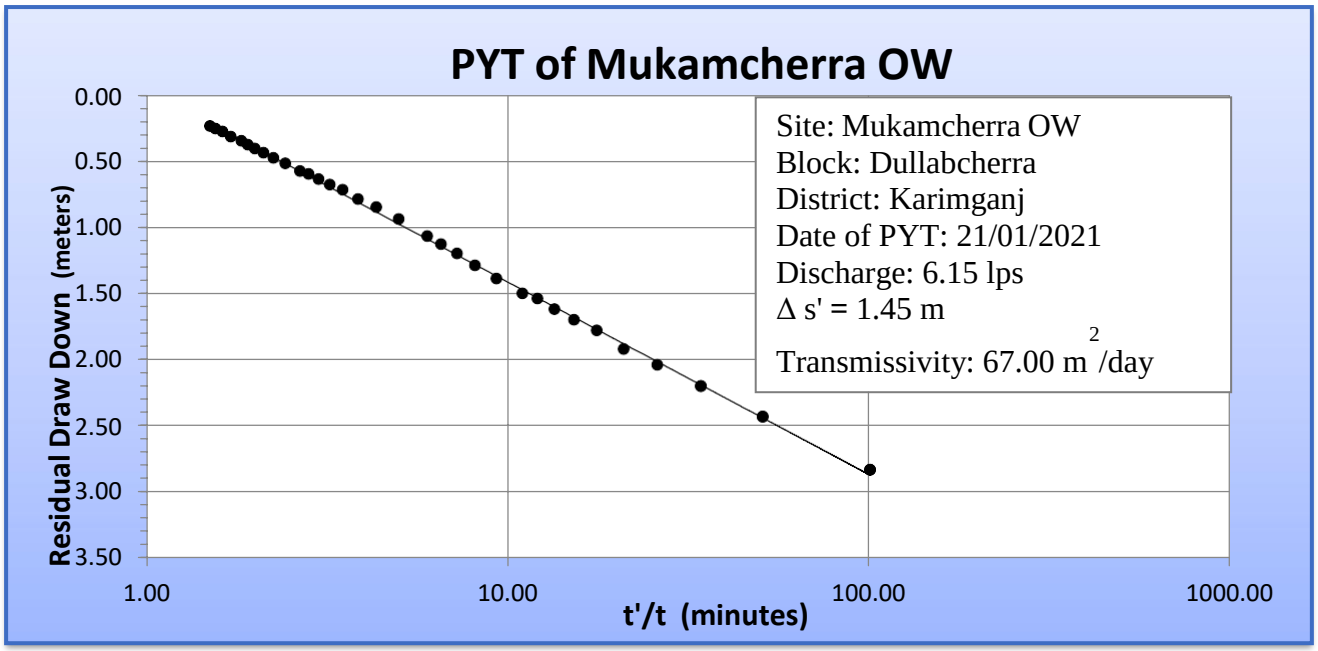
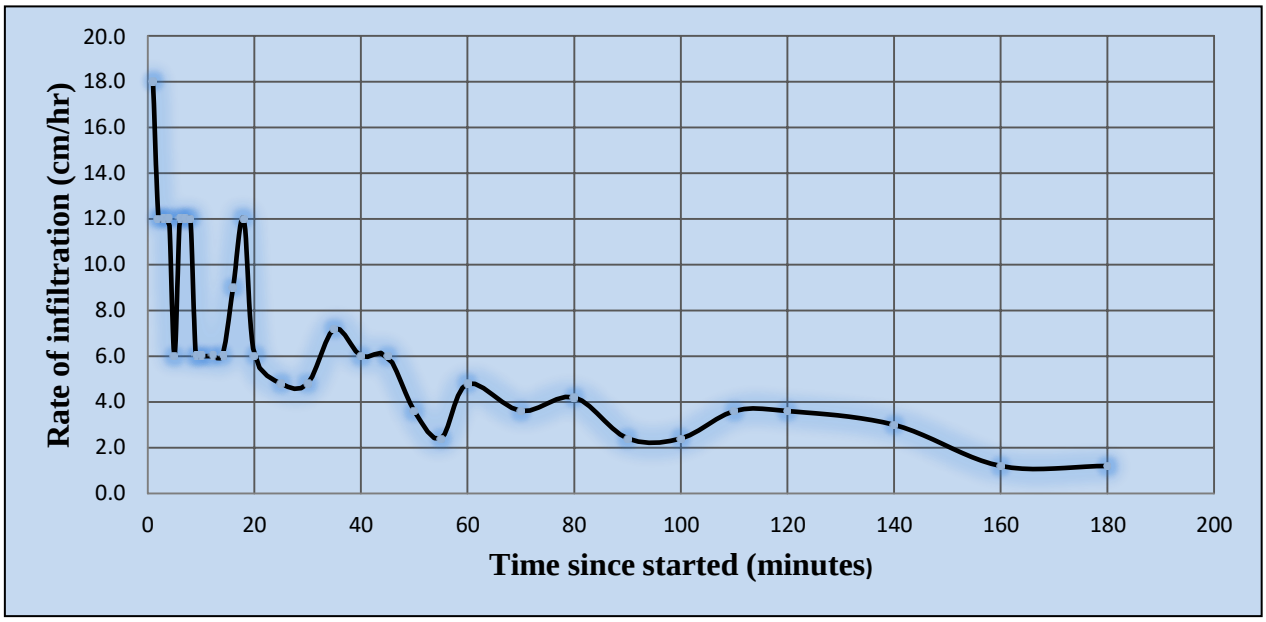

PYT of Mukamcherra OW
Residual Draw Down (meters)
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
1.00
10.00
100.00
1000.00
t'/t (minutes)
Site: Mukamcherra OW
Block: Dullabcherra
District: Karimganj
Date of PYT: 21/01/2021
Discharge: 6.15 lps
Δ s' = 1.45 m
Transmissivity: 67.00 m2/day

