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MINISTRY OF JAL SHAKTI

Department of Water Resources, River Development & Ganga Rejuvenation

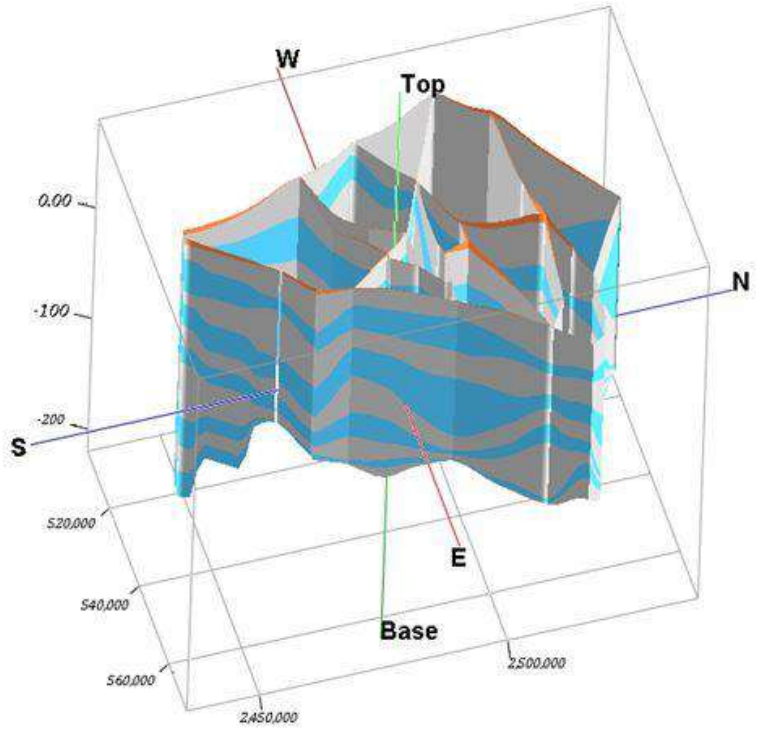
Report

On

NATIONAL AQUIFER MAPPING & MANAGEMENT PLAN

In

Paschim Medinipur District (parts), West Bengal



Central Ground Water Board

Eastern Region, Kolkata

केंद्रीय भूमि जल बोर्ड

जल संसाधन, नदी विकास और गंगा संरक्षण विभाग

जल शक्ति मंत्रालय

भारत सरकार

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NATIONAL AQUIFER MAPPING AND MANAGEMENT PLAN

Paschim Medinipur District (parts), West Bengal

पूर्वी क्षेत्र, कोलकाता

Eastern Region, Kolkata

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FOREWORD

To understand the nature and occurrences of groundwater, Aquifer geometry, dispositions & characteristics and management of groundwater resource, National Aquifer Mapping & Management Programme (NAQUIM) has been taken up by CGWB under XIIth Plan. During the Annual Action Plan 2022-2023, Aquifer Mapping studies & Management plan was taken up in Paschim Medinipur district.

The study under the aegis of NAQUIM includes four major components namely; Data gap analysis, Data generation, Data collection & compilation and preparation of Aquifer maps and Aquifer Management Plan.

This report is presented in three parts, where Part-I embodies general report for the study area, Part-II include Block Management Plans and Part-III comprises Data Gap Analysis done for the district. Relevant data in respect of the said subjects have been collected and collated from different Departments and their publications, viz. Public Health Engineering Directorate, State Water Investigation Directorate, Sixth Minor Irrigation Census Report, Bureau of Economics & Statistics, Land & Land Reforms Dept., India-Water Resources Information System (INDIA-WRIS), India-Groundwater Resources Estimation System (IN-GRES), District Census Handbook, PMKSY-District Irrigation Plan of Govt. of India etc, have also been used. Hydrogeological data is sourced from the scientific studies of CGWB pertaining to groundwater explorations, hydrogeological surveys, chemical analysis and outsourcing explorations being taken up for data generation.

Compilation of this report, evaluation of data and preparation of relevant maps, 2D cross-sections & 3D models of aquifers and their representation in the form of present report is outcome of the efforts given by Mr. Arpan Kumar Banerjee, Scientist-'C' (HG), Dr. Nilamoni Barman, Scientist-'B'(HM), Sh. Rajesh Kumar Sahoo (AHG) and Miss Rajyashree Nandy, Young Professional (HG), Miss Mahasweta Mukherjee, Young Professional; under the supervision of Dr. Indranil Roy, Scientist-'D'(HG) & OIC(NAQUIM). The section pertaining to Hydrochemistry has been prepared by Shri Prasanth Yentapalli, STA (Chemist) and his effort is thankfully acknowledged. Geophysical inputs for this report have been provided by Sh. Sujit Sarkar, Scientist-'D' (GP).

Effective method of dissemination of the existing technical information to different user agencies is an important aspect of NAQUIM which plays a very vital role in the safe and optimal development of groundwater resources in our country. In this regard, Central Ground Water Board has taken up a great initiative in incorporating NAQUIM project since 2012 to fulfil this directive. It is much anticipated that, this report will become an important tool not only for various user agencies, Engineers, Scientists, Administrators, Planners and others involved in groundwater planning, development and management but also to the common people to make them aware of local groundwater issues and its sustainable management.

Dr. Anadi Gayen
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CGWB, ER, Kolkata

EXECUTIVE SUMMARY

National Aquifer Mapping and Management Plan (NAQUIM) studies in Paschim Medinipur District (parts) of West Bengal were taken up during the Annual Action Plan period of 2022-23. The NAQUIM study area comprises of 11 blocks of PaschimMedinipur districts in West Bengal. The total geographical area is 6308 sq. km of which mappable area is about 2038 sq. km.

Climatologically Paschim Medinipur represents humid sub-tropical climate characterised by moderately cold winters and hot summer with relative humidity ranging from 64 to 75% in the morning and 30 to 40% in the afternoon. The mean annual rainfall in the district varies from 1295 mm to 1637 mm. The normal annual rainfall of the district is in the tune of 1626.8 mm of which 80% is contributed by South-West monsoon.

Geomorphologically, the district is represented by upper alluvial plain, lower alluvial plain and valley bottom.The rivers / streams of the district flow either in easterly or south-easterly directions with predominantly dendritic drainage pattern.Soils in the district are in general fine sandy loam to coarse sandy loam and fine to very fine type.17.77% of the district is under forest cover and can be classified as Tropical dry deciduous type. Irrigation in the district is both groundwater and surface water based.Paddy is the primary crop grown in the district along with some production of wheat, potato, vegetables, oilseeds, pulses, sugarcane, jute, maize, betel nut etc.

Cainozoic laterites are exposed in the north-western and south-western parts of the district. The Cainozoic gravel bed (Tertiary gravel bed) constitutes gravels and pebbles of quartz, which are occasionally embedded in the laterites. The grey clay bed is persistent throughout the area and is considered as the ‘marker horizon’ which separates the Quaternary sediments and Tertiary sediments. The Quaternary sediments are mostly of fluviatile origin and have been deposited by the Subarnarekha, Kangsabati and Rupnarayan rivers.

The major two distinct water bearing formations are the (a) the upland platform sedimentary region in the north western part of the district is characterized by the occurrence of laterite capping with older alluvium and upper tertiaries and (b) recent sediments (younger alluvium) of eastern and southern part of the district. The laterite capping and the top sand-clay layers of 10-20 m depth constitute the near surface phreatic aquifer which is extensively developed by dug

wells and show marked fluctuation between pre and post monsoon season. The laterite sequence and top soil is followed by sequence of clay, fine to medium grained sand, sandy clay, coarse sand upto 130-250 m depth. Ground water in these formations occurs under semi-confined conditions and in confined conditions in the tertiaries separated by thick clay beds from the surface aquifer.The yield prospect for the aquifers of older alluvium varies from 25-40 lps and more than 40 lps in younger alluvium. The pre-monsoon and post-monsoon water table elevation contours for both shallow and deeper aquifers depicts the flow direction of Groundwater from North-west and West to East and South-East.

Aquifer disposition in the district indicates three major groupings of Aquifer I, Aquifer II and Aquifer III. Aquifer II and Aquifer III are further sub-divided into sub-groups of Aquifer-IIA, Aquifer-IIB and Aquifer-IIIA, Aquifer-IIIB. Aquifer-I is generally the shallow phreatic aquifer with approximate depth upto55 to 70 meters below ground level, Aquifer-II ranges approximately from below 70 to 75 meters to 150 meters below ground level. The deeper sand formations Aquifer-III ranges from below 150-160 meters to more than 200 meters below ground level. Discharge of the shallow aquifers ranges from 46.2 lpm to 840 lpm., the discharge of the deeper aquifers ranges from 220 lpm to 3900 lpm. Transmissivity of the aquifers ranges from 22.29 m^2/day to 4106 m^2/day. Storativity of the confined aquifers ranges from $1.1x10^{-2}$ to $3.87x10^{-5}$. Depth to water level for shallow aquifers during pre-monsoon ranges from less than 2 mbgl to more than 10 mbgl. Depth to water level for deeper aquifers during pre-monsoon ranges from less than 10 mbgl in some pockets to more than 20 mbgl in majority of the district. Depth to water level for shallow aquifers during pre-monsoon ranges from less than 2 mbgl to more than 10 mbgl. Depth to water level for deeper aquifers during post-monsoon ranges from less than 5 mbgl in some pockets to more than 10 mbgl in major part of the district. The long-term pre-monsoon and post-monsoon decadal hydrographs show there is stable water level at parts of Garhbeta, Medinipur town, Chandrakona road, Keshiary, Andhar Nayan, Dharampur, Kanthra while minor long term declining trend in Khirpai and in Salboni.

The stage of ground water development in the district stands at 56.57%, categorized as ‘Safe’.

The quality of groundwater in the district is relatively fresh and potable except in some areas where Iron and Nitrate are beyond permissible limits. Piper trilinear plot depicts the majority of the water to be of Calcium Bicarbonate and mixed type.

Artificial recharge structures are suggested as based on existing hydrogeological conditions. These are to be adopted both through short term and long term measures. Recommended interventions include - Percolation Tanks, Check Dams, Gabion Structures, Sub-Surface Dykes, Re-Excavation of existing tanks with Recharge Shafts, Urban Roof Top Rainwater harvesting.

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PART – I

AQUIFER MAPPING & MANAGEMENT PLAN OF PASCHIM MEDINIPUR DISTRICT (PARTS), WEST BENGAL

CHAPTER-1

INTRODUCTION

In XII five-year Plan, National Aquifer Mapping (NAQUIM) had been taken up by CGWB to carry out detailed hydrogeological investigation on toposheet scale of 1:50,000. Aquifer mapping is a process wherein a combination of geologic, geophysical, hydrologic and chemical analyses is applied to characterize the quantity, quality and sustainability of ground water in aquifers. The rainfall variations, inherent heterogeneity & nature of soft rock aquifers, over exploitation of once copious alluvial aquifers, lack of regulation mechanism has a detrimental effect on ground water scenario of the Country in last decade or so. Thus, prompting the paradigm shift from "traditional groundwater development concept" to "modern groundwater management concept". Varied and diverse hydrogeological settings demand precise and comprehensive mapping of aquifers down to the optimum possible depth at appropriate scale to arrive at the robust and implementable ground water management plans. The proposed management plans will provide the "Road Map" for ensuring sustainable management and equitable distribution of ground water resources, thereby primarily improving drinking water security and irrigation coverage. Thus, the crux of NAQUIM is not merely mapping, but reaching the goal-that of ground water management through community participation. The aquifer maps and management plans in parts of Paschim Medinipur district will be shared with the administration of West Bengal, India for its effective implementation.

1.1 Objective and Issues

The broad objective of the study is to establish the geometry of the underlying aquifer systems in horizontal and vertical domain and characterize them, so as to work out the development potential and prepare block wise aquifer maps and finally to formulate aquifer-wise and block wise ground water management plan with respect to issues concerned i.e. (i) Water scarcity in the District, (ii) Quantity and Quality of groundwater resources, (iii) Salinity as well as Iron & Arsenic contaminations within the available limited aquifers, (vi) Rejuvenation of the major source of groundwater.

1.2 Scope of Study

The scope of the present study is broadly within the framework of National Aquifer Mapping & Management Programme (NAQUIM) being implemented by CGWB. There are four major activities components viz. (i) data collection / compilation (ii) Data gap analysis (iii) Data generation (iv) Preparation of aquifer maps and management plan to achieve the primary objective. Data compilation included collection, and wherever required procurement, of all maps from concern agencies, such as the Survey of India, Geological Survey of India, State Governments etc. computerization and analysis of all acquired data, and preparation of a knowledge based. Identification of Data Gap included ascertaining requirement of further data generation in respect of Hydrogeological, Geophysical, Chemical, Hydrological, Hydro-meteorological studies, etc. Data generation includes those of hydrometeorology, chemical quality of groundwater, litho-logs and aquifer parameters. Generation of groundwater chemical quality data was accomplished by collection of water samples and their laboratory analyses for all major parameters, and some of the heavy metals. Additional data pertaining to sub-surface lithology and aquifer parameters were obtained through drilling of additional exploratory wells and slim holes, pumping tests at drilling sites. As per the revised annual action plan groundwater management studies in parts of Paschim Medinipur districts covering an area of 2038 square kilometre was taken up by CGWB, ER, Kolkata. In this report the salient features of aquifer geometry, characteristics, ground water occurrences, availability, and resource vis-a-vis quality, development & management, scope of ground water have been covered.

1.3 Approach and methodology

A stepwise approach and methodology adopted to achieve the major objective have been shown below.

i) Compilation of existing data.
ii) Identification of data gap.
iii) Data generation based on data gap.
iv) Preparation of thematic maps on GIS platform.
v) Preparation of 2D/3D aquifer disposition maps.
vi) Compilation of Aquifer data collection from different sources and preparation of block-wise Aquifer Maps and Aquifer / Ground Water Management Plan.

1.4 Location, Extent and Accessibility

The entire district of Paschim Medinipur lies between 22.75°N to 22.97°N latitudes and 87.035°E to 87.89°E longitudes with a total geographical area of 6308 Sq. Kms.

The district is bounded in the north by the Bankura district, in the north-west by the Purulia district, in the south-west and west by Jhargram district, in the north-east by Hooghly district, in the east and south-east by Purba Medinipur district, in the south by Mayurbhanj and Baleswar districts of Odisha respectively.

The area can be located in Survey of India Degree Sheet nos.73 N.Major portion of this NAQUIM area iscoveredby Toposheet **73 N/1**, **73 N/2, 73 N/5, 73 N/6 and 73 N/7.**Minor portion of the NAQUIM area is covered by five other Toposheets **73 N/3 & 73 N/4, 73N/8, 73N/9 and 73 N/10.**

The area is well connected with the State Capital Kolkata by road and rail. Kharagpur is an important railway junction which connects 5 important lines Howrah-NagpurMumbai line, Howrah-Chennai main line, Howrah-Kharagpur line, Asansol–Tatanagar– Kharagpur line and Kharagpur-Puri line.National Highway (NH-6) passes through the district connects other cities as Surat in Gujarat; Dhule, Amarawati and Nagpur in Maharashtra; Durg and Raipur in Chhattishgarh; Sambhalpur in Odisha . The district is well connected with other districts like Purba Medinipur, Bankura, Birbhum and Murshidabad through National Highway (NH-6). Besides the National Highway. State Highway (SH)-4 connects Sarenga, Goaltore, Chandrakona, Ghatal and Panskura. SH-5 connects Banspahan, Narayanpur, Silda, Lodhasuli, Kharagpur (via NH-6), Keshiary and Belda. Administrative map of the study area is given in **Figure 1.1.**

The NAQUIM area of 2038 sq. kmincluding 11 blocks of Paschim Medinipur district of West Bengal given in**Figure.1.2** is located between 22.75°N to 22.97°N latitudes and 87.035°E to 87.89°E longitudes.

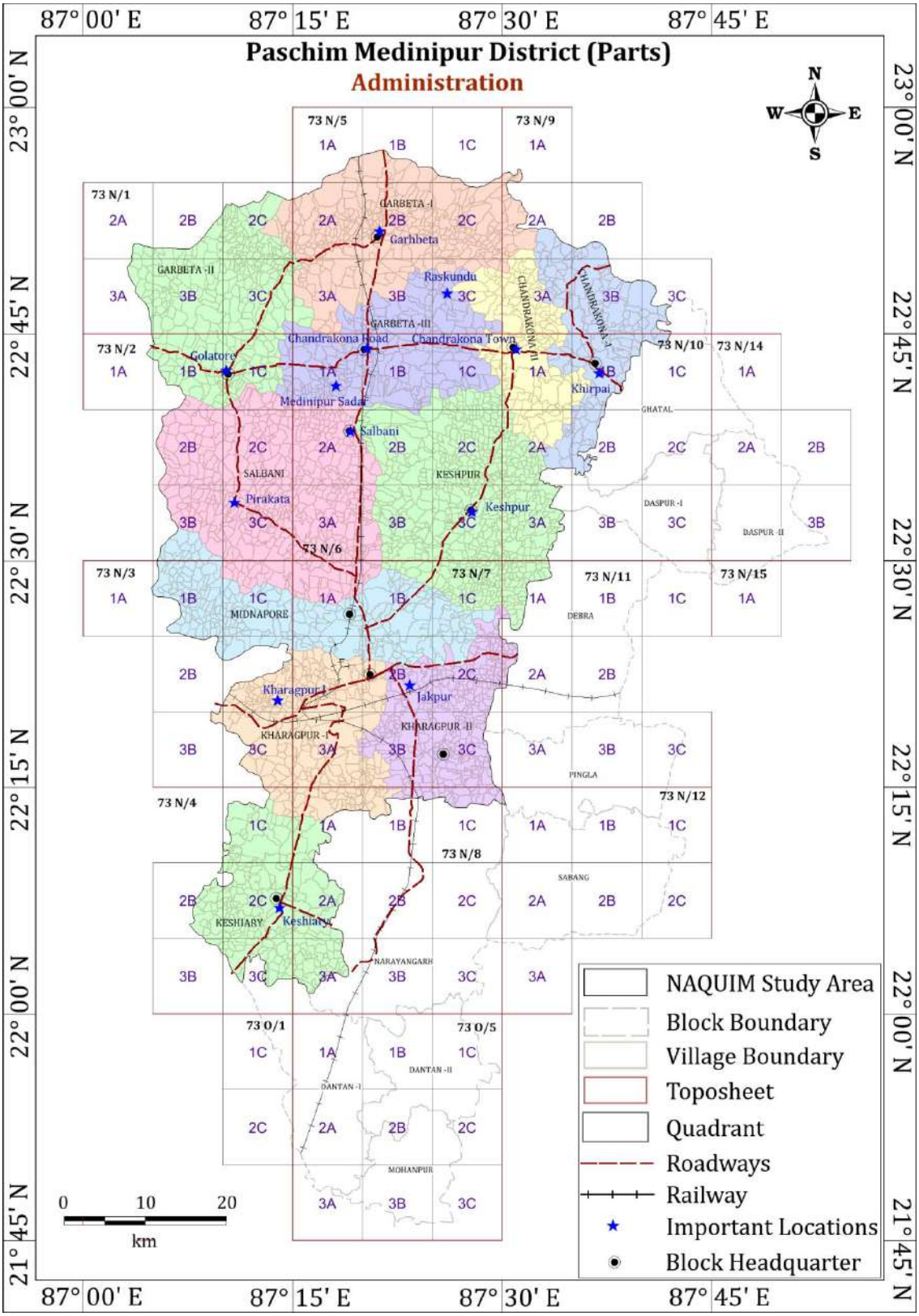


Figure 1.1 Administrative map of the study area

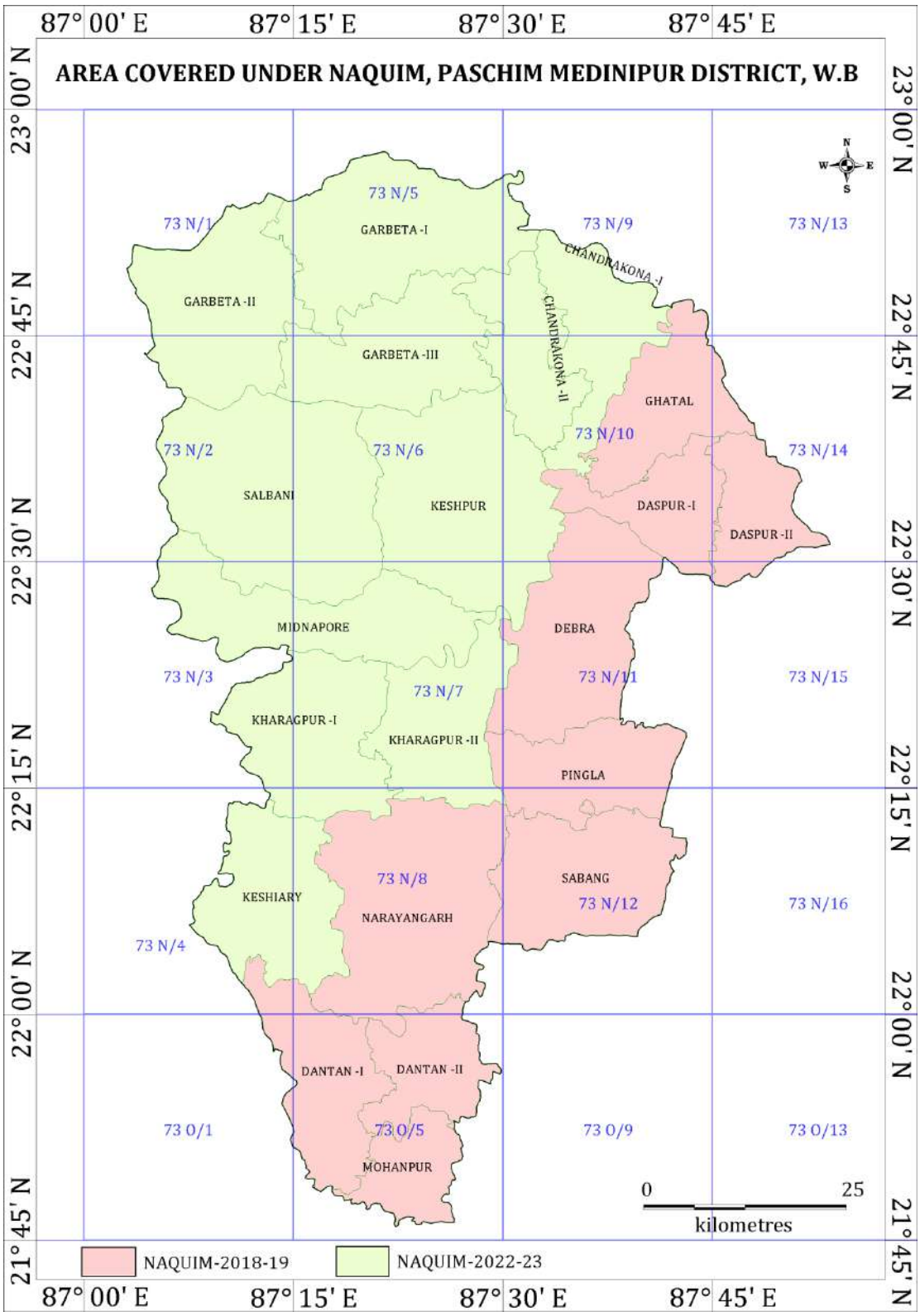


Figure 1.2 NAQUIM study area map of Paschim Medinipur

1.5 Administrative Division and Demography:

The district with its Headquarter at Medinipur has As per 2011 Census, there are 7 Municipalities in Paschim Medinipur district viz. Kharagpur(M), Medinipur(M), Ghatal(M), Chandrakona(M), Ramjibanpur(M), Kshirpai(M) and Kharar(M) and 10Census Towns with total population of 59,13,457 as per 2011 Census of which male and female were 3007885 and 2905572 respectively. The administrative detail of the district is given in **Table 1.1.**