Table 2.1 – Soil Infiltration Test Report of Mukamcherra

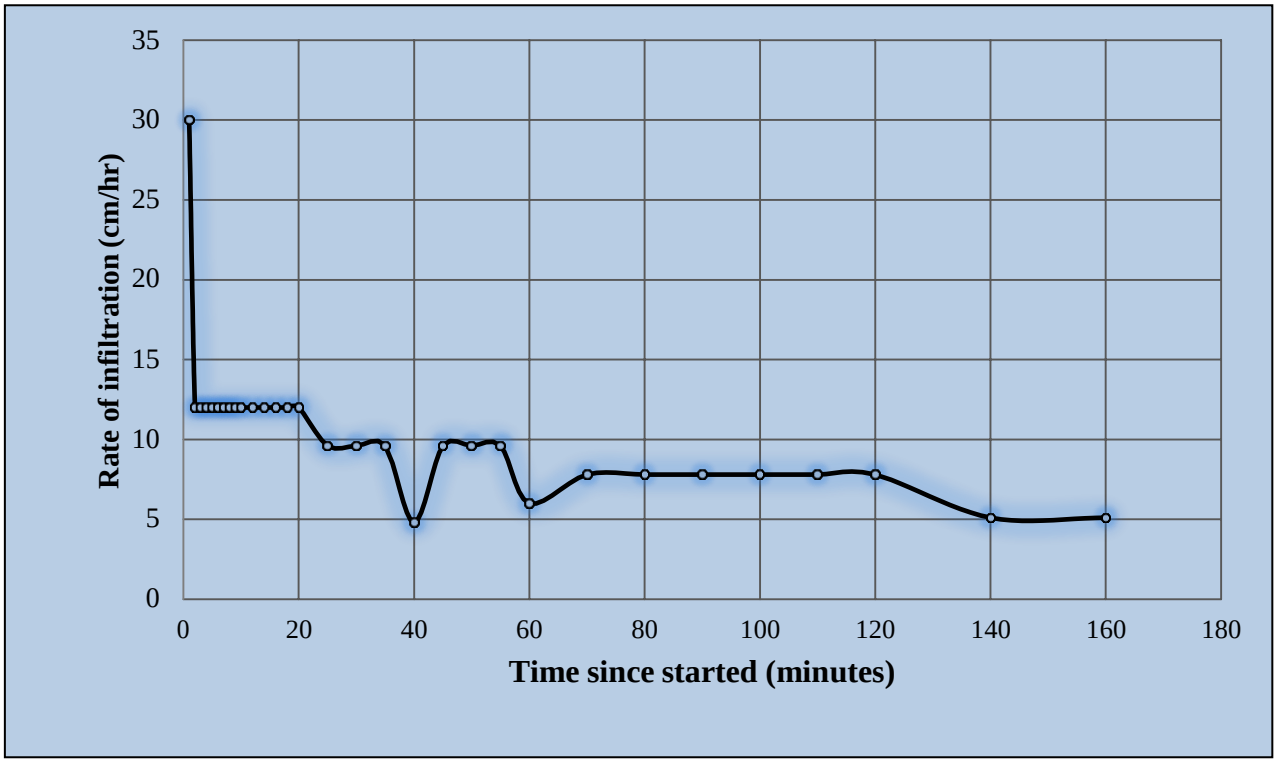
Location - Mukamcherra, Dullabcherra Block, Karimganj district								
Lat- 24.504122			**Long - 92.439378**					**RL- 7m**
Time (t)	**Time difference**	**After filling**	**Before filling**	**Depth of Infiltration**	**Cumm. Infiltration**	**Infiltration rate**	**f-fc**	**Remarks**
min	**min**	**cm**	**cm**	**cm**	**cm**	**cm/hr**	**f0**	
0		**21.5**		**0**	**0**	**f0 = 1.2 from the curve**	**ft**	
1	1	21.5	21.2	0.3	0.3	18.0	16.8	
2	1	21.2	21.0	0.2	0.5	12.0	10.8	
3	1	21.0	20.8	0.2	0.7	12.0	10.8	
4	1	20.8	20.6	0.2	0.9	12.0	10.8	
5	1	20.6	20.5	0.1	1.0	6.0	4.8	
6	1	20.5	20.3	0.2	1.2	12.0	10.8	
7	1	20.3	20.1	0.2	1.4	12.0	10.8	
8	1	20.1	19.9	0.2	1.6	12.0	10.8	
9	1	19.9	19.8	0.1	1.7	6.0	4.8	
10	1	19.8	19.7	0.1	1.8	6.0	4.8	
12	2	19.7	19.5	0.2	2.0	6.0	4.8	
14	2	19.5	19.3	0.2	2.2	6.0	4.8	
16	2	19.3	19.0	0.3	2.5	9.0	7.8	
18	2	19.0	18.6	0.4	2.9	12.0	10.8	
20	2	18.6	18.4	0.2	3.1	6.0	4.8	
25	5	18.4	18.0	0.4	3.5	4.8	3.6	
30	5	18.0	17.6	0.4	3.9	4.8	3.6	
35	5	17.6	17.0	0.6	4.5	7.2	6.0	
40	5	17.0	16.5	0.5	5.0	6.0	4.8	
45	5	16.5	16.0	0.5	5.5	6.0	4.8	
50	5	16.0	15.7	0.3	5.8	3.6	2.4	
55	5	15.7	15.5	0.2	6.0	2.4	1.2	
60	5	15.5	15.1	0.4	6.4	4.8	3.6	
70	10	15.1	14.5	0.6	7.0	3.6	2.4	
80	10	14.5	13.8	0.7	7.7	4.2	3.0	
90	10	13.8	13.4	0.4	8.1	2.4	1.2	
100	10	13.4	13.0	0.4	8.5	2.4	1.2	
110	10	13.0	12.4	0.6	9.1	3.6	2.4	
120	10	12.4	11.8	0.6	9.7	3.6	2.4	
140	20	11.8	10.8	1.0	10.7	3.0	1.8	
160	20	18.0	17.6	0.4	11.1	1.2	0.0	refilled
180	20	17.6	17.2	0.4	11.5	1.2	0.0	



Rainfall Recharge Factor	
Quantum of water applied in m	0.287
Quantum of water infiltrated in m	0.115
Sy (8 %)	0.08
Mukamcherra RRF	3.21 %

Table 2.2 – Soil Infiltration Test Report of Baruatilla.

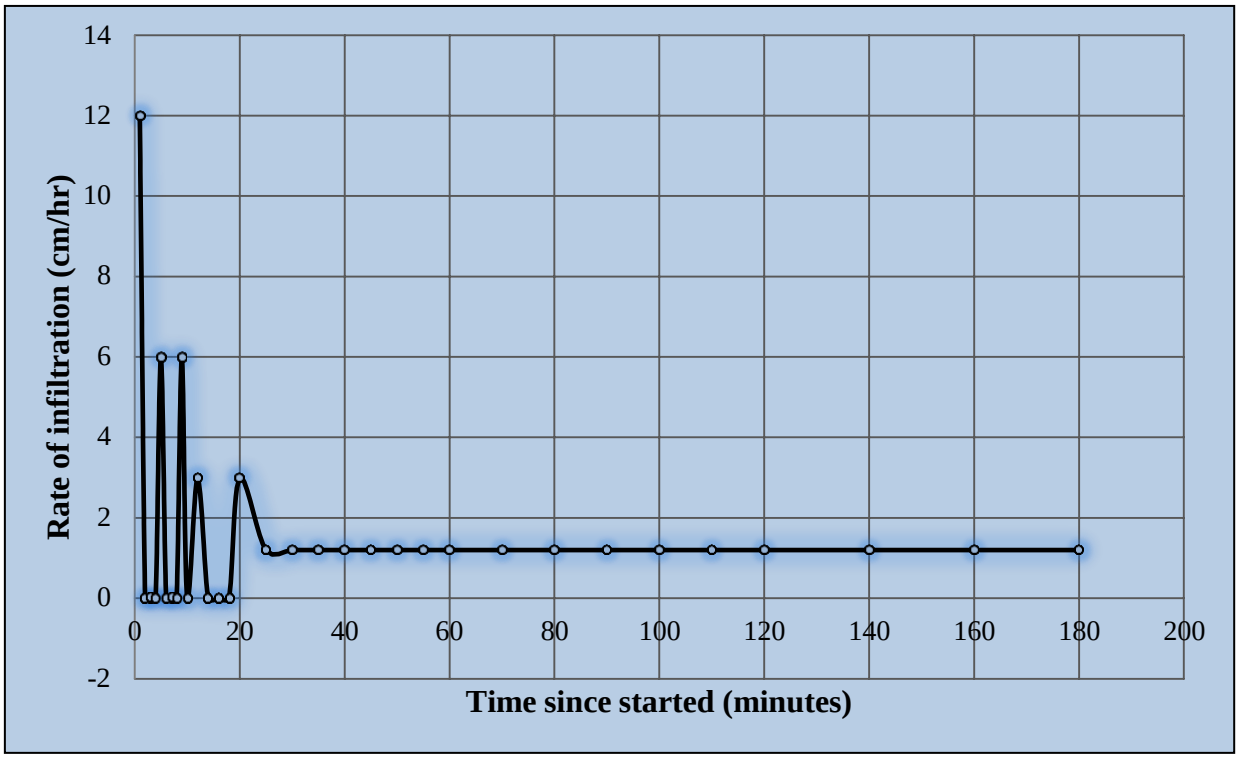
Location - Baruatilla, Dullabcherra Block, Karimganj district								
Lat- 24.3000				**Long - 92.4028**				**RL - 70**
Time (t)	**Time difference**	**After filling**	**Before filling**	**Depth of Infiltration**	**Cumm. Infiltration**	**Infiltration rate**	**f-fc**	**Remarks**
min	**min**	**cm**	**cm**	**cm**	**cm**	**cm/hr**	**f0**	
0	**0**	**24**		**0**	**0**	**f0 = 5.1 from the curve**	**ft**	
1	1	24	23.5	0.5	0.5	30	24.9	
2	1	23.5	23.3	0.2	0.7	12	6.9	
3	1	23.3	23.1	0.2	0.9	12	6.9	
4	1	23.1	22.9	0.2	1.1	12	6.9	
5	1	22.9	22.7	0.2	1.3	12	6.9	
6	1	22.7	22.5	0.2	1.5	12	6.9	
7	1	22.5	22.3	0.2	1.7	12	6.9	
8	1	22.3	22.1	0.2	1.9	12	6.9	
9	1	22.1	21.9	0.2	2.1	12	6.9	
10	1	21.9	21.7	0.2	2.3	12	6.9	
12	2	21.7	21.3	0.4	2.7	12	6.9	
14	2	21.3	20.9	0.4	3.1	12	6.9	
16	2	20.9	20.5	0.4	3.5	12	6.9	
18	2	20.5	20.1	0.4	3.9	12	6.9	
20	2	20.1	19.7	0.4	4.3	12	6.9	
25	5	19.7	18.9	0.8	5.1	9.6	4.5	
30	5	18.9	18.1	0.8	5.9	9.6	4.5	
35	5	18.1	17.3	0.8	6.7	9.6	4.5	
40	5	22.4	22	0.4	7.1	4.8	-0.3	Refilled
45	5	22	21.2	0.8	7.9	9.6	4.5	
50	5	21.2	20.4	0.8	8.7	9.6	4.5	
55	5	20.4	19.6	0.8	9.5	9.6	4.5	
60	5	19.3	18.8	0.5	10	6	0.9	
70	10	18.8	17.5	1.3	11.3	7.8	2.7	
80	10	17.5	16.2	1.3	12.6	7.8	2.7	
90	10	16.2	14.9	1.3	13.9	7.8	2.7	
100	10	14.9	13.6	1.3	15.2	7.8	2.7	
110	10	13.6	12.3	1.3	16.5	7.8	2.7	
120	10	12.3	11	1.3	17.8	7.8	2.7	
140	20	11	9.3	1.7	19.5	5.1	0	
160	20	9.3	7.6	1.7	21.2	5.1	0	



Rainfall Recharge Factor	
Quantum of water applied in m	0.291
Quantum of water infiltrated in m	1.36
Sy (8 %)	0.08
Baruatilla RRF	37.39 %

Table 2.3 – Soil Infiltration Test Report of Nayabari.

Location - Nayabari, North Karimganj Block, Karimganj district								
Lat- 24.87280				**Long - 92.34099**				**RL - 10**
Time (t)	**Time difference**	**After filling**	**Before filling**	**Depth of Infiltration**	**Cumm Infiltration**	**Infiltration rate**	**f-fc**	**Remarks**
min	**min**	**cm**	**cm**	**cm**	**cm**	**cm/hr**	**f0**	
0		**25**		**0**	**0**	**f0 = 1.2 from the curve**	**ft**	
1	1	25	24.8	0.2	0.2	12	0.6	
2	1	24.8	24.8	0	0.2	0	-11.4	
3	1	24.8	24.8	0	0.2	0	-11.4	
4	1	24.8	24.8	0	0.2	0	-11.4	
5	1	24.8	24.7	0.1	0.3	6	-5.4	
6	1	24.7	24.7	0	0.3	0	-11.4	
7	1	24.7	24.7	0	0.3	0	-11.4	
8	1	24.7	24.7	0	0.3	0	-11.4	
9	1	24.7	24.6	0.1	0.4	6	-5.4	
10	1	24.6	24.6	0	0.4	0	-11.4	
12	2	24.6	24.5	0.1	0.5	3	-8.4	
14	2	24.5	24.5	0	0.5	0	-11.4	
16	2	24.5	24.5	0	0.5	0	-11.4	
18	2	24.5	24.5	0	0.5	0	-11.4	
20	2	24.5	24.4	0.1	0.6	3	-8.4	
25	5	24.4	24.3	0.1	0.7	1.2	-10.2	
30	5	24.3	24.2	0.1	0.8	1.2	-10.2	
35	5	24.2	24.1	0.1	0.9	1.2	-10.2	
40	5	24.1	24	0.1	1	1.2	-10.2	
45	5	24	23.9	0.1	1.1	1.2	-10.2	
50	5	23.9	23.8	0.1	1.2	1.2	-10.2	
55	5	23.8	23.7	0.1	1.3	1.2	-10.2	
60	5	23.7	23.6	0.1	1.4	1.2	-10.2	
70	10	23.6	23.4	0.2	1.6	1.2	-10.2	
80	10	23.4	23.2	0.2	1.8	1.2	-10.2	
90	10	23.2	23	0.2	2	1.2	-10.2	
100	10	23	22.8	0.2	2.2	1.2	-10.2	
110	10	22.8	22.6	0.2	2.4	1.2	-10.2	
120	10	22.6	22.4	0.2	2.6	1.2	-10.2	
140	20	22.4	22	0.4	3	1.2	-10.2	
160	20	22	21.6	0.4	3.4	1.2	-10.2	
180	20	21.6	21.2	0.4	3.8	1.2	-10.2	



Rainfall Recharge Factor	
Quantum of water applied in m	0.25
Quantum of water infiltrated in m	0.038
Sy (8 %)	0.08
Nayabari RRF	1.25 %

Table 3.1 : Details of the granular zones delineated by electrical logging

EXPLORATORY WELL	GRANULAR ZONES IDENTIFED FROM ELECTRICAL LOGGING
ANIPUR EW	12.19-18.26, 28.04-33.53, 41.15-48.46, 50.29-54.25, 56.99-62.48, 67.05-77.72, 82.29-96.92, 102.10-106.68, 115.82-120.39, 130.06-136.55, 138.07-141.12, 146.91-152.40, 158.49-169.16, 177.39-182.80, 197.80-202.69, 206.35-212.75, 234.69-242.31, 262.12-265.17, 273.71-276.75
MAHAKALSH	18.29-28.95, 41.15-48.77, 71.63-76.81, 79.25-85.95, 87.78-93.57, 95.40-106.68, 123.44-131.06, 146.30-149.96, 150.57-160.02, 160.63-178.31, 182.88-192.02, 206.65-211.53, 211.83-216.91, 217.93-231.65, 237.74-248.41
NAIRGRAM EW	13.71-28.04, 31.01-36.57, 46.33-50.91, 52.43-57.92, 60.96-64.01, 67.06-88.39, 89.91-96.02, 108.20-111.25, 128.62-138.07, 144.78-158.50, 160.02-177.71, 179.24-184.93, 187.42-191.90, 214.82-217.92, 225.60-235.21, 238.31-242.22, 251.32-255.90, 261.13-263.62, 272.72-276.43, 277.30-286.50
CHANDPUR EW	77.70-90.80, 100.60-109.70, 115.80-123.40, 155.40-167.60, 184.40-197.50, 205.70-220.40, 225.50-232.60, 240.80-248.40, 257.60-265.20
FAKIRA BAZAAR EW	39.62-59.43, 60.96-74.67, 76.20-85.34, 88.39-104.24, 111.25-121.92, 125.57-135.63, 141.72-147.21, 149.35-153.92, 158.50-167.60, 179.80-191.90, 195.91-198.91, 201.76-213.30
LOHARPARA EW	23.77-38.71, 44.20-54.80, 56.39-60.0, 62.48-68.58, 71.63-73.76, 76.81-82.90, 89.01-102.71, 108.20-115.82, 124.97-127.40, 129.54-135.02, 160.02-165.61, 170.71-175.22, 207.20-225.60
HASIMGANJ EW	13.71-15.85, 16.76-19.19, 22.26-39.62, 42.67-49.38, 59.44-61.87, 74.06-83.51, 85.95-89.91, 90.52-92.96, 99.36-101.50, 103.63-109.12, 111.86-115.82, 128.62-131.05, 133.52-135.03, 137.77-141.72, 147.82-150.26, 158.56-166.12, 166.73-176.80, 211.82-216.04, 217.62-219.40, 268.20-277.30

Table 3.3: Aquifer Properties of Deeper Aquifer, Karimganj District

Location	Longitude	Latitude	Depth Drilled (mbgl)	Zones Encountered up to 50 m.b.g.l.	Zones Encountered up to 100 m.b.g.l.	Zones encountered up to 200 m.b.g.l.	Granular zones tapped (m)	Static Water level (mbgl)	Discharge (m^3/hr)	Draw Down (m)	T (m2/ day)
FAKIRA BAZAR EW	92.2950	24.8633	297.25		44-59, 62-74, 78-84, 90-96	114-120, 128-143, 142-148	57	1.19	58.29	15.3	102
NAIRGRAM EW	92.4100	24.8370	293.55	43-49	53-56, 67-82, 91-97		30	2.00	64.53	13.7	167
HASIMGANJ EW	92.3291	24.6316	294.30	41-49	51-55, 75-82, 86-92,	104-108, 112-116, 133-141	39	2.47	108.86	15.3	208
LOHARPARA EW	92.3716	24.7600	281.20	44-54	57-60, 63-67, 77-82, 90-102	109-114, 130-135, 160-165, 171-175	53	1.88	90.95	7.0	348
ANIPUR EW	92.4283	24.5466	287.60	42-48	57-62, 68-77, 84-96	103-106	35	0.12	78.47	11.6	246
MAHAKAL EW	92.4926	24.8094	200.00		98-100	110-110, 122-134, 161-167	30		12.26		
R.K. NAGAR EW	92.4543	24.5831	182.30								
MUKAMCHERA EW	92.4393	24.5041	142.10		51-60, 73-79, 94-100	117-126	30	0.45	78.77	10.6	60
MUKAMCHERA OW	92.4393	24.5040	67.32		51-60		9	0.7	22.13	4.6	67
BARUATILLA EW	92.4028	24.3000	114.00	Abandoned due to lack of granular zones							