Table 1.1 Administrative details of the Study area

Sub-Division	C.D Block/M	Panchayets			Mouzas	Inhabited Villages (R)	House-holds	Municipality		Census Towns	Total
		Samity	Gram	Gram Sansad	2001	2011	2011	No.	Ward		
Sadar	Salboni	1	10	134	528	411	39334	-	-		
	Keshpur	1	15	230	634	570	68756	-	-		
	Garhbeta-I	1	12	162	371	306	46452	-	-	2	2
	Garhbeta-II	1	10	110	334	264	30680	-	-		
	Garhbeta-III	1	8	115	232	188	34484	-	-	3	3
	Medinipur	1	9	129	271	232	42326	-	-		
	Medinipur(M)	-	-	-	-	-	37392	1	25		
Kharagpur	Keshiary	1	9	110	220	202	35298				
	Kharagpur-I	1	7	112	269	228	58335				
	Kharagpur-II	1	9	129	353	330	44637				
	Kharagpur (Town)	-	-	-	-	-	44618	1	35	-	1
Ghatal	Chandrakona-I	1	6	102	132	126	30369				
	Chandrakona-II	1	6	86	131	122	26263				
	Chandrakona(M)	-	-	-	-	-	5260	1	12		1
	Khirpai(M)	-	-	-	-	-	3568	1	10		1
Total		11	101	1419	3475	2979	547772	4	82	5	8

(Source-District Statistical Handbook, 2014)

The details distribution of population in the administrative units of the study area is given in **Table 1.2.**

Table 1.2 Distribution of population in the administrative units of the study area

Sub-Division	C.D Block/M	Rural population			Urban population			Total Population		
		Male	Female	Total	Male	Female	Total	Male	Female	Total
Sadar	Salboni	95195	93458	188653	-	-	-	95195	93458	188653
	Keshpur	173504	165744	339248	-	-	-	173504	165744	339248
	Garbeta-I	111379	106860	218239	5241	5033	10274	116620	111893	228513
	Garbeta-II	75165	73245	148410	-	-	-	75165	73245	148410
	Garbeta-III	75562	73247	148809	10461	10258	20719	86023	83505	169528
	Medinipur	97490	94215	191705	-	-	-	97490	94215	191705
	Medinipur(M)				84977	84287	169264	84977	84287	169264
	Total	**628295**	**606769**	**1235064**	**100679**	**99578**	**200257**	**728974**	**706347**	**1435321**
Kharagpur	Keshiary	75601	73659	149260	-	-	-	75601	73659	149260
	Kharagpur-I	84489	81472	165961	46584	45495	92079	131073	126967	258040
	Kharagpur-II	92546	90894	183440	-	-	-	92546	90894	183440
	Kharagpur(M)	-	-	-	106559	101045	207604	106559	101045	207604
	Total	**252636**	**246025**	**498661**	**153143**	**146540**	**299683**	**405779**	**392565**	**798344**
Ghatal	Chandrakona-I	69820	66186	136006	-	-	-	69820	66186	136006
	Chandrakona-II	63180	60089	123269	-	-	-	63180	60089	123269
	Chandrakona(M)	-	-	-	11977	11652	23629	11977	11652	23629
	Khirpai(M)	-	-	-	8254	8130	16384	8254	8130	16384
	Total	**133000**	**126275**	**259275**	**20231**	**19782**	**40013**	**153231**	**146057**	**299288**

(Source- District Statistical Handbook, 2014)

The Geographical and Mappable area of the 11 blocks under NAQUIM 2022-23 is given in **Table 1.3.**

Table 1.3 Geographical and Mappable area for the given study area

Block_Name	GeographicalArea (Sq.Km)	MappableArea (Sq.Km)	Total AnnualRainfall (mm)
Chandrakona-I	193.5	185	2282
Chandrakona-II	150.4	150.4	2282
Garhbeta-I	413	195	1775
Garhbeta-II	361.9	191	2418.2
Garhbeta-III	312.12	159	2411.62
Keshiary	293	178	2241.8
Keshpur	497	263	2571.4
Kharagpur-I	313.31	161	2411.62
Kharagpur-II	265.6	159	2411.62
Salboni	553.4	173	2411.62
Medinipur	323.64	206	2411.62

Table 1.4 Land Use, Cropping Pattern and Irrigation

Category	Area (Ha)	Percentage
Cultivable Area	389584.7	61.76
Forest Area	112129.8	17.77
Land under non- agricultural use	102745.4	16.28
Permanent pastures	736.9	0.116
Cultivable wasteland	3560.7	0.56
Land under Misc. tree crops and groves	6038.8	0.96
Barren and uncultivable land	1108.6	0.17
Current fallows	12221.2	1.93
Other fallows	2673.79	0.42
TOTAL	630800	100

(Source-Agriculture Contingency Plan for District, Paschim Medinipur)

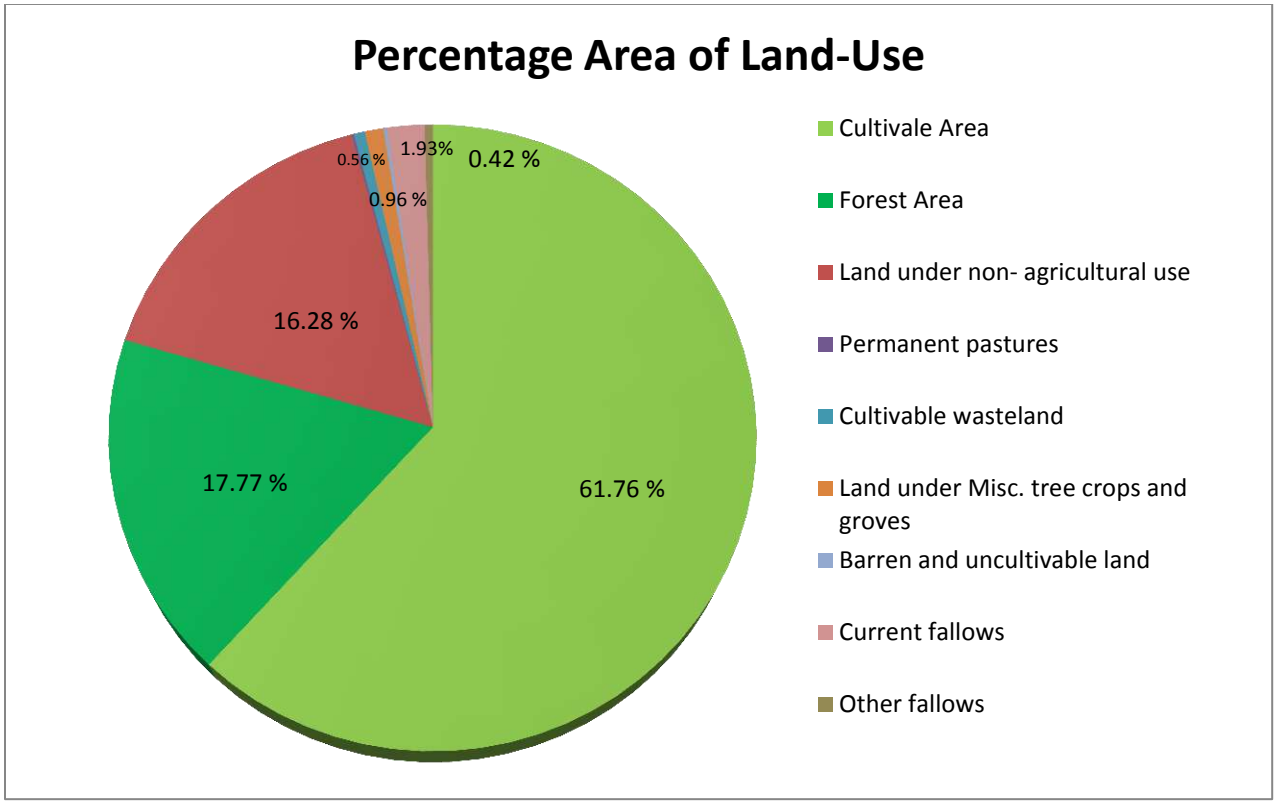


Figure 1.3 Pie Diagram depicting Landuse pattern of the District

1.6. Land Use, Cropping Pattern and Irrigation

The district land area has been utilized into various categories as classified in Table 1.4.It is observed that, 61.76 % of the reporting area is under cultivable area, 17.77 % is under forest area,16.28 % of land is under non-agricultural use, 0.116 % is reported as permanent pastures, 0.56 % is reported as cultivable wasteland, 0.96 % is reported as land under miscellaneous tree crops and groves, 0.17 % is reported as barren and uncultivable land, 1.93 % of land is reported as current fallows, 0.42 % of land is reported as other fallows. The Land Use, Cropping Pattern and Irrigation is given in **Table 1.4.** Pie Diagram depicting Landuse pattern of the District is given in **Figure 1.3.**Classification of Block-wise Land Utilisation Statistics in Paschim Medinipur District is given in**Table 1.5.**District lanuse-landcover map is given in **Figure 1.4.** Forest cover map is given in **Figure 1.5.**

Table 1.5 Classification of Block-wise Land Utilisation Statistics in Paschim Medinipur District

Classification of Blockwise Land Utilisation Statistics in Paschim Medinipore District									
Area in Hectares									
Year	Block	Area	Area under Agriculture				Area under Forest	Area under wasteland	Area undue other uses
			Gross cropped Area (1)	Net Sown Area (2)	Area sown more than once (1-2)	Cropping intensity (%)			
1	Medinipur	32364	26790	19462	7328	138	5823	2348	4731
2	Salbani	55340	38780	24856	13924	156	20671	3674	6794
3	Keshpur	48283	72050	36450	35600	198	3727	2064	6042
4	Garhbeta I	36141	49700	23593	26107	211	6707	1925	3916
5	Garhbeta II	39405	33210	21043	12167	158	13261	1665	3436
6	Garhbeta III	31212	31320	16379	14941	191	10279	1363	3191
7	Kharagpur-I	28037	16492	12053	4439	137	3306	1987	5626
8	Kharagpur-II	26563	31235	22328	8907	140	144	549	3542
9	Keshiary	29209	33755	21575	12180	156	2288	646	4700
10	Chandrakona-I	19354	40450	15961	24489	253	11	736	2646
11	Chandrakona-II	15043	33027	12659	20368	261	361	593	1430

(Source: District Irrigation Plan under PMKSY)

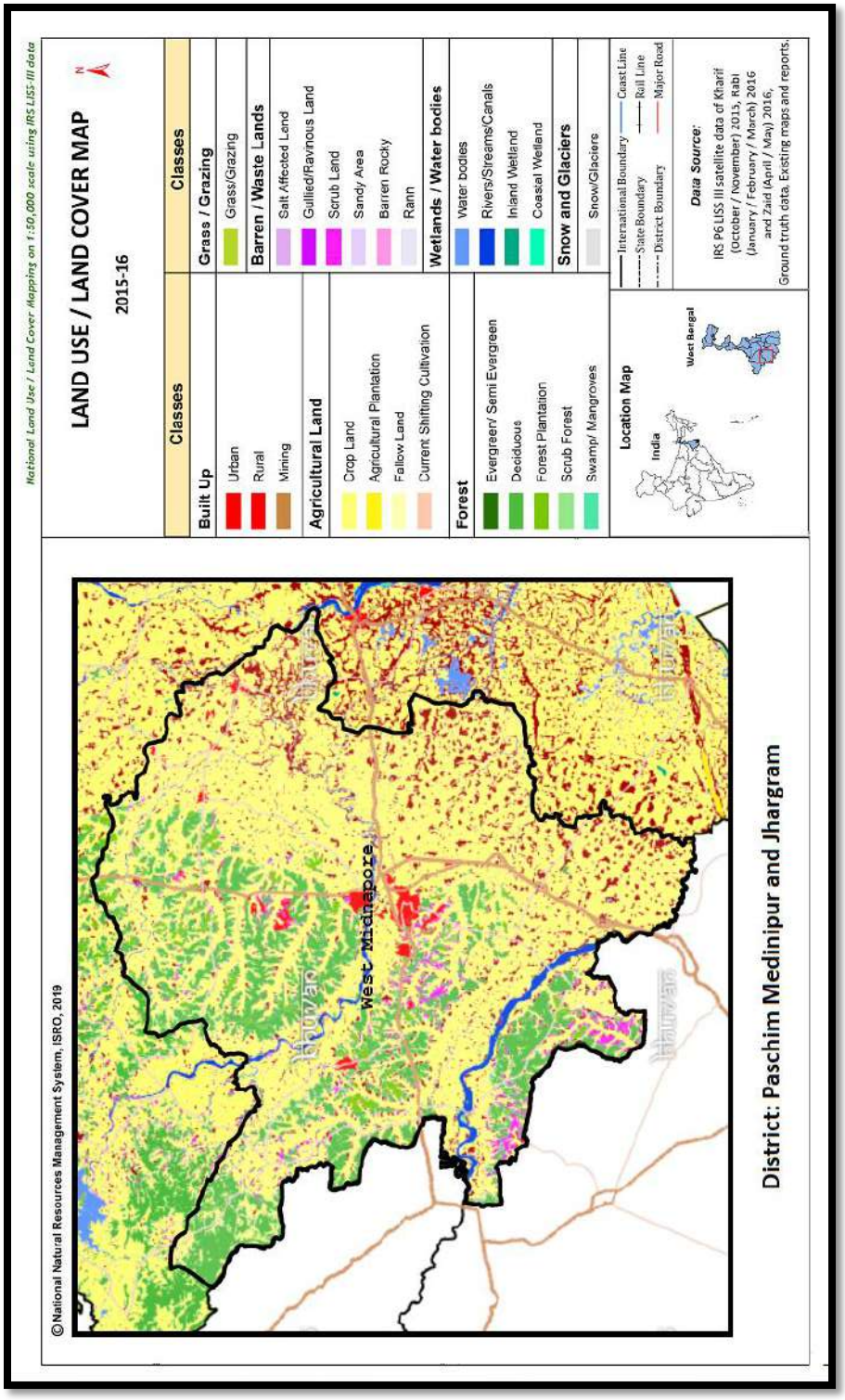


Figure 1.4 Landuse/Landcover Map of Paschim Medinipur and Jhargram District (2015-16)

(Source-bhuvan.nrsc.gov.in)

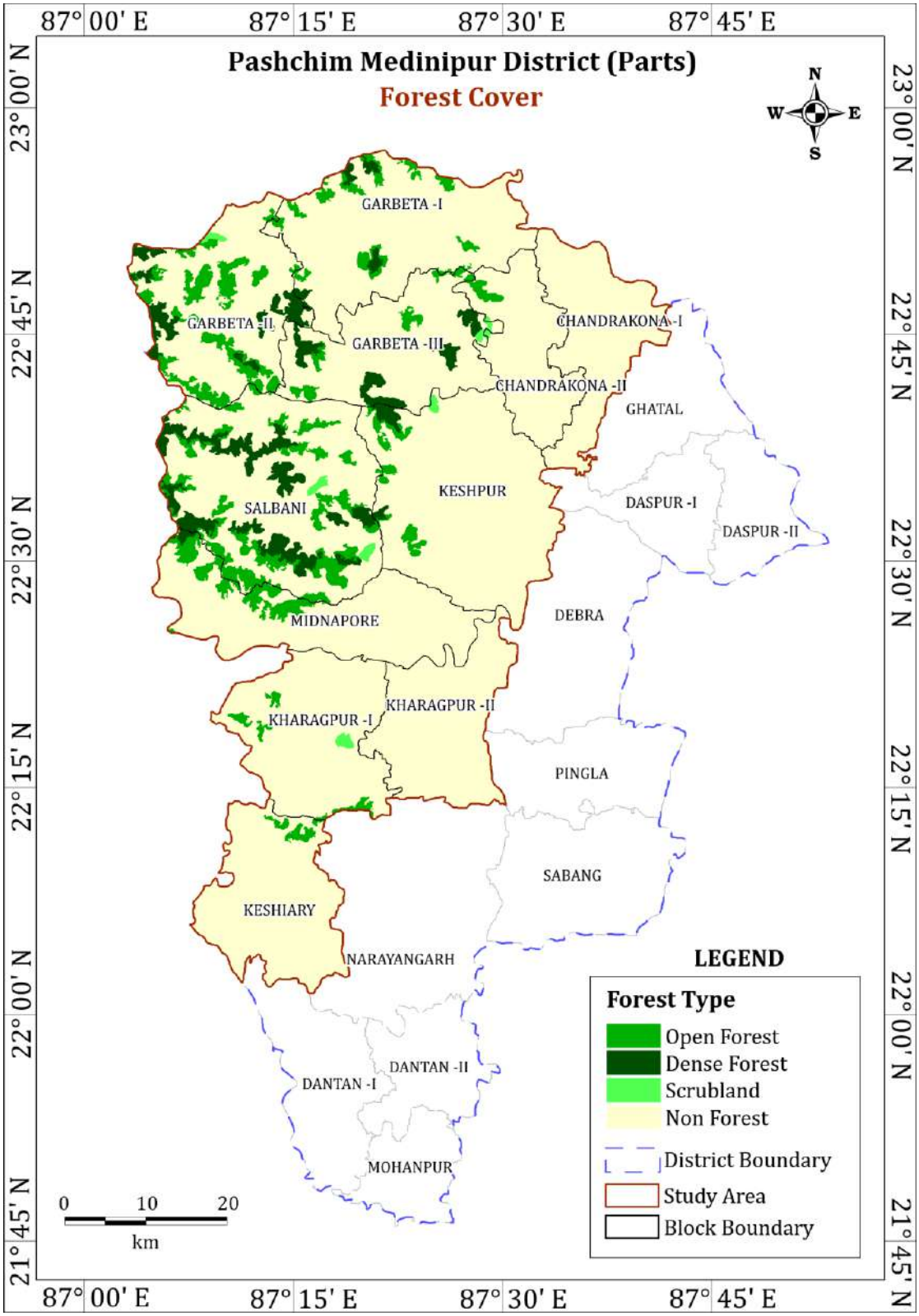


Figure 1.5 Forest cover map of NAQUIM study area

Cropping Pattern: - The type of crops grown in the district is a direct influence of relief, soil, slope, climate, irrigation facilities and traditional social conditions. The important crops grown are Paddy and Wheat (grown in about 243770 hectares of land). Other crops are potato, vegetables, oilseeds, pulses, sugarcane, jute, maize, betel nut etc. The physical and chemical properties of the soil as its texture, permeability, porosity, alkalinity, acidity have a significant impact on the agriculture. Soil characteristics are lateritic to alluvial and fine loamy, coarse loamy, gravelly loam types. The Aman cultivation basically dominates the Kharif season. In the year 2014-15, with an yield rate of 2717.67 Kg/hectare, Paschim Medinipur district was one of the top three districts in Aman rice cultivation with production of 1348329 tons, Boro cultivation with production of 580442 tons, Aus cultivation with production of 80300 tons. Wheat production in the district with yield rate of 2125.02 kg/hectare was 12259 tons in the year 2014-15. (Department of Statistics and Programme Implementation, Government of West Bengal, 2016). Block-wise Crop Water Requirement in NAQUIM area is given in **Table 1.6.**

Irrigation: - The anicut structure across Kangsabati river in Mohanpur, Medinipur has been reconstructed by the Irrigation and Waterways Department, Govt. of West Bengal for irrigating 38000 Ha of area in blocks of Kharagpur-II, Debra, Pingla, Narayangarh, Panskura; thus benefitting around 30 lakhs population. With assistance from Accelerated Irrigation Benefit Program (AIBP), the West Bengal State Govt. has undertaken large extension and improvement of the canals and providing irrigation water for Kharif, Rabi and Boro cultivation. Drainage development works have also been carried out along major rivers and channels like Kaliaghai, Kapeleshwari. Subarnarekha Barrage project, a major irrigation project of Irrigation and Waterways Department, Govt of West Bengal, with an irrigation potential of 1,14,200 Ha, has been proposed for assistance from Accelerated Irrigation Benefit Program (AIBP), Govt. of India. Existing Type of Irrigation (District Irrigation Plan under PMKSY) is given in **Table 1.7.**Source-wise Culturable Command Area, Paschim Medinipur District is given in **Table 1.8.**Irrigation Potential (IP) created by different sources in Paschim Medinipur District is given in **Table 1.9.**