Table 3.5 – Pre & Post Monsoon DTWL and fluctuation data of Key wells

BLOCK	AREA	LATITUDE	LONGITUDE	PRE MON DTWL (mbgl)	POST MON DTWL (mbgl)	FLUCTUATION (m)
Badarpur	Badarpur	24.87439	92.58333	2.7	0.9	1.8
	Chandrapur	24.77789	92.48478	2.9	1.8	1.1
	Mahakal	24.84510	92.49191	2.1	0.9	1.2
	Marjatkandi	24.81033	92.48056	2.4	1.3	1.1
	Srigouri	24.85853	92.52248	3.8	1.7	2.0
	West hassanpur	24.84563	92.50403	2.1	0.7	1.4
Dullabcherra	Birozapur	24.33888	92.39395	2.1	0.6	1.5
	Durlabchera	24.48192	92.43913	5.5	4.4	1.1
	Hem Kali Mandir	24.37349	92.39935	3.3	1.3	2.0
	Rangpur	24.30271	92.39774	5.7	2.0	3.7
	Sarkaribari	24.56525	92.41242	1.6	1.2	0.5
	Wangirbond	24.41271	92.41832	4.8	2.8	2.0
Lowaipowa	Adamtilla	24.60665	92.27783	0.8	0.5	0.3
	Bagaon	24.46431	92.23594	1.6	1.0	0.6
	Charaibari	24.44193	92.25346	4.4	2.7	1.7
	Dengarbond	24.54066	92.32253	1.6	1.3	0.3
	Hathikira	24.47789	92.31828	1.7	1.6	0.1
	Hatyarbond	24.34034	92.29892	2.6	1.5	1.1
	Isabhil TE	24.41758	92.30758	3.5	0.6	3.0
	Kacharigaon	24.49381	92.24026	4.2	4.0	0.2
	Kotamani	24.37114	92.30315	1.0	0.4	0.5
	Kukitol	24.52083	92.24734	3.3	2.1	1.2
	Longai TE	24.57103	92.28493	1.3	0.8	0.5
	Piplagool	24.54717	92.26362	3.1	2.5	0.6
	Rangamati	24.28054	92.29144	3.4	1.4	2.1
	Sashan Kali Mandir	24.55858	92.29173	1.3	0.8	0.5
North Karimganj	Akbarpur	24.85853	92.32248	6.2	2.2	4.0
	Mahisashan	24.82693	92.29034	3.3	2.8	0.5
	Nawagram	24.78531	92.29932	2.8	1.0	1.8
	Sadarasi	24.89200	92.31667	1.5	1.0	0.5
	Tangabari	24.75425	92.31849	3.3	1.3	2.1
Patharkandi	Bazarghat	24.60148	92.39429	2.2	1.3	0.9
	Dhaulia	24.62406	92.36228	0.4	0.1	0.3
	Lakhipur	24.64648	92.27069	0.2	0.0	0.2
	Patharkandi	24.59450	92.32078	1.6	0.9	0.6
	Sunatula	24.67153	92.2901	1.4	1.0	0.4
R.K. Nagar	Chandkhani	24.59413	92.46840	3.3	2.2	1.1
	Debodargaon	24.70249	92.45643	5.1	3.5	1.6
	Kalingar	24.58417	92.48375	2.3	1.7	0.7
	Netajinagar	24.62979	92.48003	4.4	3.0	1.3
	R.k nagar	24.57000	92.46000	4.0	2.9	1.1
	Samridhipur	24.66965	92.45904	3.6	1.4	2.2
	Taturgul	24.71344	92.49510	5.0	2.2	2.8
South Karimganj	Adarkona	24.74891	92.51410	3.0	1.6	1.4
	Bazarghat	24.83317	92.34525	4.7	3.7	1.0
	Karimganj	24.86519	92.36375	1.5	0.5	1.0
	Kayasthagram	24.72069	92.34611	1.4	0.8	0.7
	Nathupur	24.82603	92.41173	3.6	1.6	2.0
	Nilambazar	24.71308	92.39506	1.3	1.2	0.1
	Sarisa	24.85461	92.37958	0.7	0.5	0.2

Table No. 4.1 – Chemical data of GWMS of Karimganj District (Pre-Monsoon)

Location	Latitude	Longitude	Source	Temp °C	pH	EC (µs/cm) 25^0 C	TDS	CO_3^{-2}	HCO_3^-	TA (as $CaCO_3$)	Cl^-	SO_4^{-2}	NO_3^-	F^-	Ca^{+2}	Mg^{+2}	TH (as $CaCO_3$)	Na	K	Fe	As (in ppb)
							In mg/lit														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Abdullahpur	24.7449	92.3433	Handpump	27.3	6.5	108.4	61.3	0.0	36.6	36.6	14.2	51.2	1.2	0.2	10.0	3.6	40.0	13.9	20.2	8.0	ND
Adamtilla	24.6067	92.2778	Dug Well	20.1	6.7	43.4	23.6	0.0	36.6	36.6	14.2	7.8	0.1	0.2	8.0	4.9	40.0	7.8	1.9	0.3	ND
Adarkona	24.7489	92.5141	Dug well	25.5	7.9	420.1	217.4	0.0	207.6	207.6	255.2	7.3	0.5	0.4	50.0	34.0	265.0	85.9	28.2	0.5	0.0
Akbarpur	24.8621	92.3179	Hand pump	25.1	8.4	220.6	112.6	9.0	225.9	234.9	95.7	4.7	0.6	0.5	36.0	10.9	135.0	65.7	22.0	4.1	12.1
Akbarpur	24.8621	92.3179	Dug well	24.8	8.2	334.0	176.6	18.0	207.6	225.6	95.7	20.7	1.1	0.3	54.0	15.8	200.0	50.0	8.6	3.2	0.8
Akbarpur	24.7564	92.3631	Tube Well	23.3	8.6	244.8	128.7	9.0	164.8	173.8	39.0	17.6	2.9	0.4	22.0	43.7	235.0	5.1	2.1	0.8	ND
Anipur	24.5478	92.4280	Hand pump	25.4	8.1	88.3	46.9	0.0	79.4	79.4	14.2	13.0	0.0	0.2	10.0	8.5	60.0	7.6	5.7	17.1	ND
Anipur	24.5478	92.4280	Hand pump	27.2	7.1	95.5	49.8	0.0	109.9	109.9	81.5	1.5	0.0	0.2	22.0	8.5	90.0	37.2	10.0	3.9	0.0
Asiura	24.9126	92.2904	Tarapump	26.3	8.4	426.9	222.6	6.0	317.5	323.5	78.0	15.8	0.2	0.8	32.0	81.3	415.0	9.8	2.8	0.7	0.6
Badarpur	24.8744	92.5833	Dug well	25.8	7.0	289.3	147.4	0.0	48.8	48.8	198.5	11.6	2.0	0.2	30.0	3.6	90.0	77.1	34.8	0.2	1.4
Bahadurpur	24.6702	92.3175	Tarapump	26.9	8.0	200.3	101.5	0.0	146.5	146.5	99.3	3.1	0.2	0.7	20.0	15.8	115.0	47.4	11.8	4.3	5.3
Balidighi	24.7260	92.3506	Hand pump	23.8	8.1	166.3	88.4	0.0	195.4	195.4	10.6	3.4	0.7	0.3	14.0	14.6	95.0	22.9	2.9	28.3	6.0
Baruala	24.5902	92.4378	Tara pump	25.5	7.9	199.6	105.2	0.0	116.0	116.0	17.7	3.7	1.3	0.3	20.0	7.3	80.0	18.1	1.5	63.2	10.5
Basail	24.8228	92.4799	Hand pump	25.0	7.8	158.7	87.9	0.0	134.3	134.3	14.2	8.4	0.3	0.7	30.0	2.4	85.0	21.7	3.1	0.2	ND
Basattihal	24.5641	92.4321	Tara pump	24.5	8.2	114.3	61.6	6.0	109.9	115.9	14.2	3.1	0.1	0.3	14.0	8.5	70.0	8.2	3.1	13.3	ND
Bataiya	24.7089	92.3474	Hand pump	25.9	8.3	525.7	269.4	48.0	305.2	353.2	74.4	2.3	0.8	0.4	74.1	24.2	285.0	39.7	22.2	2.2	7.2
Bhanga Bazar	24.8612	92.4782	Tube Well	24.7	7.7	271.8	148.1	0.0	201.5	201.5	95.7	41.9	2.6	1.1	114.1	16.9	355.0	4.8	4.7	6.9	15.7
Bhatgram	24.8455	92.3852	Hand pump	22.6	8.4	278.6	156.8	9.0	189.3	198.3	17.7	6.5	4.9	0.3	12.0	12.6	82.0	31.6	8.4	81.6	24.7
Brahmansashan	24.7787	92.3234	Tarapump	27.6	8.3	227.7	117.3	21.0	183.1	204.1	60.3	2.2	0.0	0.7	22.0	10.9	100.0	56.8	20.7	0.2	0.4
Brajendra nagar	24.8153	92.3735	Tarapump	25.3	7.4	183.5	93.6	0.0	146.5	146.5	60.3	28.4	1.7	0.5	32.0	3.6	95.0	44.2	13.0	4.1	24.6
Brajendranagar	24.8127	92.3741	Tarapump	26.4	7.6	267.2	139.0	0.0	195.4	195.4	78.0	1.4	0.2	0.2	20.0	8.5	85.0	59.0	23.4	4.0	17.9
Chandrapur	24.7779	92.4848	Dug well	25.7	7.7	152.1	77.8	0.0	476.2	476.2	109.9	4.6	0.8	0.1	26.0	7.3	95.0	4.0	2.5	0.2	0.0
Charakuri	24.8612	92.3779	Hand pump	23.0	8.3	136.7	76.9	3.0	134.3	137.3	14.2	4.4	0.4	0.4	10.0	3.2	38.0	24.4	3.1	6.0	ND
Chorgula	24.5401	92.4075	Hand pump	26.9	8.2	149.2	79.6	0.0	134.3	134.3	17.7	4.6	0.7	0.3	10.0	15.8	90.0	18.8	4.1	0.9	ND