Table 1.6 Block-wise Crop Water Requirements in NAQUIM Area

Block	Crops	Area sown (ha)	Irrigated area (ha)	Crop water demand (BCM)	Area to be irrigated (ha)	Water potential required (BCM)	Existing Water potential (BCM)	Water potential to be created (BCM)
Medinipur	Cereals	21685	9196	0.14714	2000	0.17914	0.14714	0.03200
	Coarse Cereals	30	20	0.00010	500	0.00260	0.00010	0.00250
	Pulses	40	40	0.00010	2000	0.00510	0.00010	0.00500
	Oil Seeds	1480	1480	0.00370	2000	0.00870	0.00370	0.00500
	Fibre	0	0	0.00000	200	0.00080	0.00000	0.00080
	Other crops	3555	3555	0.02133	2632	0.03712	0.02133	0.01579
Salbani	Cereals	22720	4120	0.06592	1000	0.08192	0.06592	0.01600
	Coarse Cereals	160	100	0.00050	500	0.00300	0.00050	0.00250
	Pulses	145	130	0.00033	4000	0.01033	0.00033	0.01000
	Oil Seeds	5060	5060	0.01265	4000	0.02265	0.01265	0.01000
	Fibre	0		0.00000	200	0.00080	0.00000	0.00080
	Other crops	10695	8615	0.05169	2971	0.06952	0.05169	0.01783
Keshpur	Cereals	40725	10025	0.16040	500	0.16840	0.16040	0.00800
	Coarse Cereals	235	200	0.00100	300	0.00250	0.00100	0.00150
	Pulses	705	680	0.00170	1000	0.00420	0.00170	0.00250
	Oil Seeds	16705	16705	0.04176	1000	0.04426	0.04176	0.00250
	Fibre	550	300	0.00120	500	0.00320	0.00120	0.00200
	Other crops	13130	12560	0.07536	2062	0.08773	0.07536	0.01237
Garhbeta I	Cereals	20150	6250	0.10000	500	0.10800	0.10000	0.00800
	Coarse Cereals	130	100	0.00050	500	0.00300	0.00050	0.00250
	Pulses	170	160	0.00040	1000	0.00290	0.00040	0.00250
	Oil Seeds	7485	7485	0.01871	1000	0.02121	0.01871	0.00250
	Fibre	20	0	0.00000	200	0.00080	0.00000	0.00080
	Other crops	21745	20345	0.12207	1353	0.13019	0.12207	0.00812
Garhbeta II	Cereals	18180	5590	0.08944	1000	0.10544	0.08944	0.01600
	Coarse Cereals	110	100	0.00050	500	0.00300	0.00050	0.00250
	Pulses	95	95	0.00024	1000	0.00274	0.00024	0.00250
	Oil Seeds	3840	3840	0.00960	1000	0.01210	0.00960	0.00250
	Fibre	10		0.00000	200	0.00080	0.00000	0.00080
	Other crops	10975	9785	0.05871	1798	0.06950	0.05871	0.01079
Garhbeta III	Cereals	14625	3625	0.05800	1000	0.07400	0.05800	0.01600
	Coarse Cereals	70	70	0.00035	500	0.00285	0.00035	0.00250

	Pulses	85	85	0.00021	1000	0.00271	0.00021	0.00250
	Oil Seeds	3660	3660	0.00915	1000	0.01165	0.00915	0.00250
	Fibre	5		0.00000	200	0.00080	0.00000	0.00080
	Other crops	12875	8885	0.05331	1769	0.06392	0.05331	0.01061
Kharagpur I	Cereals	13840	2080	0.03328	2000	0.06528	0.03328	0.03200
	Coarse Cereals	15	15	0.00008	1000	0.00508	0.00008	0.00500
	Pulses	65	65	0.00016	3500	0.00891	0.00016	0.00875
	Oil Seeds	635	635	0.00159	3500	0.01034	0.00159	0.00875
	Fibre	0	0	0.00000	200	0.00080	0.00000	0.00080
	Other crops	1937	1581	0.00949	3203	0.02870	0.00949	0.01922
Kharagpur II	Cereals	27040	15180	0.24288		0.24288	0.24288	0.00000
	Coarse Cereals	60	60	0.00030	200	0.00130	0.00030	0.00100
	Pulses	265	265	0.00066	500	0.00191	0.00066	0.00125
	Oil Seeds	1585	1585	0.00396	500	0.00521	0.00396	0.00125
	Fibre	5	5	0.00002	100	0.00042	0.00002	0.00040
	Other crops	2280	2280	0.01368	508	0.01673	0.01368	0.00305
Keshiary	Cereals	29605	17100	0.27360	500	0.28160	0.27360	0.00800
	Coarse Cereals	20	20	0.00010	500	0.00260	0.00010	0.00250
	Pulses	690	690	0.00173	500	0.00298	0.00173	0.00125
	Oil Seeds	1235	1235	0.00309	500	0.00434	0.00309	0.00125
	Fibre	10	10	0.00004	200	0.00084	0.00004	0.00080
	Other crops	2195	2165	0.01299	1455	0.02172	0.01299	0.00873
Chandrakona I	Cereals	20300	4702	0.07523		0.07523	0.07523	0.00000
	Coarse Cereals	0	0	0.00000		0.00000	0.00000	0.00000
	Pulses	160	160	0.00040	500	0.00165	0.00040	0.00125
	Oil Seeds	8845	8845	0.02211	500	0.02336	0.02211	0.00125
	Fibre	90	90	0.00036		0.00036	0.00036	0.00000
	Other crops	11055	11055	0.06633	1800	0.07713	0.06633	0.01080
Chandrakona II	Cereals	14070	7393	0.11829		0.11829	0.11829	0.00000
	Coarse Cereals	0	0	0.00000		0.00000	0.00000	0.00000
	Pulses	87	87	0.00022	300	0.00097	0.00022	0.00075
	Oil Seeds	8305	8305	0.02076	300	0.02151	0.02076	0.00075
	Fibre	110	110	0.00044		0.00044	0.00044	0.00000
	Other crops	10455	10455	0.06273	1159	0.06968	0.06273	0.00695
TOTAL		406809	239034	2.07059	66310	2.43784	2.07059	0.36726

(Source: District Irrigation Plan under PMKSY)

Table 1.7 Existing Type of Irrigation (District Irrigation Plan under PMKSY)

Name of Block	Source of Irrigation CA(ha)= Command Area(ha)	Surface Irrigation (1)					Ground Water (2)						Water extraction devices /			Total	
		Canal Based		Tanks / Ponds / Reservoirs			Tube		Open wells		Bore well						
		Govt. Canal	Community /Pvt.Canal	Community Ponds Including Small	Indivi dual / Pvt. Ponds	Govt. Reservoi r /Dams	Govt	Pvt	Communit y / Govt.	Pvt	Govt	Pvt.	Elect ricity pum p (4)	Diesel pump(5)	Others (6)	Irrigation sources(1+2+3)	Water extracting units (4+5+6)
Midnapur Sadar	No	29	58	86			26	1498	0	28			9	0	0	1725	9
	CA (ha)	426	653.11														
Salboni	No	456	19	138			8	1103	4	232			4	0	0	1960	4
	CA (ha)	1710	72.08														
Keshpur	No	18	112	48			69	2880	0	30			66	0	1	3157	67
	CA (ha)	161	1005.8														
Garbeta - I	No	46	393	85			35	3118	2	526			17	0	0	4205	17
	CA (ha)	506	3475.1														
Garbeta - II	No	64	403	74			23	1806	7	490			10	0	0	2867	10
	CA (ha)	410	2582.45														
Garbeta - III	No	30	204	77			38	1191	3	650			9	0	0	2193	9
	CA (ha)	303	2067.82														
Kharagpur - I	No	2	2	20			16	1154	0	10			8	0	0	1204	8
	CA (ha)	62	63.31														
Kharagpur - II	No	7	6	42			13	2278	0	1			5	0	1	2347	6
	CA (ha)	222	191.5														
Keshiary	No	8	1	3			11	1585	1	0			8	0	1	1609	9
	CA (ha)	222	28														
Chandrakona-I	No	17	60	51			18	1577	2	16			1 4	0	0	1741	14
	CA (ha)	346	1223.39														
Chandrakona-II	No	10	70	46			11	1764	0	21			11	0	1	1922	12

Table 1.8 Source-wise Culturable Command Area, Paschim Medinipur District

Block level Summary on Culturable Command Area (CCA) during 2017-2018
District Name:-PASHCHIM MIDNAPORE

Sl. No.	Block Name	Dugwell		Shallow Tubewell		Medium Tubewell		Deep Tubewell		Surface Flow		Surface Lift		Ground Water		Surface Water		Total CCA(ha.)
		No.	CCA(ha)	No.	CCA(ha.)	No.	CCA(ha.)	No.	CCA(ha.)	No.	CCA(ha.)	No.	CCA(ha.)	No	CCA(ha.)	No	CCA(ha.)	
1	CHANDROKONA -I	0	0.00	362	1522.25	803	6108.23	15	343.92	0	0.00	11	252.13	1180	7974.40	11	252.13	8227
2	CHANDROKONA -II	5	13.30	266	1058.00	893	4644.22	24	524.61	4	10.14	49	326.07	1188	6240.13	53	336.21	6576
3	DASPUR - I	1	2.05	42	109.36	539	2479.73	72	1658.63	0	0.00	50	1678.31	654	4249.77	50	1678.31	5928
4	DASPUR - II	0	0.00	68	231.70	70	691.03	16	390.40	6	194.32	39	1772.04	154	1313.13	45	1966.36	3279
5	DANTAN - II	0	0.00	87	384.71	653	3827.11	17	425.32	2	40.00	0	0.00	757	4637.14	2	40.00	4677
6	DANTAN - I	1	2.05	107	366.74	785	4954.14	42	902.09	0	0.00	1	0.23	935	6225.02	1	0.23	6225
7	DEBRA	398	1499.34	973	2671.02	1189	4752.15	122	2781.18	39	382.16	13	342.46	2682	11703.69	52	724.62	12428
8	GARBETA - I	4	14.44	301	839.01	1201	5519.24	140	3315.47	2	1.61	14	237.29	1646	9688.16	16	238.90	9927
9	GARBETA - II	58	86.99	385	1089.11	497	2094.18	122	2729.19	108	1082.20	163	1021.72	1062	5999.47	271	2103.92	8103
10	GARHBETA - III	112	158.29	44	81.25	714	3341.30	104	2446.25	14	145.45	130	613.06	974	6027.09	144	758.51	6786
11	GHATAL	0	0.00	63	270.72	774	4586.75	58	1362.21	1	17.00	51	2102.80	895	6219.68	52	2119.80	8339
12	KESHIARY	51	143.73	164	601.66	378	2401.00	155	3746.77	8	54.84	18	186.10	748	6893.16	26	240.94	7134
13	KESHPUR	20	39.12	226	704.04	2603	18010.20	51	1176.04	5	16.81	46	469.17	2900	19929.40	51	485.98	20415
14	KHARAGPUR - I	6	12.74	465	1633.09	192	1382.36	11	283.77	10	97.20	26	395.99	674	3311.96	36	493.19	3805
15	KHARAGPUR - II	3	6.15	1115	4402.92	720	4214.43	19	431.11	0	0.00	12	201.68	1857	9054.61	12	201.68	9256
16	MIDNAPORE	227	417.83	616	1821.69	160	1174.68	18	399.09	2	33.87	21	479.16	1021	3813.29	23	513.03	4326
17	MOHANPUR	1	2.00	103	250.78	486	3488.70	74	1420.02	0	0.00	0	0.00	664	5161.50	0	0.00	5162
18	NARAYANGARH	0	0.00	117	362.80	2380	12382.43	56	1220.82	1	15.01	16	316.52	2553	13966.05	17	331.53	14298
19	PINGLA	1	2.45	26	72.37	913	2560.66	104	2350.87	0	0.00	0	0.00	1044	4986.35	0	0.00	4986
20	SABANG	0	0.00	122	372.81	2256	28209.70	8	191.85	0	0.00	27	442.32	2386	28774.36	27	442.32	29217
21	SALBONI	135	231.99	628	1774.20	458	2408.64	30	696.41	76	335.92	58	778.20	1251	5111.24	134	1114.12	6225
	TOTAL:-	**1023**	**2632.47**	**6280**	**20620.23**	**18664**	**119230.88**	**1258**	**28796.02**	**278**	**2426.53**	**745**	**11615.25**	**27225**	**171279.60**	**1023**	**14041.78**	**185321**

(Source: 6th MI Census, West Bengal)

Table 1.9 Irrigation Potential (IP) created by different sources in Paschim Medinipur District

Block level Summary on Irrigation Potential during 2017-2018
District Name:-PASHCHIM MIDNAPORE

Sl. No.	Block Name	Dugwell		Shallow Tubewell		Medium Tubewell		Deep Tubewell		Surface Flow		Surface Lift		Ground Water		Surface Water		Total IPC(ha.)
		No.	IPC(ha.)	No.	IPC(ha.)	No.	IPC(ha.)	No.	IPC(ha.)	No.	IPC(ha.)	No.	IPC(ha.)	No	IPC(ha.)	No	IPC(ha.)	
1	CHANDROKONA -I	0	0.00	362	3249.07	803	9073.22	15	525.11	0	0.00	11	384.89	1180.00	12847.40	11.00	384.89	13232.29
2	CHANDROKONA -II	5	28.55	266	2045.43	893	9058.65	24	643.10	4	20.28	49	571.01	1188.00	11775.73	53.00	591.29	12367.02
3	DASPUR - I	1	6.15	42	210.57	539	3451.54	72	1295.29	0	0.00	50	2750.22	654.00	4963.55	50.00	2750.22	7713.77
4	DASPUR - II	0	4.10	68	411.87	70	752.57	16	455.85	6	291.20	39	4763.72	154.00	1624.39	45.00	5054.92	6679.31
5	DANTAN - I	1	0.00	107	763.54	785	7407.65	42	615.65	0	0.00	0	0.00	935.00	8786.84	0.00	0.00	8786.84
6	DANTAN - II	0	0.00	87	748.57	653	6665.82	17	532.57	2	30.00	1	0.57	757.00	7946.96	3.00	30.57	7977.53
7	DEBRA	398	3065.10	973	4767.72	1189	7540.19	122	1341.25	39	690.85	13	589.77	2682.00	16714.26	52.00	1280.62	17994.88
8	GARBETA - I	4	17.34	301	1402.26	1201	9394.83	140	1806.38	2	3.04	14	283.74	1646.00	12620.81	16.00	286.78	12907.59
9	GARBETA - II	58	168.01	385	2338.60	497	4273.40	122	2036.45	108	1050.09	163	1487.55	1062.00	8816.46	271.00	2537.64	11354.10
10	GARBETA - III	112	320.28	44	221.27	714	5389.77	104	1547.85	14	246.33	130	913.90	974.00	7479.17	144.00	1160.23	8639.40
11	GHATAL	0	345.23	63	540.50	774	6597.50	58	1967.51	1	24.88	51	3717.70	895.00	9450.74	52.00	3742.58	13193.32
12	KESHIARY	51	85.15	164	1208.19	378	4611.50	155	1854.04	8	109.61	18	397.72	748.00	7758.88	26.00	507.33	8266.21
13	KESHPUR	20	21.21	226	1579.71	2603	35720.10	51	1197.43	5	25.41	46	879.84	2900.00	38518.45	51.00	905.25	39423.70
14	KHARAGPUR - I	6	12.30	465	3445.98	192	3069.24	11	313.10	10	288.40	26	772.71	674.00	6840.62	36.00	1061.11	7901.73
15	KHARAGPUR - II	3	465.29	1115	8999.43	720	7499.73	19	280.13	0	0.00	12	233.48	1857.00	17244.58	12.00	233.48	17478.06
16	MIDNAPORE	227	2.54	616	3276.02	160	2071.27	18	470.55	2	29.61	21	727.82	1021.00	5820.38	23.00	757.43	6577.81
17	MOHANPUR	1	0.00	103	481.46	486	4140.23	74	1363.64	0	0.00	0	0.00	664.00	5985.33	0.00	0.00	5985.33
18	NARAYANGARH	0	0.00	117	473.35	2380	21167.55	56	994.77	1	29.00	16	675.37	2553.00	22635.67	17.00	704.37	23340.04
19	PINGLA	1	6.27	26	117.18	913	4736.58	104	772.65	0	0.00	0	0.00	1044.00	5632.68	0.00	0.00	5632.68
20	SABANG	0	0.00	122	701.01	2256	54770.89	8	174.24	0	0.00	27	1276.36	2386.00	55646.14	27.00	1276.36	56922.50
21	SALBONI	135	345.38	628	3324.08	458	4182.11	30	847.28	76	498.63	58	1171.20	1251.00	8698.85	134.00	1669.83	10368.68
	TOTAL:-	**1023**	**4892.90**	**6280**	**40305.81**	**18664**	**211574.34**	**1258**	**21034.84**	**278**	**3337.33**	**745**	**21597.57**	**27225.00**	**277807.89**	**1023.00**	**24934.90**	**302742.79**

(Source: 6th MI Census, West Bengal)

1.7. Urban area, Industries and Mining Activities:-

As per Census 2011, there are 19 urban units in Paschim Medinipur district. There are 7 nos. of Municipalities in the district viz. Ramjibanpur (M), Kshirpai (M), Chandrakona (M), Kharar (M), Ghatal (M), Medinipur (M), and Kharagpur (M). The remaining are classified as Census Towns numbering 10 and viz. Amlagora (CT), Garhbeta (CT), Durllabhganj (CT), Dwari Geria (CT), Naba Kola (CT), Kharagpur Rly.Settlement (CT), Kalaikunda (CT), Balichak (CT), Deuli (CT) and Chaulia (CT).

There are no significant industries; however significant MSME industries are present. There are a few sand mining units present in the district. Majority of them are presentacrossKangsabati and Subarnarekha Rivers.

CHAPTER-2
CLIMATE

2.1 Climate

The climate of the district is humid sub-tropical type.The district of Paschim Medinipur experiences fairly high mercury range in summer with average daily maximum temperature varies between 25ºC and 40ºC. Winter is generally dry and cold with average temperature around 17º C. The year may be divided into broadly four seasons. The cold season is from about the middle of November to the end of February. The summer season is from March to May.

The south west monsoon season starts about the beginning of June and lasts till the end of September. October and the first half of November may be termed as post monsoon season.The monsoon months are characterized by high humidity and heavy rainfall.

2.2 Rainfall

The average annual rainfall in the district is 1485 mm. Monsoon period from June to September experiences the majority of annual rainfall (around 74%). Maximum rainfall occurs in July and August months. The mean annual rainfall in the district varies from 1295 mm to 1637 mm. (Source- District Survey Report, Paschim Medinipur).Mean Annual Rainfall of Paschim Medinipur District is given in **Table 2.1**. Monthly Average Rainfall in Paschim Medinipur District is given in **Figure 2.1.**Isohyetal map of Paschim Medinipur District is given in **Figure 2.2.**

Table 2.1 Mean Annual Rainfall of Paschim Medinipur District

Month	2016 (mm)	2017 (mm)	2018 (mm)	2019 (mm)	2020 (mm)	Average
Jan	6	5	0	0	41.6	10.52
Feb	48	0	3.4	107.2	11.3	33.98
March	27.4	43.9	1.6	63.6	62.6	39.82
April	12	17.4	99.1	75.7	113.8	63.6
May	133.5	109.2	109.3	113	262.6	145.52
June	161.1	205.5	187.7	128	240.3	184.52
July	359.2	411.7	259.7	216.9	217.4	292.98
August	371.7	311.9	300.9	397.9	368.9	350.26
Sept	192.2	202.7	229.6	361.7	134.3	224.1
Oct	71.6	203.4	72.7	125.5	84	111.44
Nov	8.6	32.1	7.1	40	10.8	19.72
Dec	0	9.3	23.8	7.6	0	8.14
Yearly Total (mm)	1391.30	1552.10	1294.90	1637.10	1547.60	1484.60

(Source- District Survey Report, Paschim Medinipur)