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Debodargaon	24.7025	92.4564	Dug well	25.8	8.4	236.2	121.1	9.0	158.7	167.7	117.0	10.2	0.5	0.3	38.0	25.5	200.0	31.7	17.9	0.8	0.0
Dengarbond	24.5407	92.3225	Dug well	24.4	7.9	247.2	129.1	0.0	140.4	140.4	106.4	16.4	0.3	0.7	34.0	21.8	175.0	31.7	9.3	1.4	0.1
Dhaulia	24.6241	92.3623	Dug well	25.2	8.1	186.7	96.4	0.0	134.3	134.3	78.0	7.3	0.2	0.4	26.0	20.6	150.0	24.1	8.0	0.9	1.1
Dolgram	24.7406	92.3124	Tube Well	25.0	7.3	116.3	65.1	0.0	116.0	116.0	17.7	9.4	0.0	0.3	8.0	6.1	45.0	29.9	2.8	8.3	ND
Duliakhal	24.7628	92.3228	Tara pump	25.8	8.3	217.7	121.7	15.0	158.7	173.7	14.2	8.1	0.2	1.1	14.0	12.1	85.0	39.2	13.0	3.7	ND
Dullabchera	24.4934	92.4336	Hand pump	27.2	7.3	95.1	48.6	0.0	122.1	122.1	81.5	4.5	0.0	0.2	30.0	2.4	85.0	43.5	12.4	2.9	0.6
Farampasha	24.7309	92.3628	Tara pump	24.7	8.1	189.1	99.9	0.0	128.2	128.2	35.4	3.5	3.8	0.3	18.0	21.8	135.0	15.4	3.0	54.2	8.9
Farampasha	24.7417	92.3506	Hand pump	26.5	7.8	132.4	67.7	0.0	109.9	109.9	70.9	2.7	0.8	0.4	32.0	8.5	115.0	23.8	2.6	3.9	2.2
Girishganj	24.7914	92.3751	Hand pump	23.7	7.6	117.0	99.5	0.0	109.9	109.9	117.0	3.4	0.1	0.3	34.0	26.7	195.0	13.9	2.6	4.3	1.6
Girishganj Market	24.7914	92.3751	Hand pump	25.3	7.7	114.4	58.6	0.0	146.5	146.5	131.2	7.7	0.1	0.3	30.0	13.3	130.0	62.3	18.7	0.7	1.6
Hathikira	24.4779	92.3183	Dug well	26.2	7.8	412.1	218.7	0.0	134.3	134.3	223.3	13.6	1.3	0.3	28.0	34.0	210.0	67.9	32.3	0.6	1.9
Hatyarbond	24.3403	92.2989	Dug well	25.6	8.4	345.8	181.0	9.0	286.9	295.9	117.0	7.9	0.9	0.6	58.0	25.5	250.0	57.1	18.5	0.6	0.0
Isabeel	24.4176	92.3076	Dug well	25.2	7.7	420.0	220.6	0.0	189.3	189.3	219.8	3.3	0.7	0.4	40.0	25.5	205.0	79.0	32.5	4.1	33.2
Isabeel TE	24.4154	92.3073	Hand pump	24.2	7.2	160.9	87.4	0.0	140.4	140.4	21.3	13.7	3.3	0.4	16.0	8.5	75.0	9.7	5.5	42.2	3.6
Isabeel TE	24.4176	92.3076	Dug Well	22.4	8.3	384.0	209.6	9.0	183.1	192.1	39.0	80.1	1.3	0.4	42.0	7.3	135.0	54.1	22.5	1.4	0.1
Ishwashree	24.7463	92.3643	Tara pump	25.0	8.2	158.8	83.1	0.0	122.1	122.1	67.4	20.1	7.4	0.3	10.0	20.6	110.0	3.2	2.9	33.2	ND
Jayforpur	24.8503	92.5208	Tara pump	23.8	7.4	101.7	57.8	0.0	79.4	79.4	14.2	4.8	0.1	0.4	8.0	6.1	45.0	16.1	3.5	14.6	ND
Kalinagar	24.5842	92.4838	Dug well	25.4	8.3	311.9	163.0	27.0	201.5	228.5	78.0	1.1	0.4	0.7	40.0	14.5	160.0	45.7	24.2	1.9	0.4
Kalinagar	24.5898	92.4604	Hand pump	24.6	6.9	151.6	80.8	0.0	42.7	42.7	42.5	6.8	5.3	0.2	8.0	10.9	65.0	14.1	12.6	0.7	ND
Kalitilla	24.5582	92.4573	Tube Well	25.5	7.4	31.4	16.7	0.0	48.8	48.8	10.6	3.8	0.4	0.1	12.0	1.2	35.0	9.4	2.5	0.2	ND
Kanakpur	24.7565	92.3565	Tube Well	23.2	7.8	209.2	109.7	0.0	116.0	116.0	42.5	19.4	8.2	0.2	10.0	20.6	110.0	2.6	3.5	69.9	4.7
Karimganj	24.8652	92.3638	Dug well	23.0	8.2	574.1	297.0	15.0	274.7	289.7	326.1	2.1	1.9	0.5	70.1	139.5	750.0	15.3	1.8	3.1	5.6
Katakhal	24.8440	92.3443	Hand pump	25.6	7.2	74.5	43.2	0.0	91.6	91.6	46.1	25.7	13.6	0.3	10.0	2.4	35.0	5.6	2.6	2.1	ND
Kayasthagram	24.7207	92.3461	Bore well	26.3	7.7	275.4	145.2	0.0	189.3	189.3	81.5	1.3	0.7	0.5	26.0	34.0	205.0	20.8	2.6	4.3	30.9
Kayasthagram	24.7207	92.3461	Dug well	24.2	8.3	378.8	200.0	12.0	219.8	231.8	127.6	15.2	1.0	0.5	64.1	20.6	245.0	42.4	17.6	0.7	0.8
Kayasthgram	24.7165	92.3456	Hand pump	23.7	7.2	184.6	184.6	0.0	213.7	213.7	24.8	5.1	2.5	0.4	14.0	6.1	60.0	45.5	21.8	44.9	ND
Kayasthgram	24.7250	92.3447	Tube Well	25.6	7.2	85.9	48.4	0.0	79.4	79.4	14.2	5.9	0.0	0.3	10.0	4.8	45.0	11.5	5.1	2.5	ND
Kayasthgram	24.7207	92.3461	Dug Well	23.3	8.3	332.5	332.5	15.0	262.5	277.5	35.4	21.0	0.0	0.4	54.0	9.7	175.0	42.2	10.3	0.4	ND