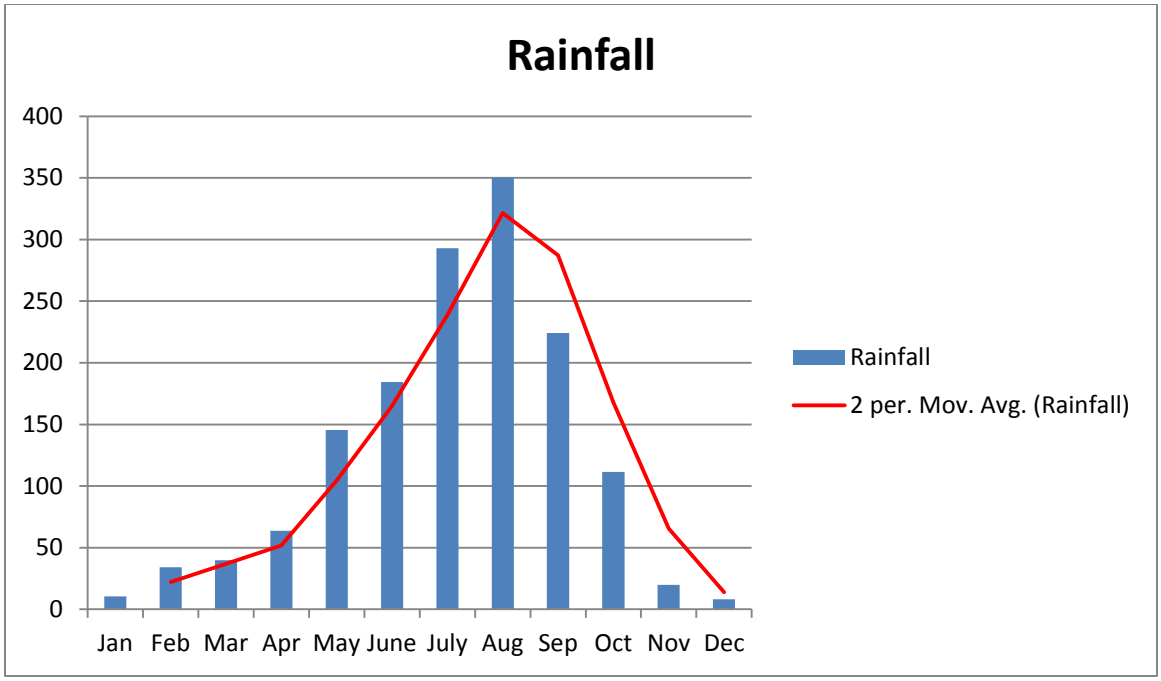


Figure 2.3 Monthly Average Rainfall in Paschim Medinipur District

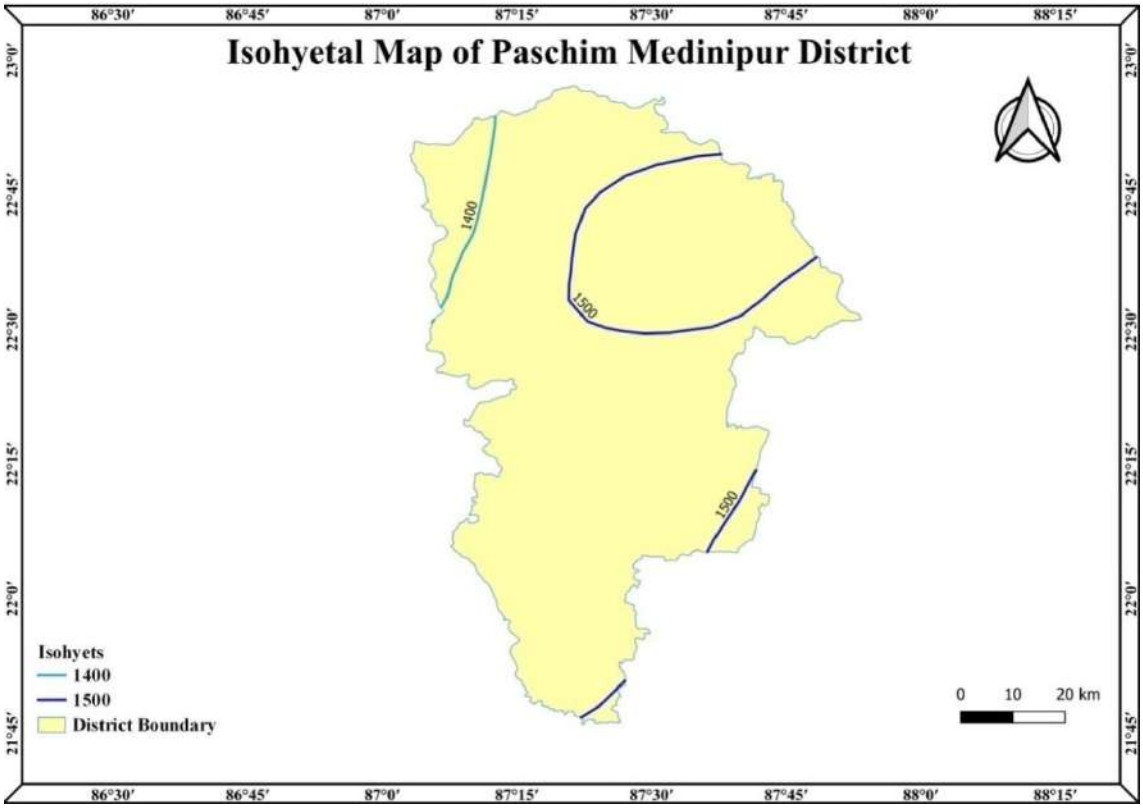


Figure 2.4 Isohyetal map of Paschim Medinipur District

2.3 Temperature

The temperature of the district is more or less uniform. April and May are the hottest months with mean maximum daily temperature of 38.6^{0}C and mean minimum daily temperature of about 26.4^{0}C. January is the coldest month with the mean daily maximum and minimum temperature at 26.2ºC and 12.5ºC respectively.Monthly mean temperature (in °C) distribution of Paschim Medinipur District is given in **Table 2.2.**Minimum and maximum monthly temperatures in Paschim Medinipur District are given in **Figure 2.3.**

Table 2.2 Monthly mean temperature (in °C) distribution of Paschim Medinipur District

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Min T	12.5	15.2	20	24.3	26.4	26.4	25.7	25.7	25.3	22.7	16.7	13.1
Max T	26.2	29	34.6	38.6	38	36	32.1	31.9	32.1	31.4	28.8	26.3

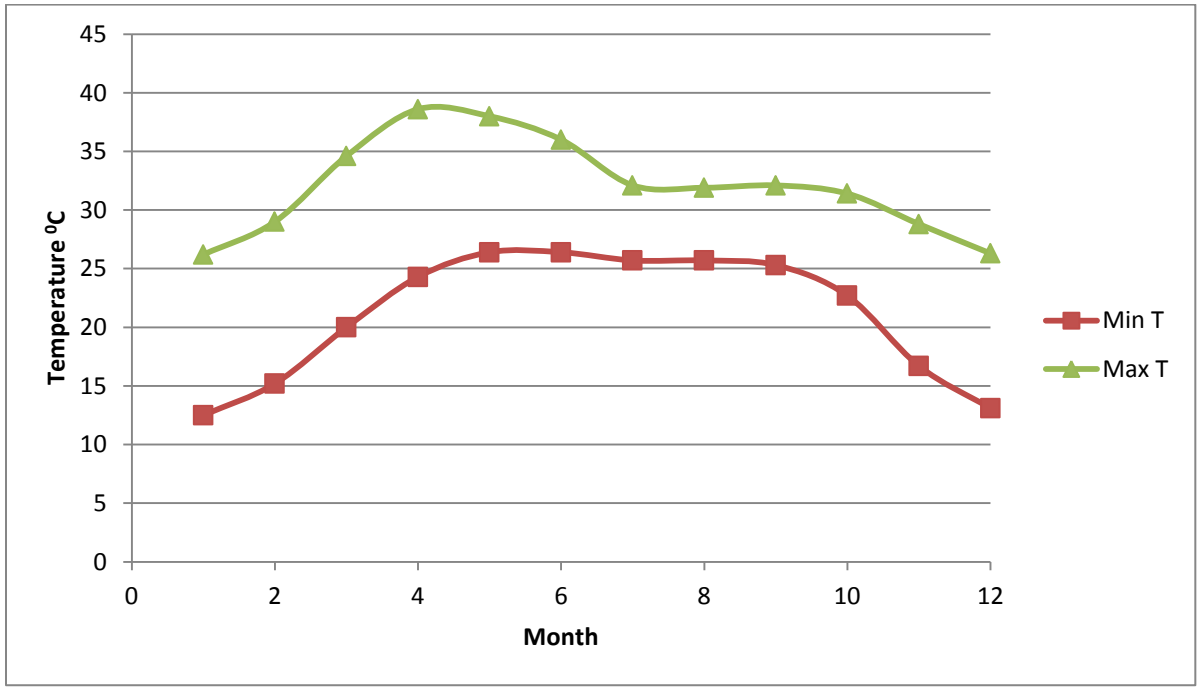


Figure.2.3 Minimum-Maximum monthly temperatures in Paschim Medinipur District

(Source-District Survey Report, Paschim Medinipur)

2.4 Humidity and Wind

Humidity is high throughout the year, but in the summer months, March and April, there is comparatively low relative humidityvarying from 64 to 75 % in the morning and 30 to 40 % in the afternoon. The humidity increases from May onwards and the skies are moderately to heavily cloudy. In the south-west monsoon season; the cloudiness increases and skies are mostly heavily clouded or overcast. From October the cloudiness decreases and in the next six months skies are clear or lightly clouded. Winds are generally light or moderate, with a slight increase in force in the summer seasons.

2.5 Evapo-Transpiration

Evapotranspiration plays a combined role where loss of water in the form of vapour occurs from the surface soil and from the leaves of the plants which is also directly related to the zone of aeration and also the capillary fringe of the saturation zone.

CHAPTER 3

GEOLOGY

The area is covered mostly by Quaternary sediments, except in the north-western parts where older rocks are exposed. The older rocks in the area belonging to Palaeo-proterozoic age group are represented by (i) Singhbhum group consisting of mica schist, phyllite, garnet-staurolite schist and quartzite, (ii) Dalma volcanics, consisting of carbon-phyllite, volcanics, pyroclastics, epidiorites and hornblende-schist in the north-western part of the district, around Silda, Jamboni area adjacent to Purulia district, and (iii) Younger intrusives belonging to Meso-proterozoic age, consisting of Kuilapal granite and quartz tourmaline rocks. Cainozoic laterites in the north-western and south-western parts of the district represent hard crust at the top, followed by a layer of nodular lateritic mass that grades down through a lithomarge (saprolite zone). There are numerous exposures of laterite in the area giving rise to bi- or tri-profile sequence indicating "in-situ" nature. The Cainozoic gravel bed (Tertiary gravel bed) constitutes gravels and pebbles of quartz, which are occasionally embedded in the laterites.

The oldest Quaternary deposits exposed in the area comprise Lalgarh formation of Early Pleistocene age consisting of fragments of quartz, phyllite, granite pebbles and gravels occasionally lateritised. The Quaternary sediments are mostly of fluviatile origin and have been deposited by the Subarnarekha, Kangsabati and Rupnarayan rivers. The Sijua formation consists of the sediments of older alluvium, comprising hard clay and silt, impregnated with caliche concretions. The overlying sediments of Basudevpur and Panskura formation constitute older flood plain deposits, consisting of sand, silt and clay of different flood regimes. The plain area lying along the coast southeast stretching from Ghatal, Tamluk, Haldia, to Contai, Digha etc., is covered by recent or younger alluvium. Recent or younger alluvium is seen to have made inroads into the laterite covered upland part of the district along the various river channels draining the area. The boundary between the laterite covered upland part of the district and the plain area lying to the south-east part of the district runs almost NNE-SSW through Chandrakona, Narayangarh and Dantan forming the transitional zone. The area, southeast and east of lateritic uplands characteristically forms monotonous plain, which is mainly underlain by grey clay of

recent age, which are overlain by more recent beach sand deposits down to a depth of 9 m at Digha (CGWB, 1982). Towards the sea, the sediments become richer in arenaceous material and on the beach area dune sands of variable sizes occur. The present day flood plain deposits are composed of sand and silts of different layers.

The geological formations, as developed in the district, range from the Precambrian consolidated rocks in the north-western part to the recent unconsolidated sediments in the alluvial plains. Phyllites, mica schists, hornblende schists, dolerites and quartzites are the most common hard consolidated rocks. The foliation of the schistose and phyllite rocks is NE-SW (CGWB, 2006). Weathering of these rocks along the structurally weak planes (fractures, foliation and joint planes) caused formation of loose regolithic material. These rocks are found to occur around Silda-Jamboni-Binpur areas adjacent to Purulia district of West Bengal and Singhbhum district of Jharkhand (Paschim Medinipur District Brochure, CGWB).

The Lateritic upland areas, the western part stretching from Garhbeta to Keshiary through Medinipur-Kharagpur are underlain by a thick sequence of clay, silt, sand of various grades and gravel.(Paschim Medinipur District Brochure, CGWB).The lithological correlation of subsurface horizons from Garhbeta in the north to Gopiballabhpur (now in Jhargram district) in southwest on one hand to Debra, Panskura, Tamluk, Haldia etc. on east and southeast on the other, shows that the Pleistocene lateritic sequence continues to the coastal parts, while boththe upland parts as well as the coastal plains are underlain by Tertiary sediments, being predominantly of grey colour. The Tertiary age of the grey sequence is supported by the shark teeth fossils at Salua near Kharagpur, which indicates a Mio-Pliocene age for the sediments in the adjacent area of Baripada in Mayurbhanj district, Odisha, which are obtained from a similar geological setting (CGWB, 1982).

The General Geological Succession is given in **Table 3.1.**

The Geological Map of Paschim Medinipur District is given in **Figure 3.1.**

Table 3.1.General Geological succession of Medinipore District (GSI)

Age	Geological Unit	Lithology	Nature and Characteristics
Holocene	Present Day Flood Plain Deposits	Sands and silts in alternate layers.	Soft unconsolidated sediments, low slope, flood proneness confined to flood plain areas, landforms of Sijua formation are on higher ground and devoid of any flood or waterlogging hazard.
	Present Day Beach Deposits	Fine to medium sands, greyish brown in colour.	
	Recent dune sand deposits	Sands, white to greyish yellow in colour, well sorted.	
	Basudebpur formation	Sands, silts and clays deposited in different flood regimes,no oxidation effect.	
	Panskura formation	Sands with silts, clays associated with Fe-nodules.	
Upper Pleistocene to Lower Holocene	Sijua formation	Greenish grey clay,impregnated with caliche nodules	
Pleistocene	Lalgarh formation	Fragments of quartz, phyllite, granite pebbles and gravels occasionally lateritised	Vast pediplain with highs and lows, immense soil erosion forming badland topography.
Cainozoic (undifferentiated)	Laterite	Laterite with occasional ring like growth of Silica	Hard crust Laterite body with pronounced soil erosion
	Tertiary Gravel Bed	Gravels of different size	Gravels, subrounded, elongated occasionally silica cemented
Miocene to Pliocene	Bhairab Banki Formation	Clay, Grit and Conglomerate	Flat terrain with scattered exposures
Mesoproterozoic	Younger Intrusive	Tourmaline-quartz rock Kuilapal Granite	Hard, foliated, easily weathered
Palaeoproterozoic	Dalma volcanics	Epidiorite/Hornblende Schist Quartzite Carbon Phyllite	Hard, both compact and schistose, grey colour banding Soft, flaky, low to medium slope
	Singhbhum Group	Quartzite	Hard layered, high to medium slope

		Garnet-Staurolite schist with Kyanite	Soft, rolling topography
			Soft, flaky
		Phyllite	Soft, flaky
		Mica schist	

(Source-Geological Survey of India)

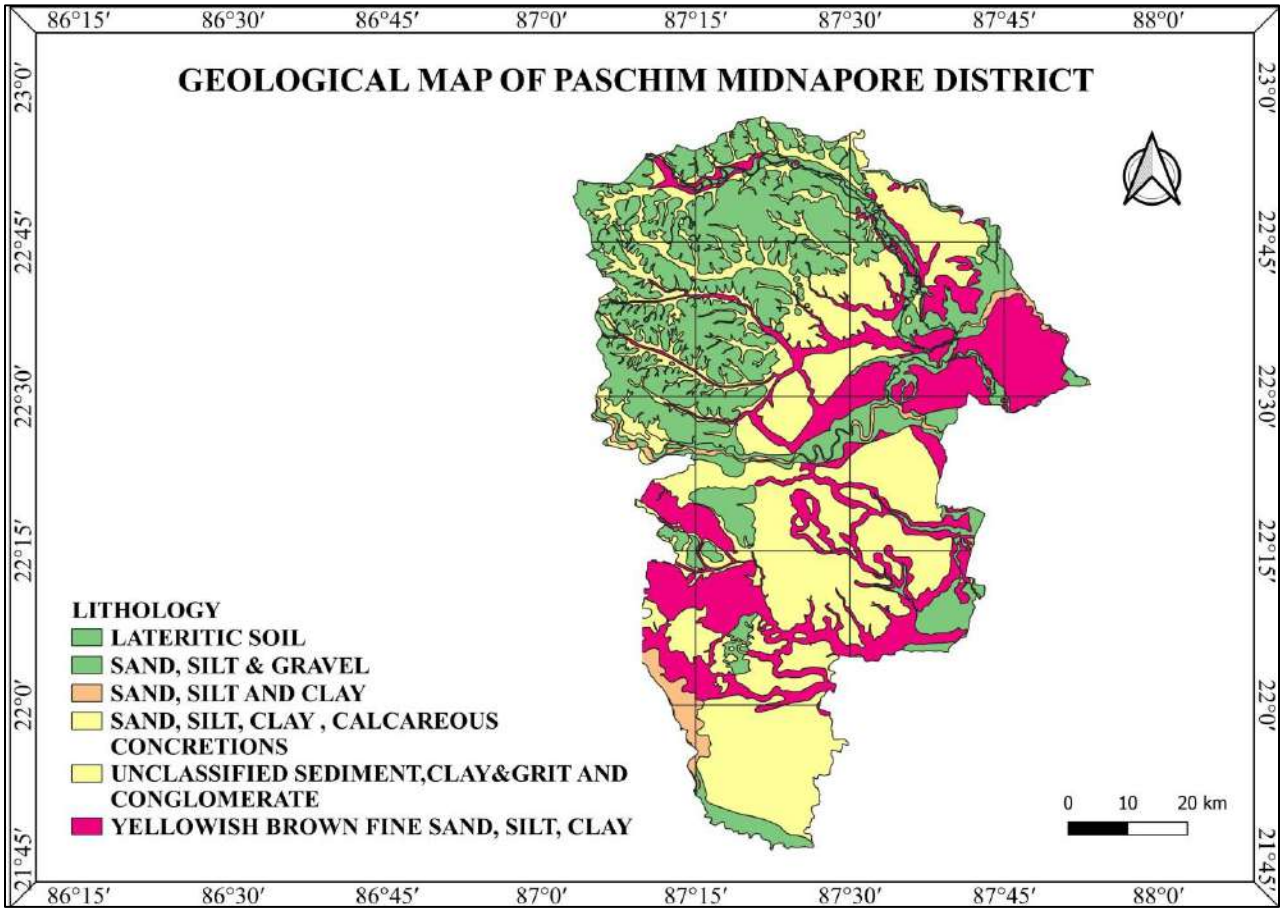


Figure 3.1 Geological Map of Paschim Medinipur District

CHAPTER 4

GEOMORPHOLOGY

Physiographically, the district of Paschim Medinipore can be divided into three distinct geomorphological units: (i) hard rock terrain with extremely rugged topography in the extreme north-western part of the district, occasionally covered by laterites. (ii) Laterite covered platform sedimentary areas underlain by deposits of older alluvium bearing rolling plains and (iii) more or less flat alluvial plain of Recent age to the east and south-east. The district presents a gradually sloping topography. The highest altitude is 132 m above M.S.L near Silda in the west, 7.55 m above M.S.L near Daspur in the east and 18.06 m above M.S.L near Sarsankha in the south-east.

4.1.Terrain

4.1.1.DIGITAL ELEVATION MODEL (DEM)

The topographic details and the land surface relief features of the NAQUIM area were prepared using SRTM (Shuttle Radar Topography Mission) DEM **(Figure 4.1).**

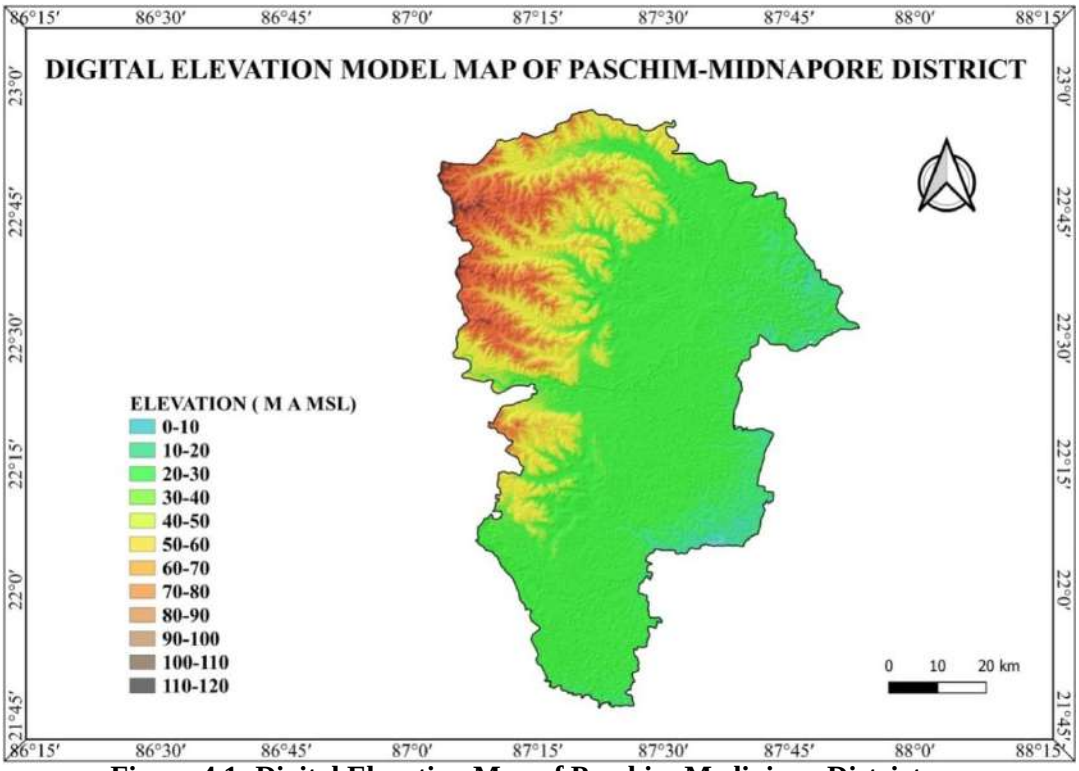


Figure 4.1- Digital Elevation Map of Paschim Medinipur District

Based on the SRTM Elevation data and studying the Toposheets, the Geomorphological map was prepared as given in **Figure 4.2**:-