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Kotamani	24.3711	92.3032	Dug well	25.7	8.3	397.9	208.9	15.0	238.1	253.1	88.6	21.1	0.6	0.6	66.1	30.3	290.0	20.1	2.0	0.5	0.0
Kurikala	24.6181	92.4566	Tube Well	24.1	8.2	92.3	49.8	0.0	91.6	91.6	14.2	3.8	0.2	0.2	12.0	7.3	60.0	12.9	3.1	7.8	ND
Lamajuar	24.8484	92.4269	Tara pump	23.1	8.0	126.4	68.1	0.0	73.3	73.3	14.2	14.4	1.0	0.2	12.0	9.7	70.0	9.3	2.7	2.1	ND
Loharpara	24.7499	92.3624	Bore well	25.2	7.6	193.9	102.2	0.0	146.5	146.5	53.2	1.7	0.3	0.4	22.0	14.6	115.0	32.9	2.5	4.2	11.2
Longai(RS)	24.8540	92.3442	Tarapump	27.9	7.9	234.2	123.3	0.0	177.0	177.0	134.7	4.8	0.2	0.4	26.0	19.4	145.0	65.1	21.2	0.3	0.0
Mahakal	24.8451	92.4919	Hand pump	24.5	7.4	110.0	55.9	0.0	140.4	140.4	99.3	2.5	0.3	0.2	28.0	18.2	145.0	35.3	11.6	2.3	0.0
Mahakal	24.8451	92.4919	Dug well	25.4	8.3	455.5	235.7	24.0	286.9	310.9	113.4	3.6	1.0	0.9	54.0	29.1	255.0	55.2	19.5	0.9	16.2
Mahakal Pt-1	24.8434	92.4917	Hand pump	25.0	7.0	136.8	70.3	0.0	67.2	67.2	24.8	18.9	5.5	0.3	12.0	3.6	45.0	12.8	2.7	28.0	ND
Mahakal Pt-1	24.8451	92.4919	Dug Well	25.6	7.7	409.3	226.1	0.0	335.8	335.8	17.7	4.5	3.6	0.7	30.0	31.5	205.0	33.6	3.3	0.8	11.1
Mahakal Pt-7	24.7949	92.4839	Hand pump	25.0	6.8	15.8	9.2	0.0	36.6	36.6	17.7	4.4	0.2	0.2	10.0	2.4	35.0	7.9	1.3	4.0	ND
Malakarpara	24.8490	92.5059	Tube Well	22.9	7.0	79.7	45.0	0.0	73.3	73.3	14.2	4.5	0.1	0.2	4.0	8.5	45.0	13.7	2.9	28.0	ND
Marjatkandi	24.8103	92.4806	Dug well	25.1	8.4	533.0	275.5	33.0	299.1	332.1	265.9	2.1	0.5	0.4	48.0	83.7	465.0	58.9	18.1	0.7	0.0
Moina	24.6562	92.3305	Hand pump	22.7	8.4	172.7	91.8	6.0	140.4	146.4	17.7	3.4	1.2	0.6	14.0	14.6	95.0	10.9	1.8	13.3	23.1
Mukamcherra	24.5041	92.4395	OW	22.4	7.2	59.6	32.1	0.0	61.0	61.0	10.6	75.6	3.7	0.3	34.0	1.2	90.0	14.9	4.1	19.1	ND
Mukamcherra	24.5041	92.4395	EW	22.6	7.1	41.8	23.8	0.0	42.7	42.7	10.6	35.8	1.5	0.2	8.0	7.3	50.0	13.2	2.2	1.9	0.0
Mukamcherra	24.5041	92.4395	Tara pump	25.4	6.2	145.7	79.8	0.0	42.7	42.7	39.0	3.7	5.4	0.1	10.0	4.8	45.0	18.1	7.1	0.3	ND
Murliband	24.4229	92.4275	Hand pump	28.0	8.3	208.1	107.0	24.0	219.8	243.8	81.5	13.8	0.3	0.3	20.0	15.8	115.0	23.9	1.7	2.7	0.9
Nakshatra	24.8643	92.3700	Tube Well	23.2	8.5	236.2	127.2	9.0	164.8	173.8	17.7	6.4	2.1	1.2	10.0	10.9	70.0	25.7	15.3	1.0	ND
Nayabari	24.8711	92.3428	Hand pump	26.5	7.2	233.3	119.1	0.0	116.0	116.0	102.8	4.5	0.1	0.2	20.0	24.3	150.0	42.9	4.7	0.4	0.8
Nayagram	24.7293	92.3761	Tube Well	24.2	8.2	116.7	60.9	0.0	91.6	91.6	67.4	15.9	9.1	0.3	12.0	26.7	140.0	3.8	2.7	11.8	ND
Nayagram	24.7393	92.3465	Tarapump	27.7	8.0	200.2	103.1	0.0	170.9	170.9	63.8	9.6	1.2	0.5	36.0	31.5	220.0	15.9	4.0	1.9	1.6
Nilambazar	24.7428	92.3496	Tube Well	24.2	8.4	134.8	71.9	3.0	97.7	100.7	14.2	2.9	2.0	0.3	18.0	6.1	70.0	5.0	8.9	1.6	3.5
Nilambazar	24.7131	92.3951	Dug well	26.0	8.5	306.5	157.8	12.0	244.2	256.2	106.4	0.0	1.6	0.5	30.0	30.3	200.0	51.9	19.0	0.7	1.7
N.Farampasa I	24.7348	92.3642	Hand pump	27.2	7.2	240.1	124.7	0.0	207.6	207.6	78.0	1.6	0.9	0.2	20.0	18.2	125.0	47.9	12.9	6.3	13.3
N.Farampasa II	24.7347	92.3634	Hand pump	27.6	6.8	159.0	82.9	0.0	152.6	152.6	92.2	2.3	0.0	0.2	82.1	2.4	215.0	16.9	2.6	7.4	0.7
N. Farampasa III	24.7371	92.3640	Tarapump	25.4	7.4	254.3	131.5	0.0	183.1	183.1	113.4	2.3	0.2	0.3	26.0	31.5	195.0	32.8	8.7	5.1	11.9
N. Farampasa IV	24.7371	92.3640	Tarapump	26.0	7.4	258.5	133.8	0.0	201.5	201.5	81.5	0.9	0.3	0.2	34.0	21.8	175.0	31.4	2.5	5.6	12.1
N.Hasanpur	24.8554	92.5160	Tube Well	20.5	7.5	135.7	75.1	0.0	91.6	91.6	17.7	5.5	1.4	0.5	10.0	3.6	40.0	29.1	4.6	0.2	ND