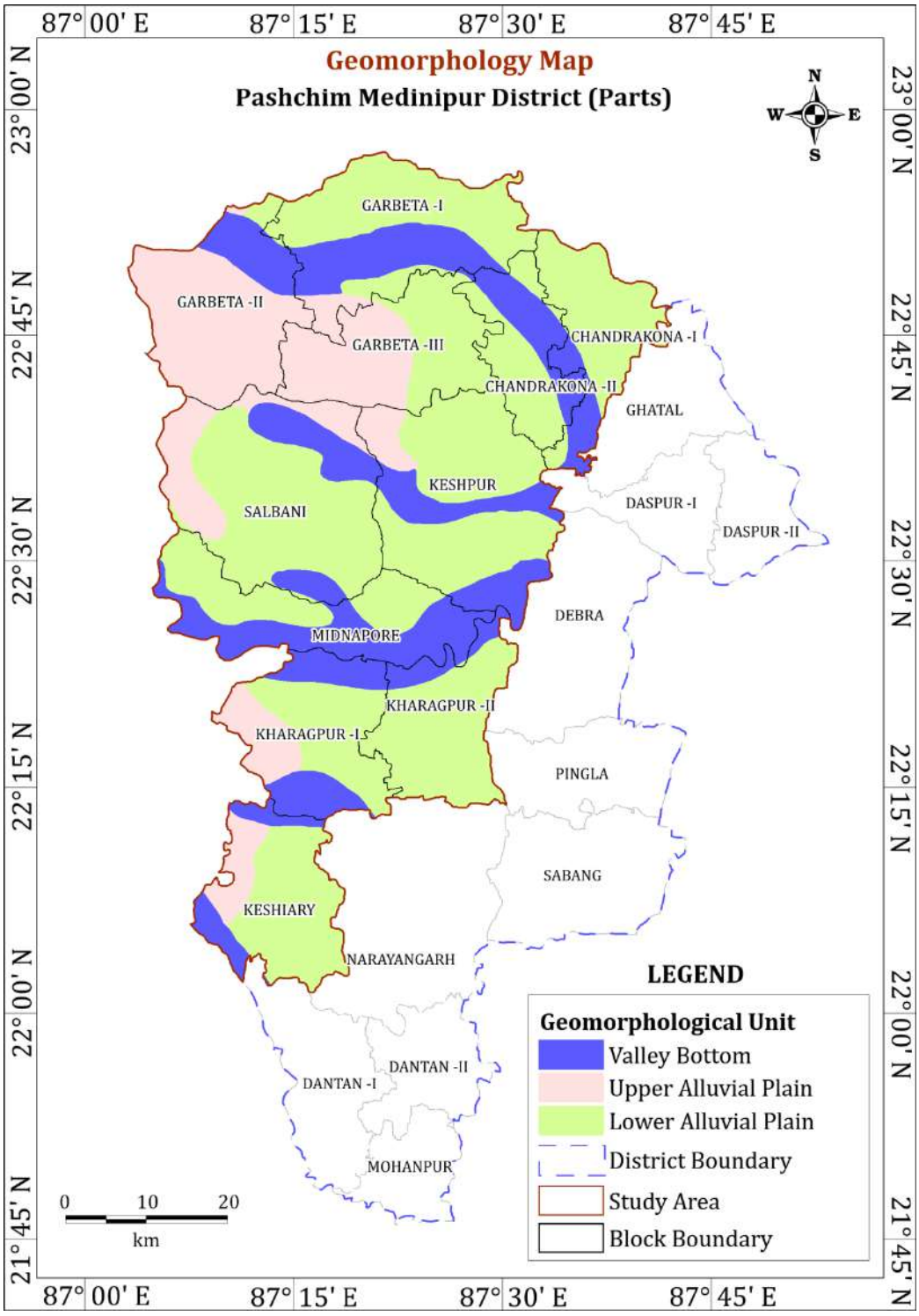


Figure.4.2 - Geomorphological map of Paschim Medinipur District

4.1.2. Drainage

Silabati, Kangsabati, Subarnarekha, Pichaboni and Rupnarayan are the major rivers.The tributaries to the major riversare Silai, Tamal, Betai, Kubai, Parong, Palasal, Dulung etc.Kangsabati River flows in a meandering course from NW to SE and on its way traverses through Medinipur town and meets the Hugli river near Haldia Anchorage in Purba Medinipur district. Rupnarayan River flows through the Northern-Eastern part of the district. Subarnarekha river which enters from Mayurbhanj district, Odisha, flows through the towns of Gopiballavpur and Nayagram and flows through the south-western part of the district of Paschim Medinipur.

Rupnarayan is generated from the combined flow of river Dwarakeswar and river Shilabati / Shilai /Silai. Shilabati is the largest tributary of the river Rupnarayan and emerges from the confluence of several smaller river streams generated from the Chhota Nagpur Plateau like Purandar, Shalad, JoyPonda, Parang, Betai, Donai, Amlagura etc. and passes through district Purulia, Bankura and enters district Paschim Medinipur after meeting river Joy-ponda at village Kenja in Block Garhbeta II. It then flows in West – South-West direction and passes through Blocks Garhbeta I, Chandrakona II, Chandrakona I and Keshpur. From Keshpur, river Shilabati moves in North- North-East direction through Blocks Debra and Dantan. Beyond Ghatal, Rupnarayan flows in South- South-Easterly direction creating the boundary of district Paschim Medinipur with districts Hugli and Haora to the East respectively, to ultimately join river Hugli (Hooghly).

Subarnarekha river originates near Nagri Village in Jharkhand in the Chhota Nagpur Plateau region, and enters district Jhargram near Bhatandiha in Gopiballavpur I, Gopiballavpur II, Sankrail and Keshiyari and Dantan blocks in Paschim Medinipur and then exits the district to enter State of Odisha.The groundwater basins in the district mostly belong to the Ganga basin and a separate basin is formed by the Subarnarekha River.

Kangsabati river originates in Chotanagpur Plateau near Muruguma in Jhalda II block of district Purulia. It then passes through district Bankura and enters district Paschim Medinipur near village Basantapur in Binpur I Block. District Head Quarter Medinipur and Kharagpur are located near the banks of river Kangsabati. Kangsabati Irrigation Project and Kangsabati reservoir is built in the upper course of the river to utilise the river water for irrigation purpose

across the Western districts of West Bengal. (Source: District Survey Report, Paschim Medinipur, 2020). Drainage Map of the NAQUIM area is given in **Figure 4.3.**

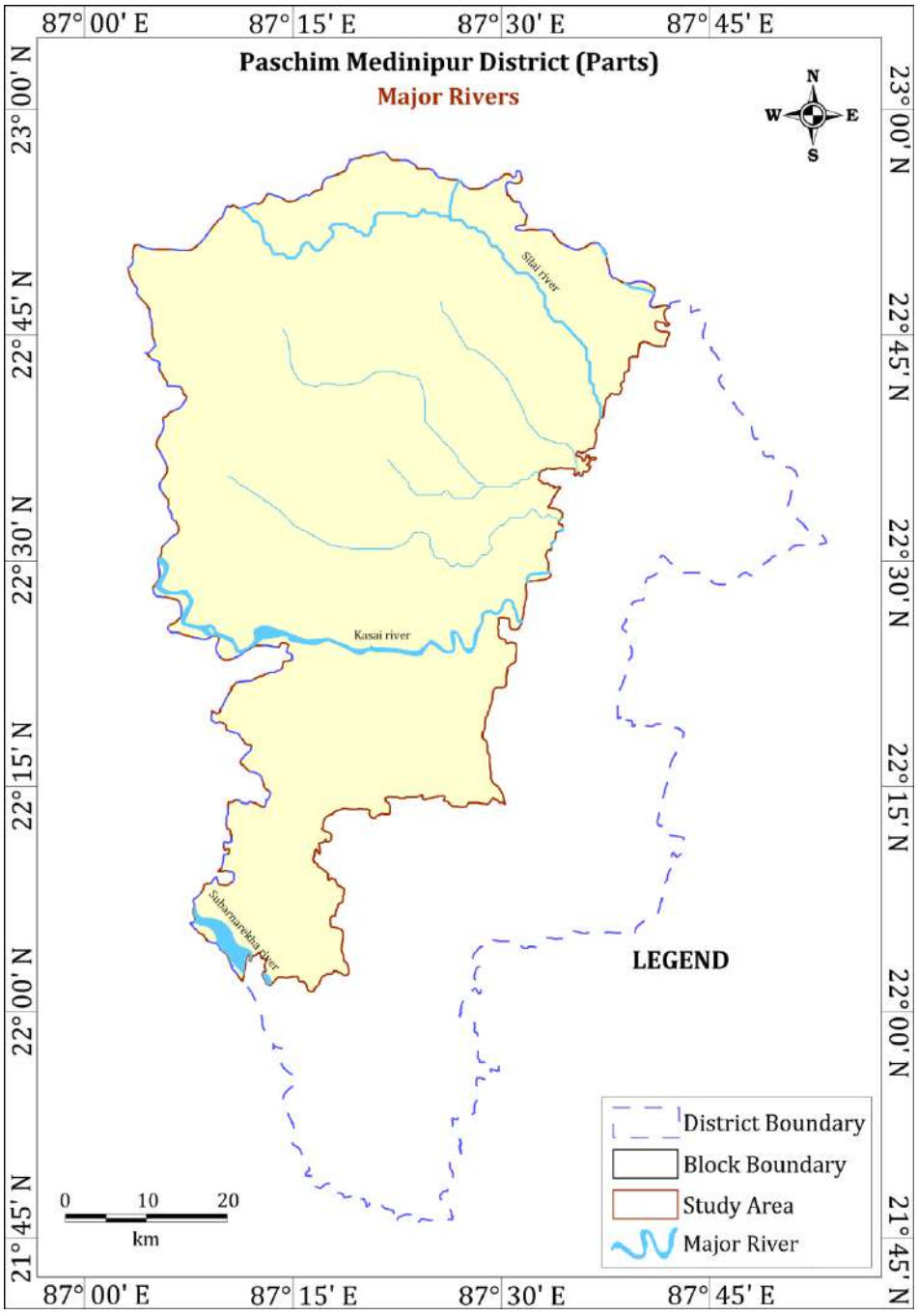


Figure 4.3.Drainage Map of Paschim Medinipur District (covering parts of NAQUIM 2022-23)

4.1.3. Sub-basin wise area of blocks

Four major drainage sub-basins have been demarcated and the sub-basin wise area of the blocks have been calculated. Drainage map with sub-basins of Paschim Medinipur District is shown in **Figure 4.4** and River Sub-Basin Area of NAQUIM Blocks is given in **Table 4.1.**

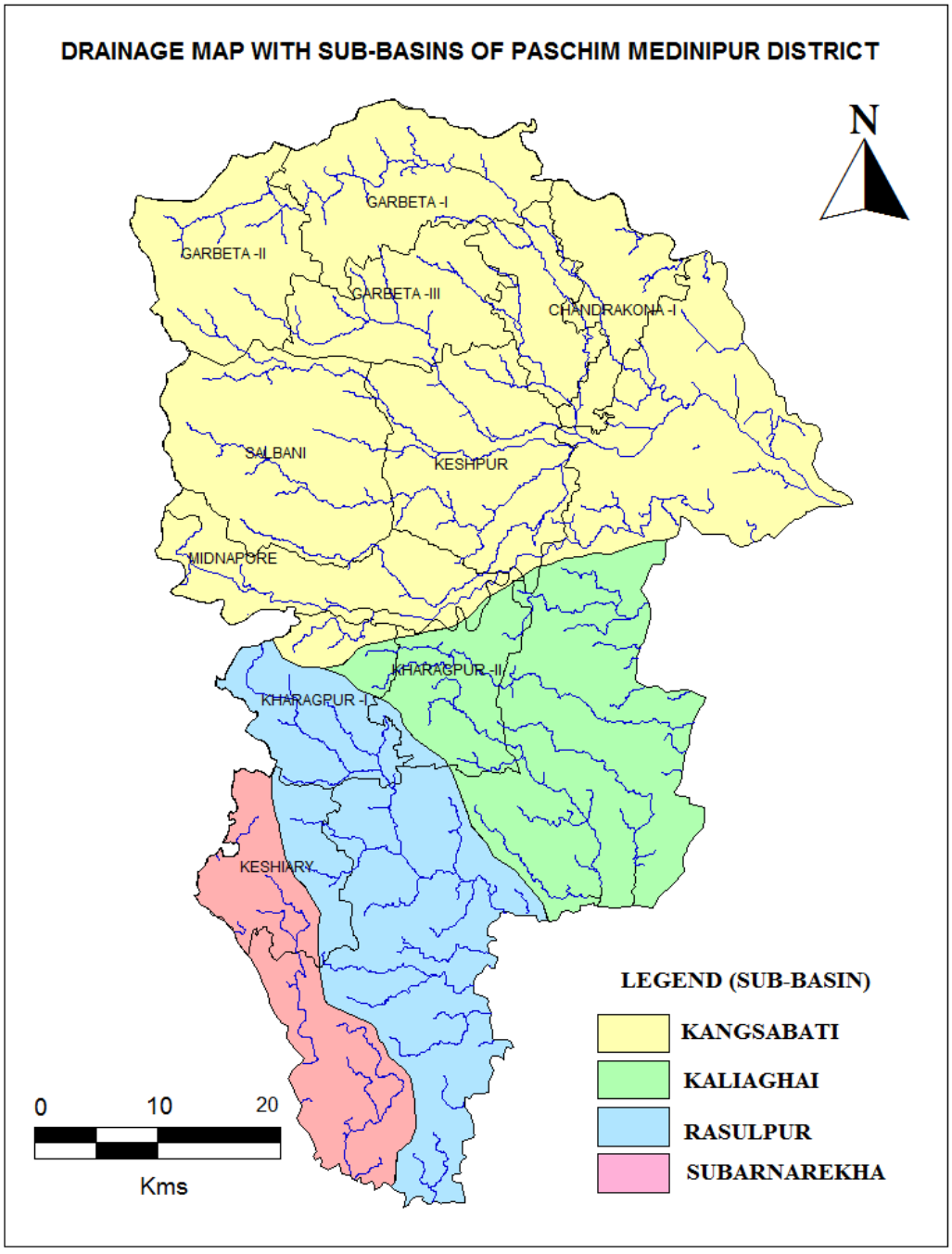


Figure 4.4. - Drainage map with sub-basins of Paschim Medinipur District

Garhbeta-I Block: - The area of Garhbeta-I block is 361.87 Sq.Kms. The entire block falls in Kangsabati sub-basin area. The block is drained majorly by first and second order streams.

Garhbeta-II Block: - The area of Garhbeta-II block is 392.55 Sq.Kms. The entire block falls in Kangsabati sub-basin area. The block is drained by first and second order streams.

Garhbeta-III Block: - The area of Garhbeta-III block is 312.8 Sq.Kms. The entire block falls in Kangsabati sub-basin area. The block is drained by first and second order streams.

Chandrakona-I Block: - The Chandrakona-I block has an area of 193.54 Sq.Kms. The entire block falls in Kangsabati sub-basin area. The block is drained by first and second order streams.

Chandrakona-II Block : - Chandrakona-II block has an area of 150.44 Sq.Kms. The entire block falls in Kangsabati sub-basin area. The block is drained by first, second and third order streams.

Salbani Block : - The area of Salbani block is 553.40 Sq. Kms. The entire block falls in Kangsabati sub-basin area. The block is drained by first and second order streams.

Keshpur Block: - The area of Keshpur block is 483.20 Sq. Kms. The majority of the block falls in Kangsabati sub-basin area (478.86 Sq Kms) and a minor portion of the block falls in Kaliaghai sub-basin area (4.29 Sq Kms). The block is drained by first, second and third order streams.

Midnapore Block: - The area of Midnapore block is 323.64 Sq. Kms. The majority of the block falls in Kangsabati sub-basin area (319.80 Sq Kms) and a minor portion of the block falls in Kaliaghai sub-basin area (3.84 Sq Kms). The block is drained by first, second and third order streams.

Kharagpur-I Block: - The area of Kharagpur-I block is 313.30 Sq. Kms. The majority of the block falls in Rasulpur sub-basin area (222.25 Sq Kms) and some portion of the block falls in Kangsabati sub-basin area (58.75 Sq Kms) and Kaliaghai sub-basin area (32.30 Sq Kms). The block is drained by first, second and third order streams.

Kharagpur-II Block: -The area of Kharagpur-II block is 187.47 Sq. Kms. The majority of the block falls in Kaliaghai sub-basin area (187.47 Sq Kms) and some portion of the block falls in Kangsabati sub-basin area (58.60 Sq Kms), while minor portion of the block falls in Rasulpur sub-basin area (19.56 Sq Kms). The block is drained by first and second order streams.

Keshiary Block: - Keshiary block has an area of 265.60 Sq Kms. The block falls in Rasulpur and Subarnarekha sub-basins. The Rasulpur sub-basin drains an area of 114.13 Sq Kms and Subarnarekha

sub-basin drains an area of 177.97 Sq Kms. The block is drained majorly by first and second order streams.

Table 4.1. River Sub-Basin Area of NAQUIM Blocks Of Paschim Medinipur (NAQUIM 2022-23)

RIVER SUB-BASIN AREA OF NAQUIM BLOCKS OF PASCHIM MEDINIPUR (NAQUIM 2022-23)					
	NAQUIM BLOCKS	**KANGASABATI SUB-BASIN AREA (Sq Kms)**	**KALIAGHAI SUB-BASIN AREA (Sq Kms)**	**RASULPUR SUB-BASIN AREA (Sq Kms)**	**SUBARNAREKHA SUB-BASIN AREA (Sq Kms)**
1	Chandrakona-I	193.54	0	0	0
2	Chandrakona-II	150.44	0	0	0
3	Garhbeta-I	361.87	0	0	0
4	Garhbeta-II	392.55	0	0	0
5	Garhbeta-III	312.80	0	0	0
6	Salbani	553.40	0	0	0
7	Keshpur	478.86	4.29	0	0
8	Midnapore	319.80	3.84	0	0
9	Kharagpur-I	58.75	32.30	222.25	0
10	Kharagpur-II	58.57	187.47	19.56	0
11	Keshiary	0	0	114.13	177.97
	TOTAL	2880.58	227.90	355.94	177.97

4.1.4. Estimation of Watershed Yields

The total quantity of surface water that is yielded from a catchment area of sub-basin depends on various factors like the amount of precipitation, runoff, infiltration and evapotranspiration **(Table 4.2)**

Table 4.2:- Block wise calculation of Surface Runoff (Monsoon and Non-Monsoon)

BLOCK	AREA (SQ KMS)	AVG ANNUAL RAINFALL (MONSOON) mm	AVG ANNUAL RAINFALL (NON-MONSOON) mm	TOTAL ANNUAL RAINFALL (mm)	SURFACE RUNOFF (MONSOON) BCM	SURFACE RUNOFF (NON-MONSOON) BCM
CHANDRAKONA-I	193.5	1582.8	699.2	2282	0.04595	0.02029
CHANDRAKONA-II	150.44	1582.8	699.2	2282	0.035717	0.01577
GARBETA-I	361.8	1160	615	1775	0.062965	0.03338
GARBETA-II	392.5	1792.6	625.6	2418.2	0.105553	0.03683
GARBETA-III	312.8	1751.7	659.92	2411.6	0.08219	0.03096
KESHIARY	292.1	1689.2	552.6	2241.8	0.074012	0.02421
KESHPUR	483.1	1812	759.4	2571.4	0.13132	0.05503
KHARAGPUR-I	313.3	1751.7	659.92	2411.6	0.082321	0.03101
KHARAGPUR-II	265.6	1751.7	659.92	2411.6	0.069788	0.02629
MIDNAPORE	323.6	1751.7	659.92	2411.6	0.085038	0.03203
SALBANI	553.4	1751.7	659.92	2411.62	0.145409	0.05478
					0.920264	0.360628

The total surface runoff during Monsoon and Non-Monsoon are calculated block wise for the eleven NAQUIM blocks by taking surface runoff coefficient as 15%. The surface runoff calculated is 0.92 BCM for monsoon and 0.36 BCM for non-monsoon. Maximum surface runoff calculated (monsoon) is 0.145 BCM from Salbani block and minimum surface runoff calculated (monsoon) is 0.036 BCM for Chandrakona-II block. Maximum surface runoff calculated (non-monsoon) is 0.054 BCM from Salbani block and minimum surface runoff calculated (monsoon) is 0.016 BCM for Chandrakona-II block.

4.1.5. Pedology

The district broadly characterized by five types of soil viz., lateritic, older alluvial, red gravelly, red sandy, younger alluvial. Among them, older alluvial soil covers maximum area with 4065.36 km2 (43.40%) followed by lateritic covering 3056.76 km2 (32.63%) and red sandy soil type cover a minimum area with 402.98 km2 (4.30%). (Source-District Survey Report, Paschim Medinipur).

The coarse loamy soil occurs in parts of Garhbeta-I, Garhbeta-II, Garhbeta-III, Salboni, Medinipur, Kharagpur-I and Keshiary. The clay content is between 0% to 18 % and silt and sand make up the remainder. The two textures in this class are Sandy Loam and loam.

The fine loamy soil occurs in majority of the areas of Garhbeta-I, Garhbeta-II, Garhbeta-III, Salboni, Keshpur, Medinipur, Kharagpur-I, Keshiary, Chandrakona-II and in part areas of Chandrakona-I and Kharagpur-II blocks. The clay content is between 18 and 35%. Sand and silt make up the remainder. Textures in this class are, fine sandy, loam, sandy clay loam, clay loam and silty clay loam.

Soils with 35 to 60% clay in the subsoil are Fine soils. This type of soil occurs in majority areas of Chandrakona-I, Chandrakona-II, Keshpur and Kharagpur-II and in minor areas of Garhbeta-I and Garhbeta-III.

Soils with more than 60 % clay in the subsoil are very fine soils. This type of soil occurs in part areas of Keshpur, Medinipur, Kharagpur-I, Kharagpur-II and in a very narrow stretch in Chandrakona-I block.(Morris, L.A. 2017.).