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
N. Kandigram	24.8651	92.4965	Hand pump	25.0	6.3	84.6	48.8	0.0	36.6	36.6	39.0	16.4	2.3	0.5	8.0	4.9	40.0	23.8	4.0	5.0	0.1
Patharkandi	24.5971	92.3207	Hand pump	24.0	8.1	223.5	120.0	0.0	164.8	164.8	39.0	14.7	10.7	0.6	18.0	18.2	120.0	5.6	2.7	55.3	35.6
Patharkandi	24.5945	92.3208	Dug well	24.6	7.8	380.8	198.2	0.0	213.7	213.7	99.3	14.3	0.4	0.5	44.0	46.1	300.0	10.7	6.6	0.8	2.1
Patharkandi	24.5971	92.3207	Dug Well	23.3	8.3	322.5	173.9	12.0	238.1	250.1	17.7	4.8	1.7	0.6	48.0	14.5	180.0	18.9	8.4	0.4	ND
Pipagool	24.5465	92.2635	Tube Well	20.3	8.3	158.7	77.0	3.0	103.8	106.8	14.2	28.1	0.6	0.4	12.0	7.3	60.0	29.6	5.2	7.1	ND
Pipagool	24.5472	92.2636	Dug Well	22.1	7.3	331.5	181.7	0.0	140.4	140.4	56.7	41.1	0.6	0.3	22.0	15.8	120.0	35.7	14.9	2.7	ND
R.K nagar	24.5666	92.4611	Bore well	25.8	7.0	56.4	29.3	0.0	97.7	97.7	81.5	6.6	0.0	0.1	28.0	9.7	110.0	27.8	11.7	2.5	0.0
R.K nagar	24.5666	92.4611	Dug well	26.5	7.8	145.7	75.3	0.0	122.1	122.1	109.9	1.4	0.5	0.2	30.0	12.1	125.0	39.4	18.4	0.7	0.0
R.K.Nagar	24.5751	92.4639	Tara pump	26.7	6.8	144.2	77.6	0.0	67.2	67.2	46.1	3.8	3.7	0.1	14.0	6.1	60.0	18.0	4.1	0.4	ND
Rangamati	24.2805	92.2914	Dug well	25.8	8.2	425.1	223.0	21.0	274.7	295.7	184.3	5.7	1.4	0.4	54.0	23.0	230.0	19.6	4.4	2.1	0.4
Ranibari	24.7900	92.3299	Tarapump	25.9	7.8	126.4	66.2	0.0	103.8	103.8	102.8	6.2	0.0	0.3	20.0	9.7	90.0	47.4	17.0	0.6	0.0
Ranikhamar	25.8552	91.3835	OW	28.4	8.1	205.2	117.3	0.0	170.9	170.9	17.7	6.4	0.2	0.6	18.0	14.6	105.0	20.6	14.5	1.8	ND
Rasulpur	24.8607	92.4846	Tara pump	26.0	7.0	142.6	79.1	0.0	152.6	152.6	21.3	5.2	4.1	0.5	8.0	4.9	40.0	37.0	11.7	9.5	ND
Ratabari	24.5605	92.4130	Hand pump	25.9	7.3	98.1	52.7	0.0	36.6	36.6	28.4	9.8	0.9	0.2	6.0	12.1	65.0	7.9	9.8	4.0	ND
Ratabari	24.5604	92.4130	Hand pump	26.6	7.2	107.8	55.1	0.0	152.6	152.6	109.9	4.0	0.9	0.1	26.0	1.2	70.0	77.2	16.9	0.8	0.0
Sadarasi	24.8951	92.3134	Tarapump	25.2	7.8	172.1	89.9	0.0	152.6	152.6	60.3	6.6	0.7	0.4	16.0	15.8	105.0	39.3	1.8	3.1	5.3
Sarisa	24.8546	92.3796	Hand pump	26.8	8.3	229.1	116.9	6.0	134.3	140.3	74.4	3.5	0.7	0.4	8.0	19.4	100.0	36.5	20.8	3.4	7.3
Sarkaribari	24.5653	92.4100	Hand pump	25.2	7.7	133.0	67.6	0.0	335.8	335.8	53.2	0.4	0.0	0.2	20.0	9.7	90.0	86.9	27.3	3.5	0.5
Sarkaribari	24.5653	92.4100	Dug well	25.2	8.2	336.1	173.5	15.0	219.8	234.8	81.5	1.8	0.2	0.4	56.0	13.3	195.0	32.4	18.7	3.2	0.4
South Hasanpur	24.8519	92.5172	Hand pump	24.2	8.3	189.4	104.6	12.0	152.6	164.6	17.7	6.0	0.7	0.9	8.0	13.3	75.0	39.3	3.3	1.4	ND
Srigouri	24.8585	92.5225	Dug Well	21.3	8.7	450.2	241.5	9.0	262.5	271.5	31.9	18.3	4.6	0.6	36.0	37.6	245.0	33.6	8.1	6.6	0.3
Srigouri	24.8585	92.5225	Dug well	24.9	8.3	485.1	251.2	18.0	293.0	311.0	102.8	2.3	1.5	0.7	42.0	25.5	210.0	56.7	31.5	4.1	14.4
Srikishna nagar	24.7579	92.3690	Hand pump	25.8	7.7	228.2	116.8	0.0	164.8	164.8	113.4	0.9	0.3	0.3	24.0	35.2	205.0	28.9	2.4	2.3	19.0
Sukur bazar	24.6688	92.3071	Hand pump	27.5	7.8	133.7	68.1	0.0	152.6	152.6	102.8	0.2	0.0	0.4	26.0	2.4	75.0	64.3	22.8	1.3	0.9
Sutarkandi	24.8730	92.2554	Hand pump	26.4	7.9	330.7	173.9	0.0	250.3	250.3	95.7	2.4	1.9	0.6	20.0	25.5	155.0	59.0	18.0	4.3	17.2
Takipur	24.7292	92.3579	Tube Well	27.2	7.9	150.6	79.6	0.0	109.9	109.9	42.5	22.9	10.7	0.3	18.0	10.9	90.0	5.4	2.1	16.6	0.7
Tangabari	24.7543	92.3185	Tarapump	28.1	7.4	250.1	132.8	0.0	201.5	201.5	99.3	4.0	1.7	0.9	26.0	21.8	155.0	50.0	12.4	4.3	48.7
Umarpur	24.8578	92.5395	Tube Well	25.9	8.6	418.4	223.8	3.0	280.8	283.8	17.7	5.4	2.6	0.8	18.0	21.8	135.0	58.9	3.3	24.7	41.9

Table 4.2: Chemical data of GWMS in Karimganj District (Post monsoon)

Location	Lat	Long	Source	Tempº C	pH	EC (µs/cm) 25 ^{0}C	Turbidity (NTU)	TDS	CO_3^{-2}	HCO_3^{-1}	TA (as $CaCO_3$)	Cl^-	SO_4^{-2}	NO_3^{-1}	F^-	Ca^{+2}	Mg^{+2}	TH (as $CaCO_3$)	Na	K	Fe	As (µg/L)
								In mg/lit														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Badarpur	24.87	92.58	Dug well	26.3	7.96	266.90	0.10	158.4	0	12.21	12.21	31.91	59.40	3.73	0.15	24.02	6.06	85	13.19	9.16	1.00	3.12
Karimganj	24.87	92.36	Dug well	27.8	8.07	199.60	0.00	117.8	0	152.62	152.62	10.64	8.66	1.56	0.26	42.03	6.05	130	6.02	0.90	3.42	4.66
Sadarasi	24.89	92.32	Dug well	25	8.10	266.70	0.00	157.9	0	158.73	158.73	21.27	23.65	1.47	0.26	34.03	13.33	140	16.63	3.87	1.57	6.00
Sadarasi	24.89	92.33	Tube well	25.3	6.9	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1.05	4.40
Nilambazar (Rupargul) near madrasa	24.71	92.40	Dug well	32	8.12	177.20	0.00	104.4	0	128.20	128.20	7.09	20.78	0.63	0.28	20.02	8.49	85	20.77	10.87	3.61	4.66
Nilambazar (Gunomoi Girls HS)	24.74	92.35	Tube well	27.5	6.6	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	6.83	8.50
Kayasthagram	24.72	92.35	Dug well	28.3	8.19	271.60	0.00	160.4	0	274.72	274.72	17.73	14.13	2.23	0.26	68.05	12.10	220	12.40	9.54	3.56	6.27
Dhaulia	24.62	92.36	Dug well	27.5	8.10	111.50	0.10	65.83	0	54.94	54.94	14.18	20.17	4.23	0.17	14.01	10.92	80	5.27	2.23	2.24	4.93
Patharkandi	24.59	92.32	Dug well	27.6	8.18	285.40	0.00	166.9	0	189.25	189.25	14.18	25.23	2.10	0.31	54.04	7.26	165	9.74	6.42	1.24	9.66
Hathikira	24.48	92.32	Dug well	27	8.04	399.80	0.00	238.7	0	115.99	115.99	42.54	75.42	7.94	0.22	16.01	21.84	130	36.04	41.11	1.48	1.16
Isabhil (Near TE)	24.42	92.31	Dug well	26.4	8.16	347.80	0.00	204.8	0	219.78	219.78	24.82	36.36	3.65	0.27	38.03	19.40	175	27.03	14.85	3.85	9.37
Kotamani (within police outpost)	24.37	92.30	Dug well	26.6	8.13	264.10	0.20	155.9	0	201.46	201.46	10.64	19.49	1.33	0.28	46.04	10.90	160	18.66	2.98	1.76	3.63
Jherjeri/ Hatyarbond (owner Altafuddin)	24.34	92.30	Dug well	26.8	8.16	253.20	0.20	149.4	0	170.94	170.94	14.18	12.41	1.88	0.27	38.03	13.33	150	14.39	4.36	2.62	4.93
Rangamati (near Forest office)	24.28	92.29	Dug well	28.8	7.96	151.00	0.00	89.10	0	73.26	73.26	24.82	11.55	0.91	0.16	16.01	6.06	65	17.91	4.26	2.28	1.88
Dengarbond (Baithakhal)	24.54	92.32	Dug well	26.7	7.92	265.70	0.40	156.2	0	177.04	177.04	17.73	17.85	1.56	0.20	48.04	10.90	165	12.37	5.82	2.43	1.40
Mahakol	24.85	92.49	Dug well	25.5	7.97	339.50	0.00	200.2	0	317.45	317.45	17.73	16.90	2.12	0.23	70.06	24.24	275	12.23	2.94	2.33	28.74
Marjatkandi	24.81	92.48	Dug well	25.4	8.00	470.70	0.00	276.7	0	366.29	366.29	60.27	21.38	0.94	0.31	52.04	43.66	310	45.98	16.67	2.62	2.13
Chandrapur	24.78	92.48	Dug well	26.8	8.08	254.40	0.00	150.0	0	170.94	170.94	14.18	0.37	1.11	0.23	28.02	6.05	95	11.92	34.0	1.34	2.13
Adarkona	24.75	92.51	Dug well	26.8	7.98	403.70	0.00	238.6	0	170.94	170.94	53.18	28.18	1.76	0.26	44.04	16.9	180	32.78	5.99	2.28	2.13