Hydrogeological characteristics of Soils in NAQUIM area is given in **Table 4.3.** Soil map of the NAQUIM area is given in **Figure 4.5.**

Table 4.3. Hydrogeological characteristics of Soils in NAQUIM area

Soil Class	Area covered	Hydrogeological characteristics
Coarse Sandy Loam	653.10 Sq Kms	Well drained and highly permeable, porosity 20-35%, specific yield 27%, hydraulic conductivity 10^{-3} to 10^{-1} cm s^{-1}, and slightly eroded.
Fine Sandy Loam	2263 Sq Kms	Well to moderately drained and well permeable, porosity 20-35%, specific yield 21%, hydraulic conductivity 10^{-5} to 10^{-3} cm s^{-1}, and very slightly eroded.
Fine	634.30 Sq Kms.	Moderate to poorly drained and slowly permeable, specific yield 18%, porosity 33-50%, hydraulic conductivity 10^{-6} to 10^{-4} cm s^{-1}, and severely eroded.
Very Fine	227.9 Sq Kms.	Poorly drained and slowly permeable, specific yield 6%, porosity 33-60%, hydraulic conductivity 10^{-7} to 10^{-5} cm s^{-1}, and severely eroded.

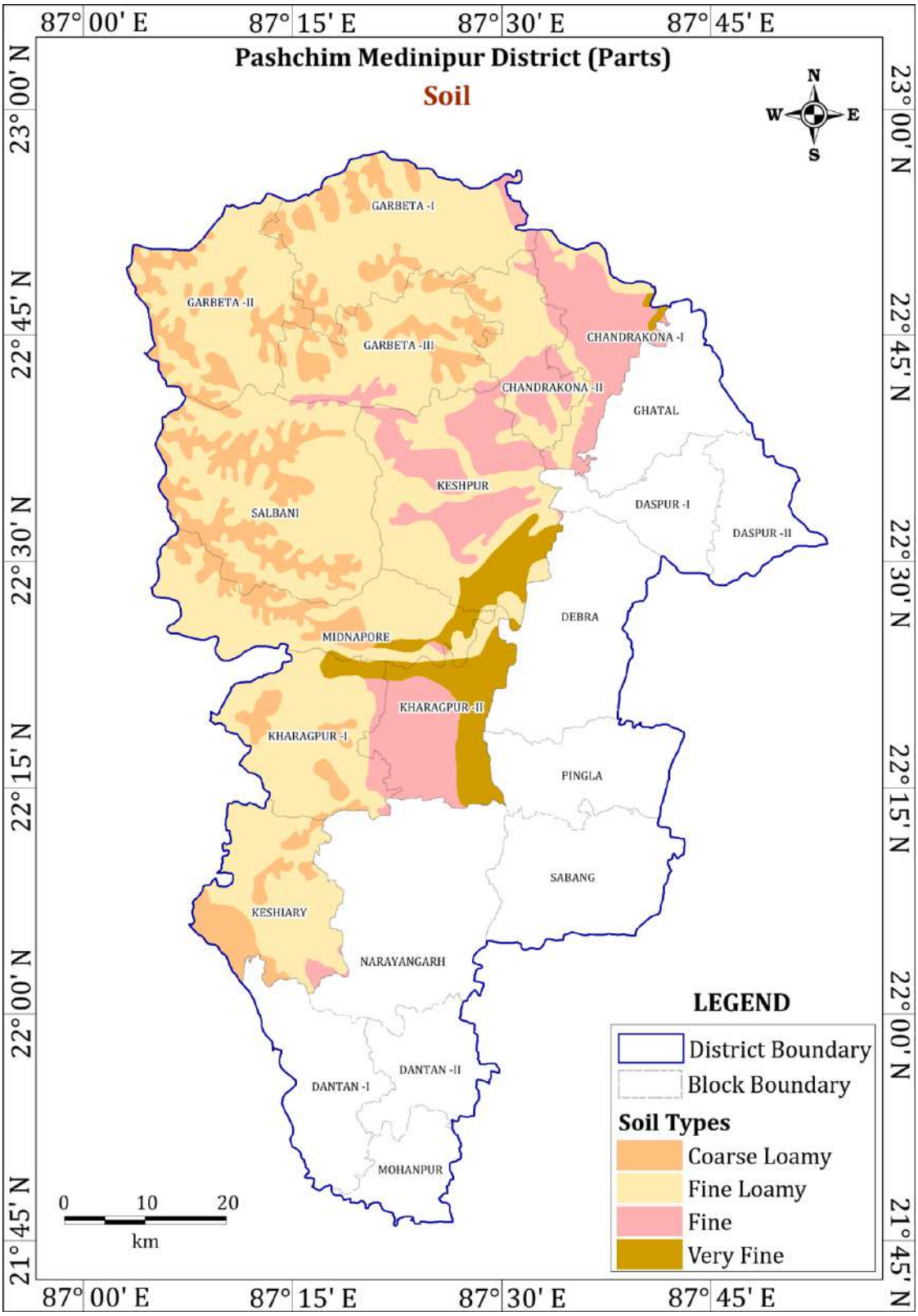


Figure 4.5 Soil map of Paschim Medinipur District (parts)

CHAPTER 5

GEOPHYSICS

5.1. Geophysical Studies

A total eighteen (18) VES were conducted on Kasai basin, Medinipurdistrict, West Bengal, covering an area of 10 Sq.Km. for tracingout the thickness of top unsaturated sand layer, saturated sandlayer and depth to the clay horizon for sinking tubewells fordrinking water supply purpose.Ten (10)VES were conducted in the southern part of Kasai basin in the district, WestBengal to delineate fresh water bearing granular zones.

5.2. Short Term Water Supply Investigations

Fifteen (15) VES and Two (2) Wenner profilings were conducted at New NotePress Project area, Salboni, Medinipur district, for pin pointingthe borehole sites. 2.095 line km. was covered during Wennerprofiling. 0.5328 Sq Km. was covered in the area. The shallowpotential granular zone is expected in the depth ranging from 10 to 20 mbgland that for the deeper is between 60 - 83 mbgl.

Four (04) VES were carried out for Air Force Base at Kalaikunda for findingout the aquifer systems and recommendation for depth drilling.

Nine (09) VES and 1 profiling were carried out for MES, Kalaikunda inconnection with demarcation of aquifer disposition.

Six (06) VES were carried out in Air Force area, Salua of the district in connection withthe identification of aquifer disposition.

Six (06) VES were carried out vithin Income Tax Quarter premises. The average rangeof shallow aquifer varies between 3 to 50 mbgl and that of deeper aquifer liesbelov/ 118 mbgl.

5.3 Reappraisal Geophysical Studies

Twenty-three (23) VES were carried out in around the Sadar of the district for identifying thesallow and deeper aquifers.

5.4 ResultsFrom Geophysical Resistivity Surveys (VES)

The results from the Geophysical Surveys (VES) carried out are mentioned as following in **Table 5.1.**

Table 5.1 Findings from Geophysical Resistivity Survey Data (VES)

District	Locations	Depth range of the fractures in mbgl	Depth range of the weathered/ granular zones	Remarks
New Note Press, Salboni			Shallow-10-20, deeper-60-80,12-171	Sand aquifers
Income Tax building complex			Shallow-3-50 Deeper-below 118	
MES, Kalaikunda			10-110	
Garbeta block			2-100	Fine to medium sand, coarse sand
Central Exiseresidential complex		40-50, 70-80	0-15	Ferruginous sandstone, ironstone shale and siltstone

The interpreted results of VES curves at New Note Press Project Area, Salboni are given in the next page and VES data of Income Tax Quarter premises, Medinipur are given in **Annexures-I and II.**Diagram of Geo-electric section at New Note Press Project Premises, Salboni is given in **Figure 5.1.**Results from Electrical Logs are given in **Table 5.4.**

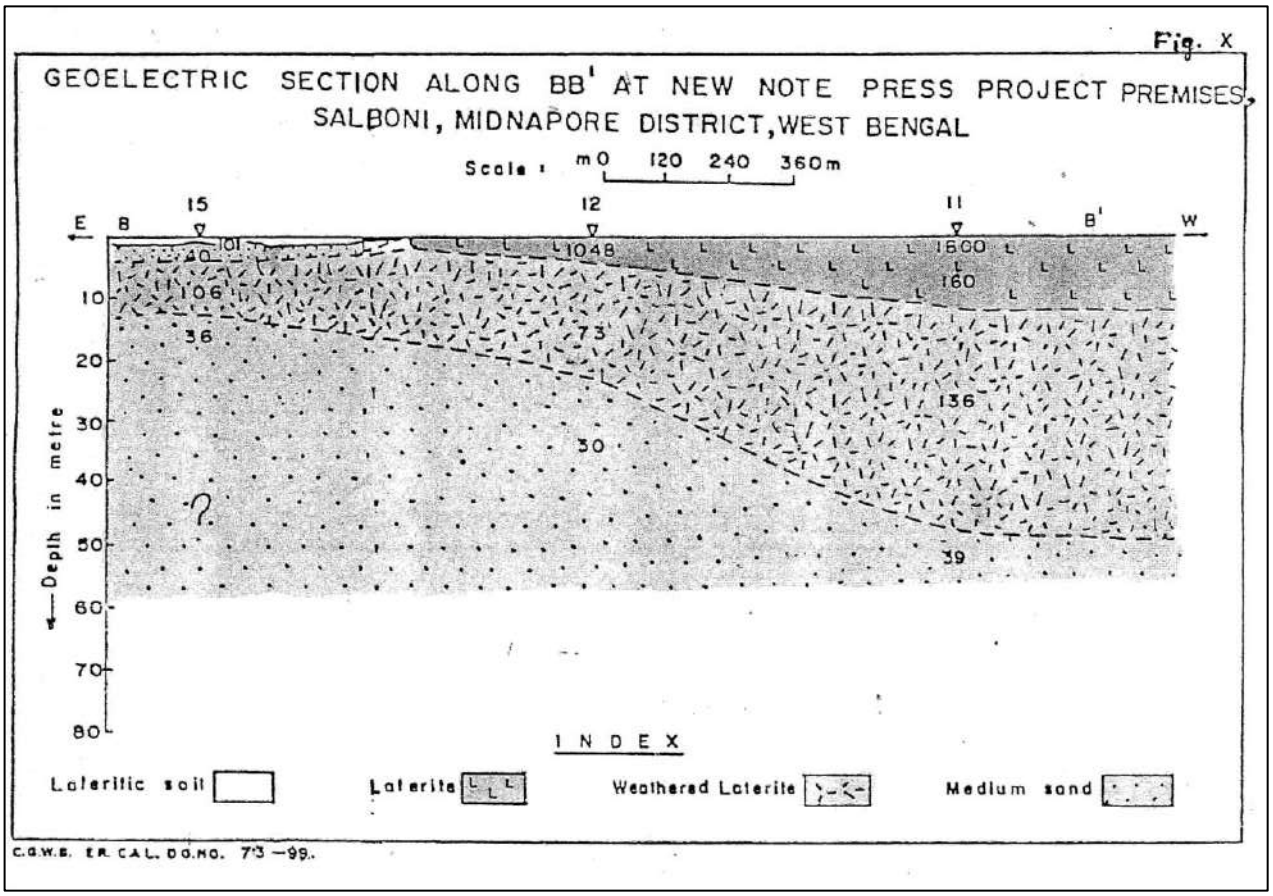


Figure 5.1 Geo-electric section along BB' at New Note Press Project Premises, Salboni, Medinipur District, West Bengal

Table 5.2 Results from Electrical Logs

Block	Location	Identified Granular Zones	Interpreted Results
Salboni	Salboni Fodder Farm, Block I	48.2-57.3	**Identified granular zones are fresh**
		61.0-73.2	
		90.2-96.3	
	Salboni Fodder Farm, Block II	38.0 - 68.0	**Identified granular zones are fresh**
		121.0-126.0	
		138.0 - 141.0	
		156.0 - 160.0	
		185.0-191.0	
		200.0-205.0	
		220.0-223.0	
		230.0-236.0	
		275.0 - 298.0	
Kharagpur-I	Kalaikunda MES	2.0 - 5.0	**Identified granular zones are fresh**
		28.0 -31.0	
		33.0 - 36.0	
		40.0 - 46.0	
		50.5-52.5	
		68.0 - 74.0	
		75.5 - 81.0	
		85.0-92.0	
		103.0-105.0	
		123.0 - 125.0	
		128.0- 132.0	
		155.0-159.0	
		166.0-183.0	
	Vidyasagar Abasan, Kharagpur	20.0-28.0	**Identified granular zones are fresh**
		30.0-38.0	
		54.0-58.0	
		65.0-71.0	
		89.0-92.0	
		105.0-109.0	
		114.0- 118.0	
		120.0-132.0	
		134.0-140.0	

Block	Location	Identified Granular Zones	Interpreted Results
	Kalaikunda MES	6.0-10.0	**Identified granular zones are fresh**
		15.0-19.0	
		35.0-53.0	
		58.0-60.0	
		62.0-71.0	
		77.0-86.0	
		111.0-125.0	
		130.0-163.0	
		168.0-175.0	
		185.0-196.0	

CHAPTER 6

HYDROGEOLOGY

6.1. Introduction

The area represents two distinct geomorphic and hydrogeological provinces, viz, (a) the upland area in the west, and (b) the alluvial plains in the east. In the upland areas, groundwater occurs under unconfined water table conditions within the laterite profile. The wells in this zone have a depth range from 5 mbgl to 20 mbgl. On the other hand, in the in the east and south-east of the district, groundwater occurs under unconfined to semiconfined condition. Near surface aquifers are tapped by tubewells ranging in depth range from 15 mbgl to 50 mbgl.

Existing borehole data from previous studies by CGWB indicates that there is lateral facies variation resulting in coalescing of granular zones and gradation into silty/clayey beds towards east, south and southeast. The top of the Tertiary sediment is generally represented by 'grey clay'. This grey clay bed is persistent throughout the area and is considered as the 'marker horizon' which separates the Quaternary sediments and Tertiary sediments. The arenaceous unconsolidated Quaternary sediments vary considerably in thickness from 60 m west and northwest to 150 m east and southeast. It is predominantly arenaceous in the north and northwest to mostly argillaceous in the south and southeast. The thickness of the newer alluvium varies between 10 m and 60 m in the NW-SE direction. The thickness of the older alluvium varies between 50 m in the northwest to over 90 m in the southeast direction. The newer alluvium is devoid of any significant granular zones.

6.2. Water bearing Formation

The major water bearing formations are the (a) the upland platform sedimentary region in the north western part of the district is characterized by the occurrence of laterite capping with older alluvium and upper tertiaries and (b) recent sediments (younger alluvium) of eastern and southern part of the district.

6.3. Aquifer Disposition

The north-western part of the study area is characterized by older alluvium with laterite capping followed by thick sand-clay sequence down to depth of 250 mbgl. The laterite capping and the top

sand-clay layers of 10-20 m depth constitute the near surface phreatic aquifer which is extensively developed by dug wells and show marked fluctuation between pre and post monsoon season. The laterite sequence and top soil is followed by sequence of clay, fine to medium grained sand, sandy clay, coarse sand upto 130-250 m depth. Ground water in these formations occurs under semi-confined conditions and in confined conditions in the tertiaries separated by thick clay beds from the surface aquifer.

Blockwise Aquifer Disposition and Parameters is given in **Table 6.3.1**

Table-6.3.1. Blockwise Aquifer Disposition and Parameters

Block / Taluka	Location	Latitude	Longitude	Type of Well	Depth drilled(m bgl)	Depth of Well Constructed (m bgl)	Zone tapped/ Fractures encountered (mbgl)	S.W.L. (m bgl)	Discharge (lpm)	Drawdown (m)	Transmissivity (m^2/day)	Storativity
Mohanpur I	Mohanpur	21.813	87.433	Pz-II	134.1	68	36.00-42.00,52.50-66.50		504			
Salboni	Salboni	22.644	87.326	Pz-I	200.6	177	80.00-90.00,114.00-119.00,170.00-175.00		1008			
Salboni	Salboni	22.644	87.326	Pz-II	101.4	87	59.00-85.00		504			
Salboni	Salboni	22.644	87.326	EW	229.66	128	45.68-52.49,65.45-71.01,82.69-89.33,104.99-135.18,112.21-115.40,118.56-124.67	15.34	745.8	6.9	43.151	
Pingla	Pingla	22.305	87.589	DPz	150	117	103.00-115.00					
Pingla	Pingla	22.305	87.589	SPz	95.6	77	64.00-76.00					
Pingla	Pingla	22.305	87.589	SPz	25	17	9.00-15.00					

Pingla	Jalchak	22.322	87.614	DEW-I	249.5	190	110.00-120.00,130.00-147.00,160.00-170.00,177.00-187.00		3900		4106	1.0x10-3
Pingla	Jalchak	22.322	87.614	DOW-I	200	161	147.00-159.00					
Pingla	Jalchak	22.322	87.614	SEW	100	72	42.00-44.00,67.0-70.0		840		772	5.7x10-4
Pingla	Jalchak	22.322	87.614	SOW	66	47	44.00-45.00					
Pingla	Jalchak	22.322	87.614	IPz	100	87	83.00-85.00					
Sabang	Sabang	22.186	87.633	SPz	30	21	13.00-19.00					
Kesiari	Kesiari	22.119	87.244	DEW-I	403.2	148	85.00-105.00,115.00-145.00		729	4.18	192 (Theis) 222 (Jacob)	4.5x 10-3
Kesiari	Kesiari	22.119	87.244	DEW-II	200	169	150.0-160.00,160.00-166.00					
Kesiari	Kesiari	22.119	87.244	DEW-III	250	223	190.00-220.00					

Kesiari	Kesiari	22.119	87.244	SEW-I	100	77	52.00-58.00,60.00-74.00					
Kesiari	Kesiari	22.119	87.244	SEW-II	100	41	31.00-37.00					
Narayangarh	Narayangarh	22.136	87.409	EW	229.21	130	68.58-79.24,86.25-97.23,115.21-126.79					
Daspur-I	Daspur	22.61	87.744	DEW-I	400.07	160	130.0-157.00		2940		3847	3.87x10-5
Daspur-I	Daspur	22.61	87.744	DOW-I	200	151	132.0-148.00					
Daspur-I	Daspur (I)	22.61	87.744	IPz-I	100	49	45.0-48.00					
Daspur-I	Daspur (I I)	22.61	87.744	IPz-II	200	174	171.0-174.00					
Dantan-I	Sarasankha	21.915	87.268	DEW-I	413.62	223	79.00-85.00,92.00-104.00,120.00-126.00,145.00-157.00,178.00-184.00,214.00-220.00		2640	16.778	2370 (Theis) 2649(Jacob) 3609 (Hantush)	1.9x10-2 1.1x10-2 8.1x10-3

Dantan-I	Sarasankha	21.915	87.268	DOW-I	300	221	80.00-86.00,92.00-104.0,120.00-128.00,145.00-151.00,178.00-184.00,214.00-220.00					
Dantan-I	Sarasankha	21.915	87.268	SEW-I	200	64	40.00-46.00,56.00-62.00					
Dantan-I	Sarasankha	21.915	87.268	SOW-I	65	58	39.00-44.00,52.00-57.00					
Dantan-I	Sarasankha	21.915	87.268	IPz	80	76	74.00-75.00					
Dantan-I	Sarasankha	21.915	87.268	DPz	420	407	398.00-406.00					
Medinipur Sadar	Kumarpur	22.441	87.304	EW	250	243	97.00 – 103.00,106.00 – 110.00,157.00 – 169.00,172.00 – 175.00,182.00 – 188.00,213.50 – 219.50,231.00 – 240.00	19.815	268.8	2.912	530.24	5.125 X 10-4
Medinipur Sadar	Kumarpur	22.441	87.304	OW	242.24	239.5	99-102,107-110,160-166,172-175,184-187,215-218,234-237					

Medinipur Sadar	Belia Primary School	22.424	87.291	EW-I	209	155	107.00-110.00,126.00-129.00,133.00-135.00,150.00-152.00	9.13	220.2	6.92		
Medinipur Sadar	Belia Primary School	22.424	87.291	EW-II	213.77	211	105-109,125-128,134-136,156.50-159.50,188-191,193.5-196.5,205-208	2.77	900			
Medinipur Sadar	Ramkrishna Mission Ashram	22.424	87.304	EW	250	205	62.00 - 74.00,184.00 - 202.00	6.38	435	7.15	76.21	
Medinipur Sadar	Ditpur	22.424	87.294	EW	241.14	100	26.90-30.18,54.79-58.07,69.22-79.72,86.28-96.78	2.36	1206	11.29	22.29	
Garbeta-III	Dhobaberia	22.763	87.445	EW	329.39	296	44.62-47.90,75.46-78.74,157.48-177.82,183.73-187.00,206.69-216.53,246.72-253.28,282.80-292.65	6.34	1206	8.4	43.65	
Garbeta-I	Digri	22.847	87.428	EW	139.57	118	43.50-49.50,73.50-83.50,97.50-103.50,106.50-115.50	14.79	647.4			

Keshpur	Brindabanpur	22.576	87.472	EW-I	157.5	113	48.00-63.00,81.00-87.00,105.00-111.00	2.78	577.8			
Keshpur	Brindabanpur	22.576	87.472	EW-II	145.5	121.5	33.00-45.00,100.50-103.50,109.50-118.50	3.59	568.2			
Ghatal	BIRSINGHA	22.721	87.662	EW					440	2.82	644.17	

6.4. Water level behaviour

The water level behaviour of Paschim Medinipur for shallow aquifers (Aquifer-I) and deeper aquifers (Aquifer-II) during the pre-monsoon are given in the **Figure 6.4.1** and **Figure 6.4.2**below:

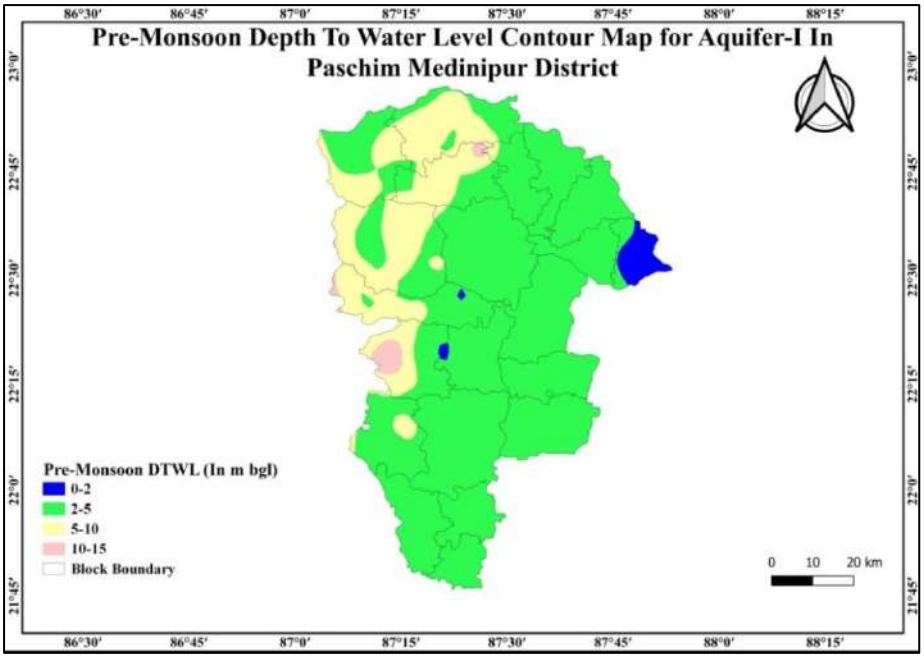


Figure 6.4.1.Pre-Monsoon Depth To Water Level Contour Map for Aquifer-I in Paschim Medinipur District

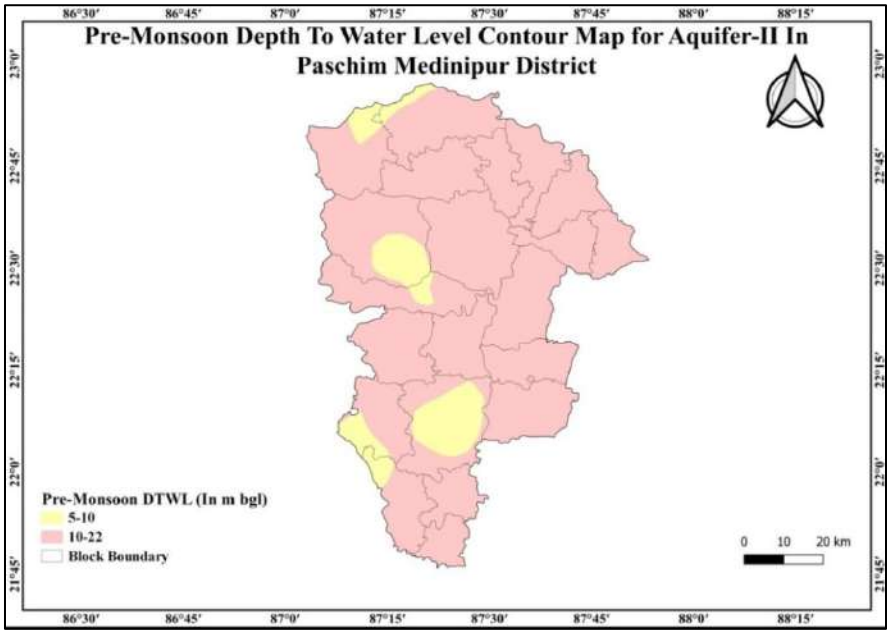


Figure. 6.4.2. Pre-Monsoon Depth To Water Level Contour Map for Aquifer-II in Paschim Medinipur District

The water level behaviour of Paschim Medinipur for for shallow aquifers (Aquifer-I) and deeper aquifers (Aquifer-II) during the post-monsoon period are given in the **Figure 6.4.3** and **Figure 6.4.4** below:

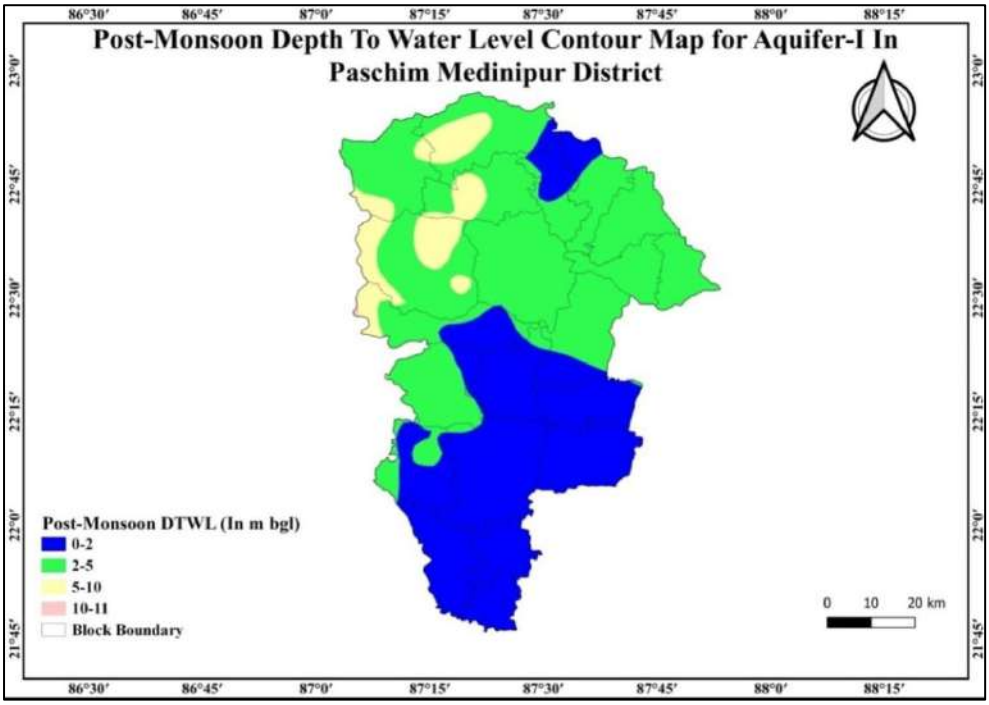


Figure 6.4.3.Post-Monsoon Depth To Water Level Contour Map for Aquifer-I in Paschim Medinipur District

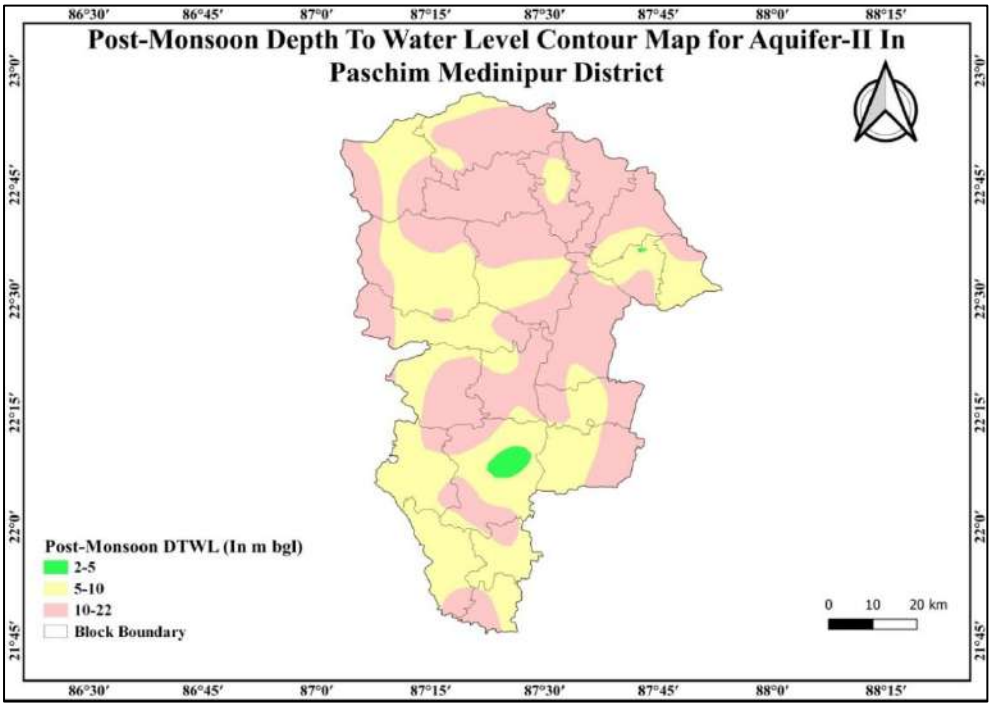


Figure. 6.4.4 Post-Monsoon Depth To Water Level Contour Map for Aquifer-II in Paschim Medinipur District

6.5. Annual Water Level Fluctuation Map

The Annual water level fluctuation maps for shallow and deeper aquifer are given in **Figure 6.5.1** and **Figure 6.5.2.**

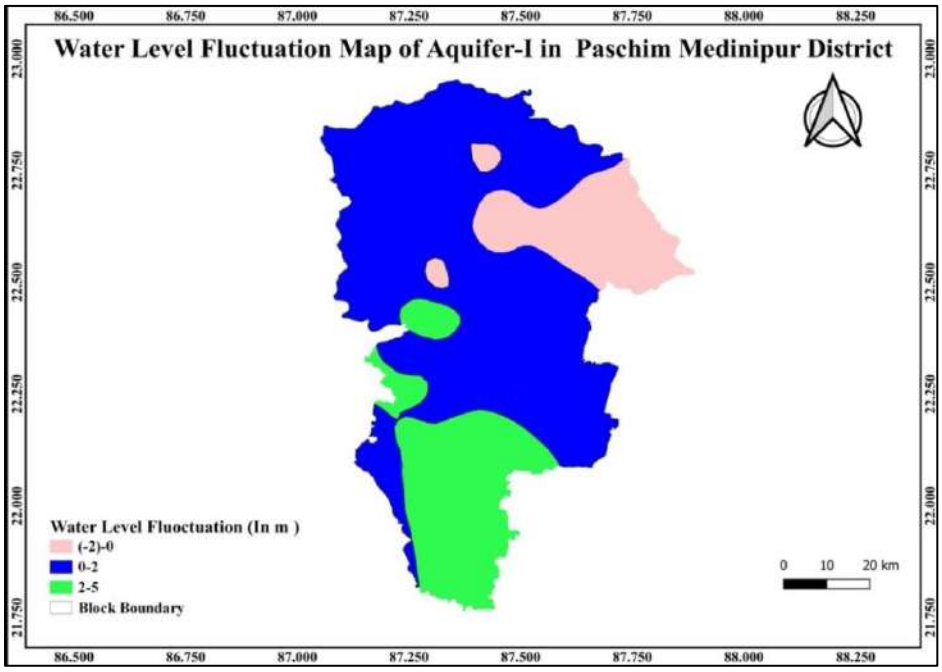


Figure 6.5.1 Annual Water Level Fluctuation Map for Aquifer-I in Paschim Medinipur District

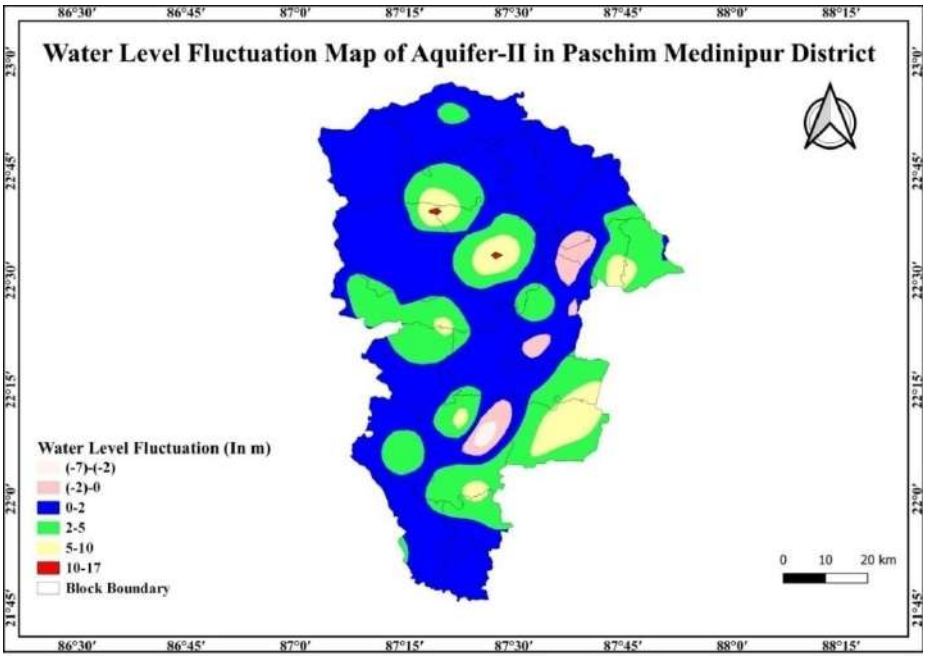
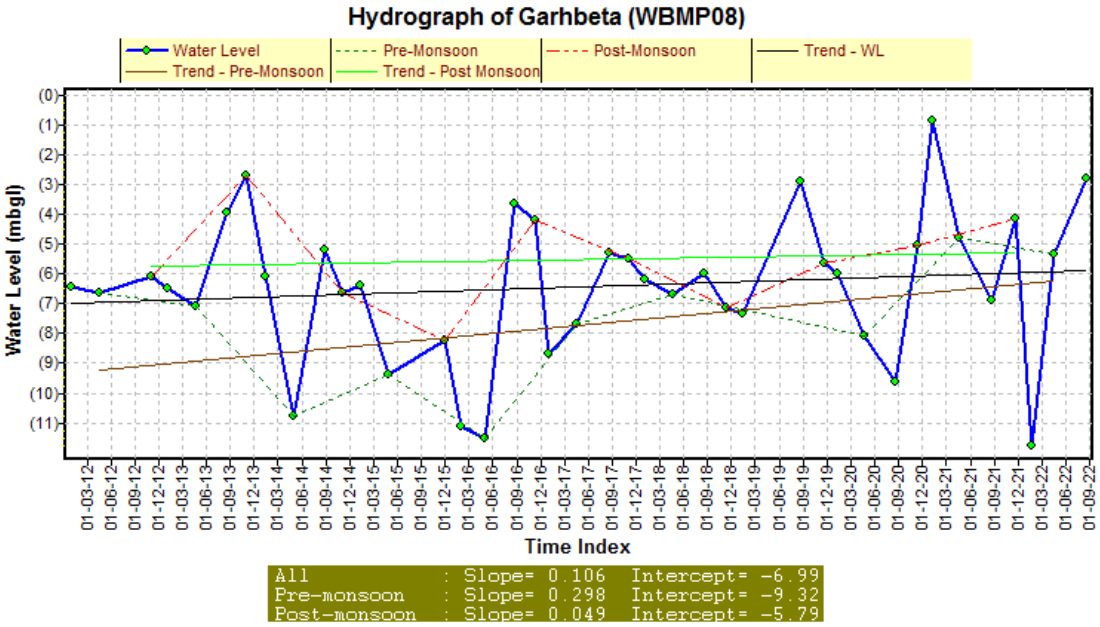


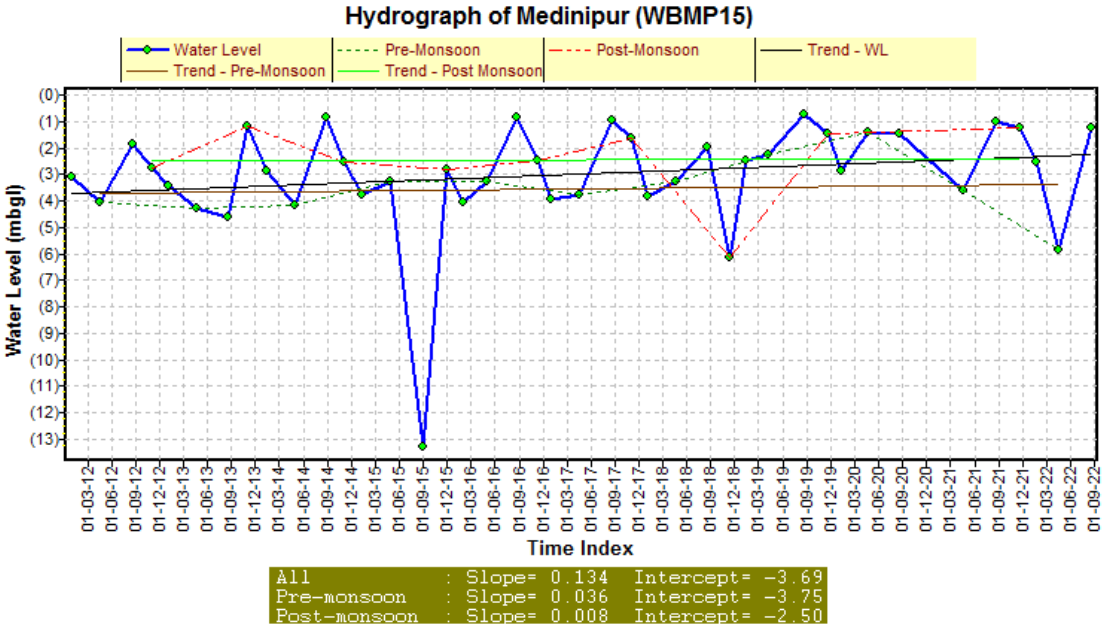
Figure 6.5.2.Annual Water Level Fluctuation Map for Aquifer-II in Paschim Medinipur District

6.6. Hydrographs showing long term (decadal) Fluctuation

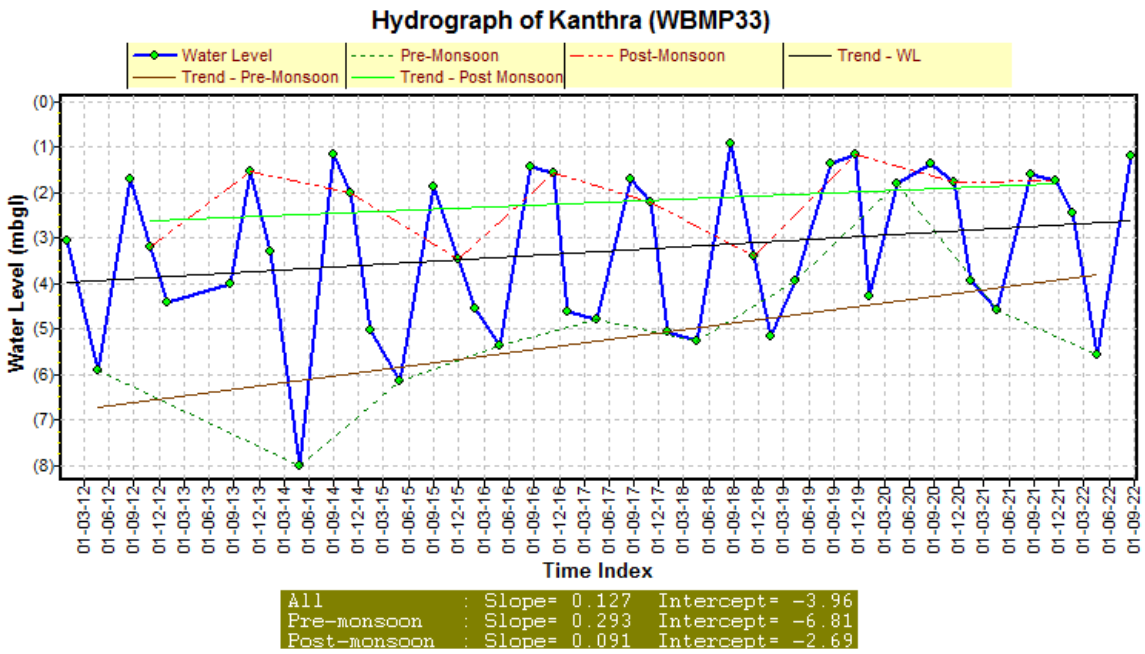
- **Decadal Long term Water Level Trend of Garhbeta (Well No. WBMP08), Block Garhbeta-I**



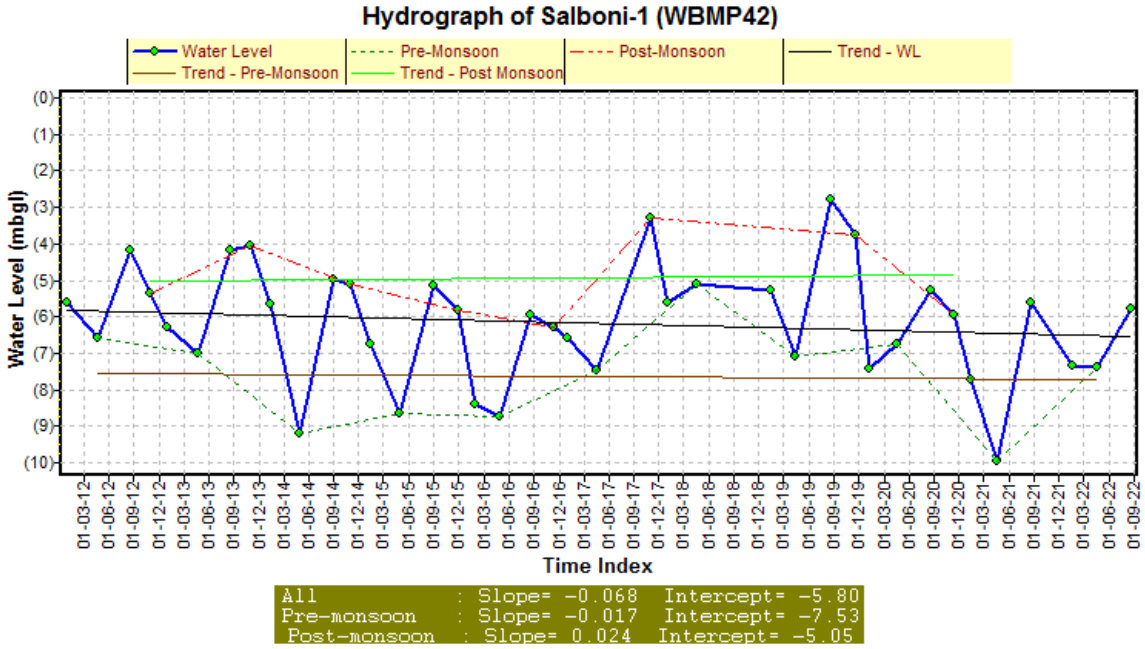
- **Decadal Long term Water Level Trend of Medinipur (Well No. WBMP15), Block Medinipur**