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Taturgul	24.71	92.50	Dug well	26.1	7.80	135.60	0.00	79.43	0	91.57	91.57	14.18	7.32	0.77	0.24	18.01	9.70	85	11.59	0.87	2.00	1.16
Debodargaon (near sonbeel)	24.70	92.46	Dug well	26.6	7.26	139.10	0.20	81.95	0	79.36	79.36	17.73	7.66	0.49	0.12	16.01	7.27	70	13.97	5.30	0.77	1.16
Samridhipur	24.67	92.46	Dug well	27.6	7.83	117.20	0.00	69.01	0	61.05	61.05	21.27	14.88	0.54	0.13	20.02	8.49	85	7.75	1.50	1.15	0.92
Barapunji	24.80	92.29	Tube well	25.6	7	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	6.03	1.16
Bazarghat G.S quarter (Ratabari)	24.60	92.39	Dug well	25.5	8.04	143.10	0.00	84.14	0	73.26	73.26	14.18	18.55	0.88	0.14	20.02	9.70	90	5.91	3.98	1.00	3.12
Bazarghat (Ratabari) owner Pranab nath	24.60	92.39	Tube well	25.8	6.9	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3.14	3.89
Sarkaribari	24.57	92.41	Dug well	26.7	8.06	262.50	0.00	153.1	0	244.2	244.20	14.18	5.92	1.46	0.24	54.04	10.90	180	16.25	7.71	5.18	1.40
Durlabchera (Tea garden area)	24.48	92.44	Dug well	27	7.64	222.10	0.10	129.6	0	30.52	30.52	46.09	24.92	7.96	0.07	10.01	10.92	70	23.76	9.94	0.20	0.97
Durlabchera (Tea garden area) Owner Dev kr. Kurmi	24.48	92.44	Tube well	26.5	5.3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2.52	1.64
Kalingar	24.58	92.48	Dug well	26.4	7.82	305.90	0.00	178.3	0	189.25	189.25	24.82	22.78	1.80	0.31	34.03	15.76	150	35.05	4.31	3.37	1.40
Nathupur (near Barkatpur)	24.83	92.41	Dug well	26.1	7.93	237.20	0.00	138.7	0	146.52	146.52	17.73	13.56	0.27	0.24	28.02	18.19	145	12.65	1.70	0.44	1.64
Srigouri (Road near Srigouri Balika Vidyamandir) owner Biswajitdeb	24.86	92.52	Dug well	25.8	8.05	467.30	0.00	275.8	0	286.93	286.93	35.45	28.78	1.33	0.38	38.03	30.32	220	44.49	18.05	5.89	13.30
Akbarpur in campus of masjid, roadside	24.86	92.52	Dug well	25.8	8.06	318.70	0.00	186.4	0	189.25	189.25	17.73	27.06	1.43	0.23	38.03	23.04	190	16.76	2.26	1.24	1.404
Rangpur (bhubirband)	24.30	92.40	Dug well	26.8	8.17	406.10	0.30	238.1	0	183.15	183.15	67.35	22.46	0.58	0.24	32.03	18.19	155	48.01	7.64	2.71	1.404
Sheralipur (owner Kamal Ahmed)	24.86	92.45	Tube well	25.3	6.9	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	15.27	0.692
Mirzapur (Gangpar) owner Sujan roy	24.87	92.45	Tube well	25.3	7.1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.82	0.45
Baraigram (near hotel)	24.68	92.34	Tube well	26.6	6.2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	9.30	0.692
Moina	24.66	92.33	Tube well	26.9	6.9	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	13.56	109.45

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Hatyarbond	24.34	92.30	Tara pump	27	6.3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	12.28	4.40
Bhanga bazar	24.86	92.48	Tube well	26.1	7.9	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1.67	47.49
Kandigram (owner Sabuddin)	24.86	92.50	Tube well	26	7.1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.58	0.69
Mahakol	24.84	92.49	Tube well	25.5	7.1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1.34	0.458

a) General Description of Ground Water Assessment in Karimganj district for 2019-20 (Area in ha)

Name of Ground Water Assessment Unit	Karimganj
Type of Ground Water Assessment Unit	District
Type of rock formation	Sandstone and shale
Total area of Groundwater Assessment Unit	180900
Hilly area	13252
Command area	0
Non-command area	167648
Poor ground water quality area	0
Area considered for groundwater recharge	167648

b) Ground Water Resource Potential in Karimganj district during 2019-20

Assessment Unit / District	Karimganj
Command/ Non-Command/ Total	Total
Recharge from rainfall during monsoon season	37175.6 ham
Recharge from other sources during monsoon season	1632.9 ham
Recharge from rainfall during non-monsoon season	24199.65 ham
Recharge from other sources during non-monsoon season	226.25 ham
Total Ground Water Recharge	63234.40 ham
Annual extractable Ground Water	47345.78 ham

c) Ground Water extraction for All Uses in Karimganj district

District	Karimganj
Total extraction for domestic and industrial purpose (as per households)	1107.37 ham
Total extraction for irrigation	80.64 ham
Total groundwater extraction	1188.01 ham

d) Balance Ground Water Resources Available and Stage of Groundwater extraction in the Study Area as On 31st March 2020

Assessment Unit / District	Karimganj
Command/ Non-Command/ Total	Total
Net Annual Ground Water Availability	45998.3 ham
Existing Gross Ground Water extraction for Irrigation	80.64 ham
Existing Gross Ground Water extraction for domestic and industrial water supply	1107.37 ham
Existing Gross Ground Water extraction for All Uses	1188.01 ham
Provision for domestic requirement supply to 2	1266.17ham
Net Annual Ground Water Availability for future development	45998.3 ham
Stage of ground water extraction	2.51 %

e) Categorization for Ground Water Development of Karimganj district during 2019-20

Assessment/ Administrative Unit	Stage of Ground Water extraction %	Quantity Categorization (Safe/Semi-Critical/ Critical/ Over Exploited)	Quality Tagging	Validation of Assessment using GW Level Trends (Valid/To be Re-assessed)
Karimganj	2.51	Safe	Fresh	Could not validate, WL data not sufficient/ representative