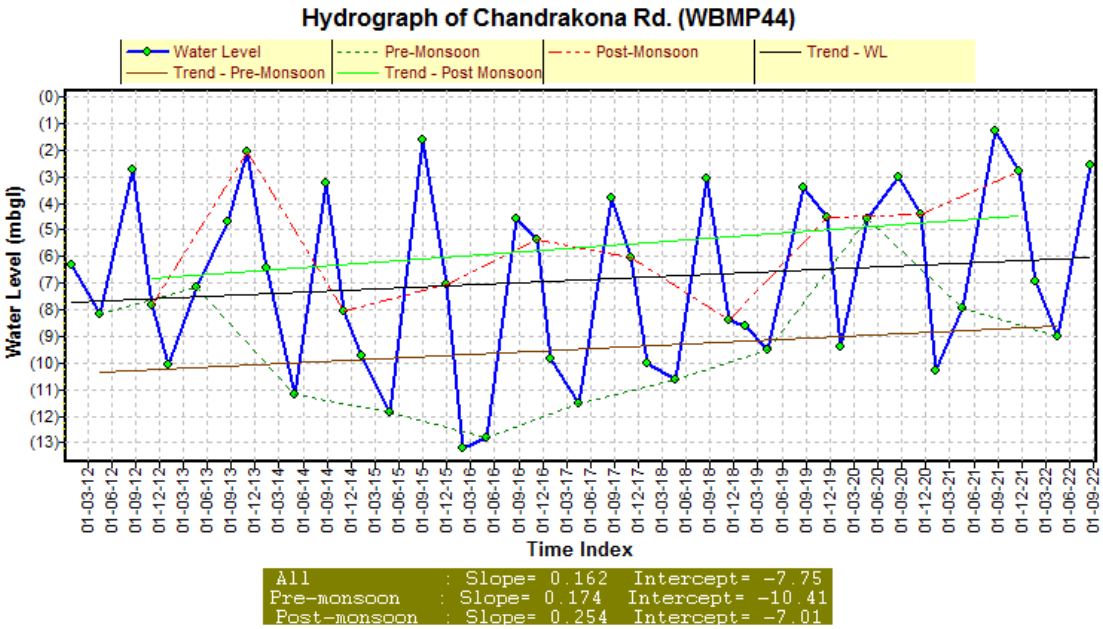
- **Decadal Long term Water Level Trend of Kanthrar (Well No. WBMP33), Block Kharagpur I**



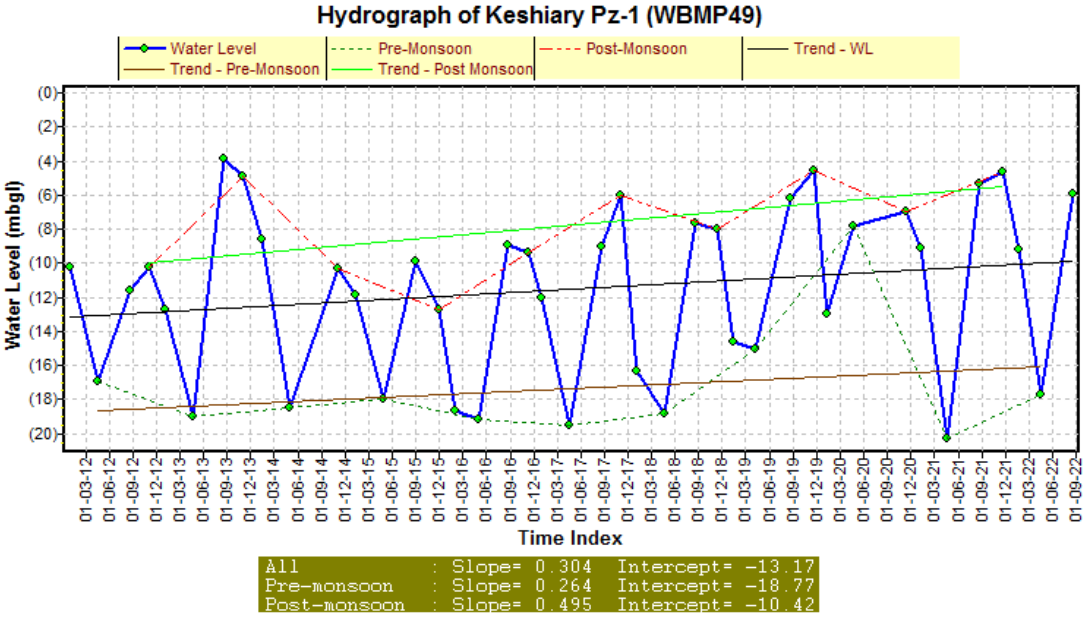
- **Decadal Long term Water Level Trend of Salboni-I (Well No. WBMP42), Block Salboni**



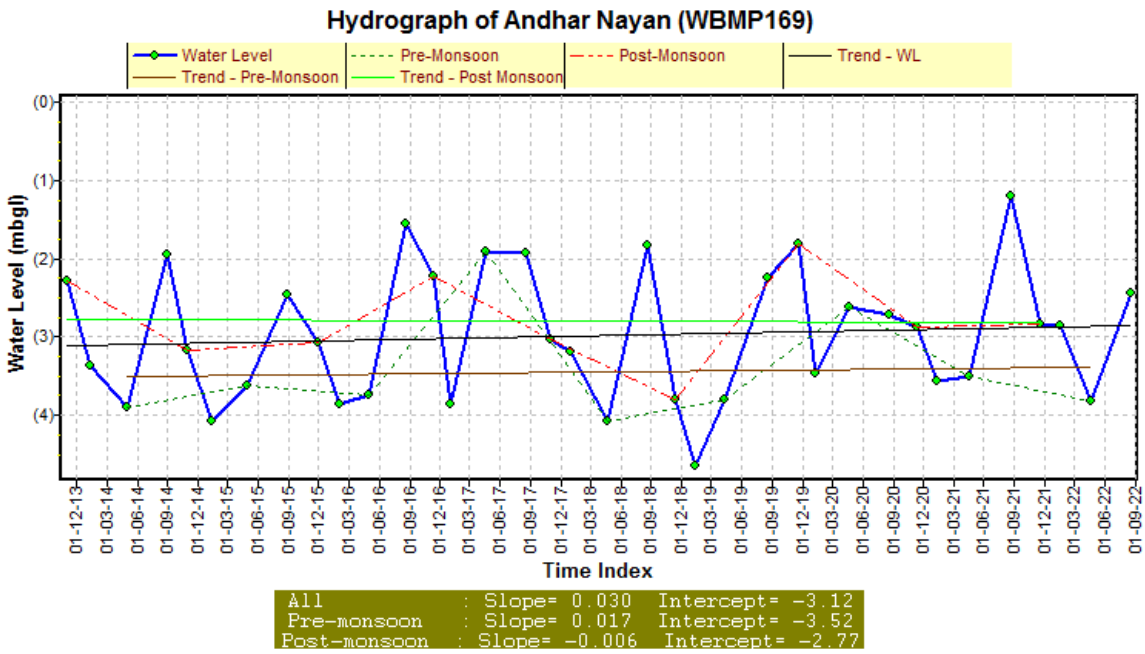
- **Decadal Long term Water Level Trend of Chandrakona Road (Well No. WBMP44), Block Garbeta II**



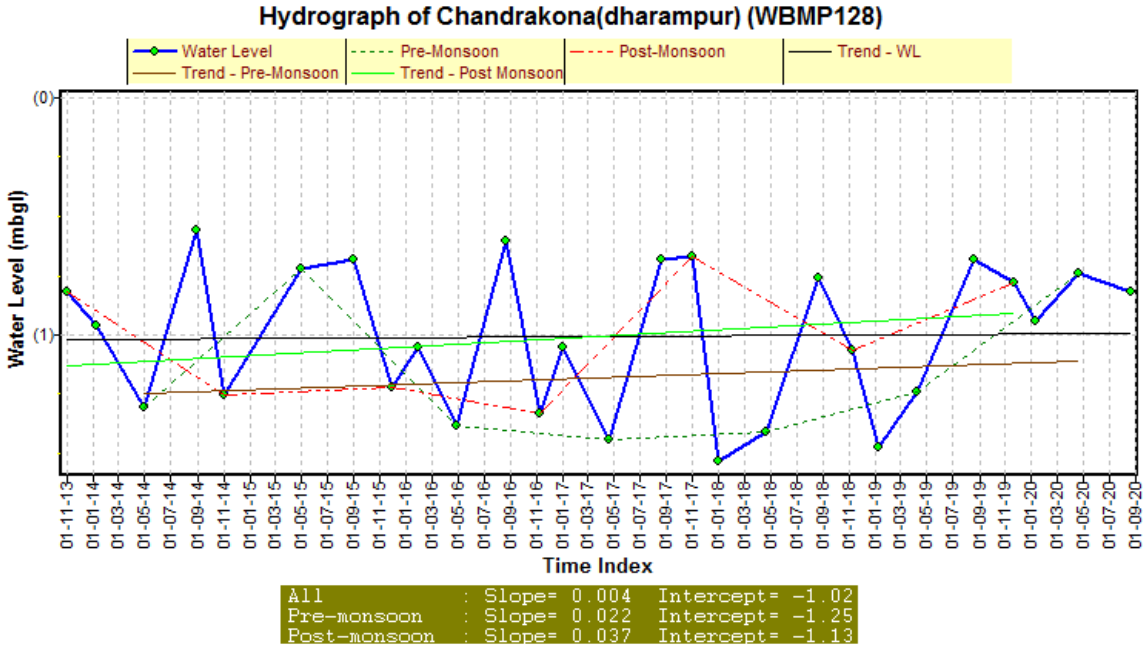
- **Decadal Long term Water Level Trend of Keshiary (Well No. WBMP49), Block Keshiary**



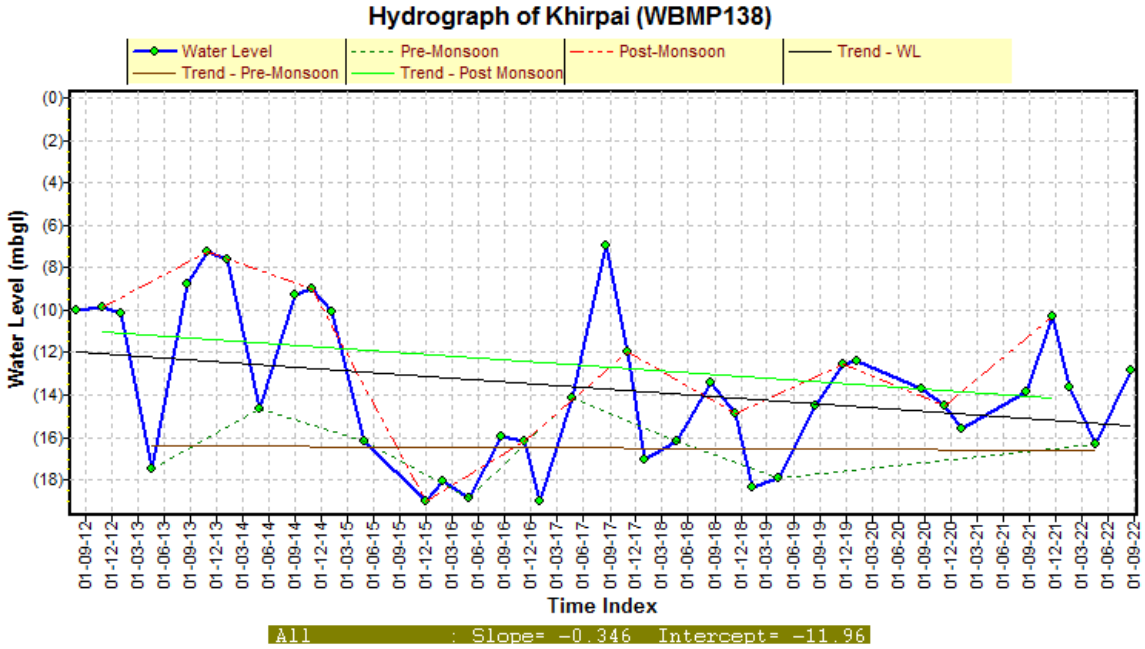
- **Decadal Long term Water Level Trend of Andhar Nayan (Well No. WBMP169), Garbeta III**



- **Decadal Long term Water Level Trend of Dharampur(Well No. WBMP128), Chandrakona I**



- **Decadal Long term Water Level Trend of Khirpai (Well No. WBMP138), Chandrakona I**



Key-wells were established at specific locations for shallow aquifers (Dugwells) and for Deeper Aquifers (Tube-wells) after studying the Toposheets falling in the study area (Figure 4.1). The Pre-monsoon and Post-monsoon Depth to water level (DTWL) and Water Table elevation datasfor dugwells (Shallow Aquifers) and Tubewells (Deeper Aquifers) are attached **(Annexure-III - Annexure-VI).**

Hydrogeological Map of NAQUIM study area is given in **Figure 6.7.**

Locations of established key-wells (Shallow and Deeper Aquifers) in NAQUIM area is given in **Figure 6.8.**

Map of Water Table Elevation contours (Shallow Aquifers) in pre-monsoon is given in**Figure 6.9.**

Map of Water Table Elevation contours (Deeper Aquifers) in pre-monsoon is given in**Figure 6.10.**

Map of Water Table Elevation contours (Shallow Aquifers) in post-monsoon is given in**Figure 6.11.**

Map of Water Table Elevation contours (Deeper Aquifers) in post-monsoon is given in**Figure 6.12.**

The Water Table elevation contours show that the Groundwater flow direction is NW-SE and W-E.

Map of 2-D section lines along the study area is given in **Figure 6.13.**

Striplogs of NAQUIM study area of Paschim Medinipur District is given in **Figure 6.14.**

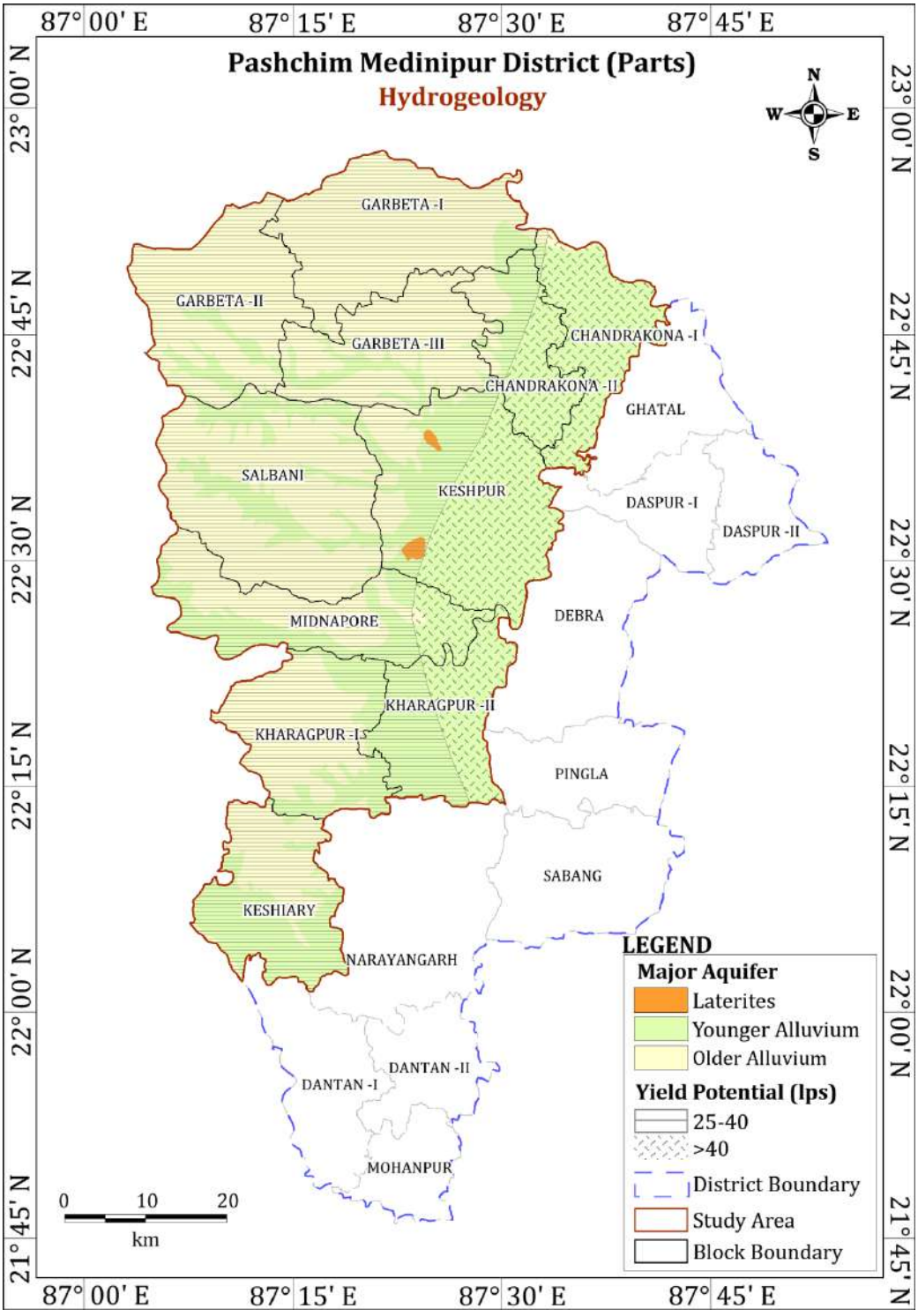


Figure 6.7. Hydrogeological Map of NAQUIM study area of Paschim Medinipur (2022-23)

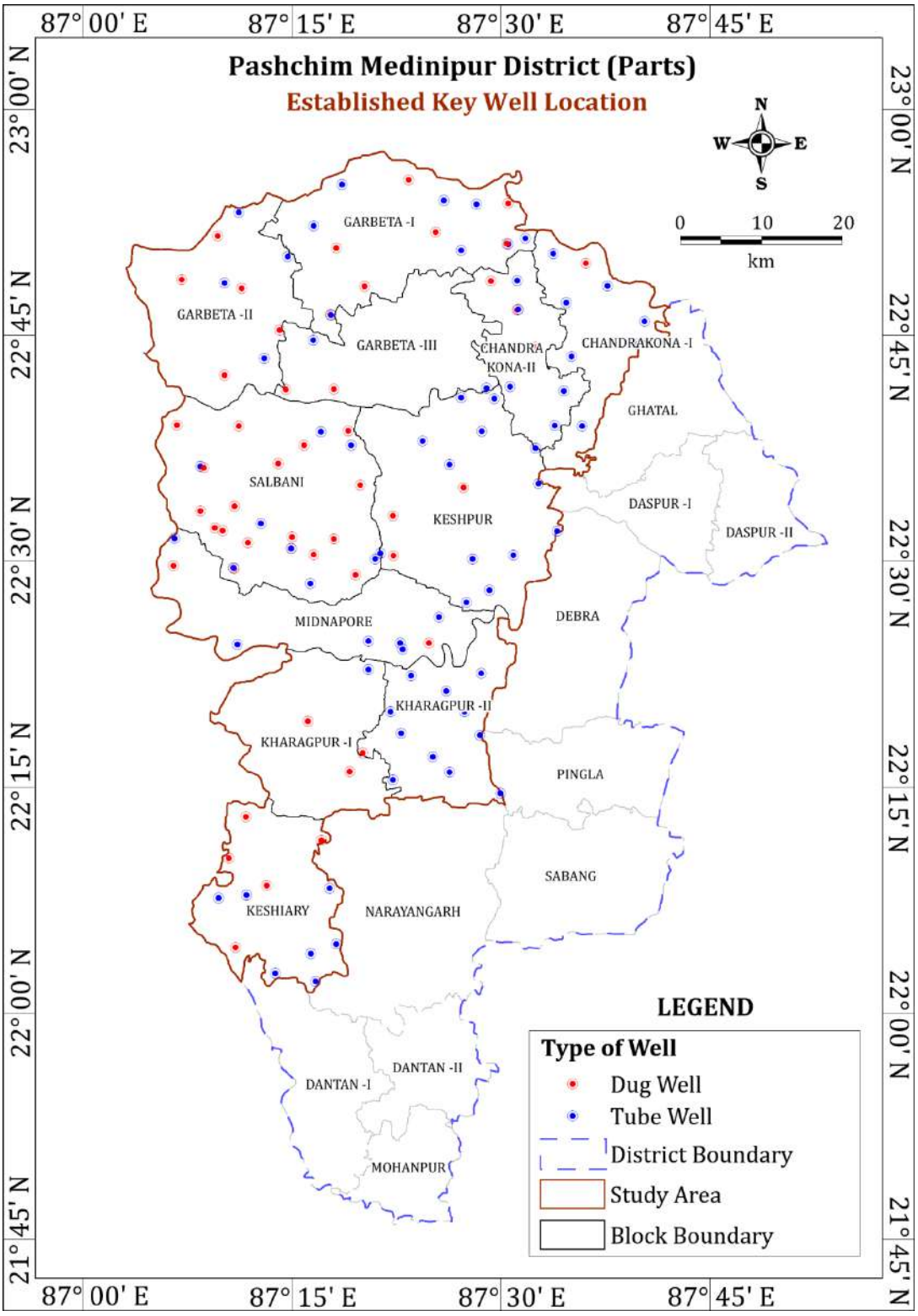


Figure 6.8- Locations of established key-wells (Shallow and Deeper Aquifers) in NAQUIM area of Paschim Medinipur District

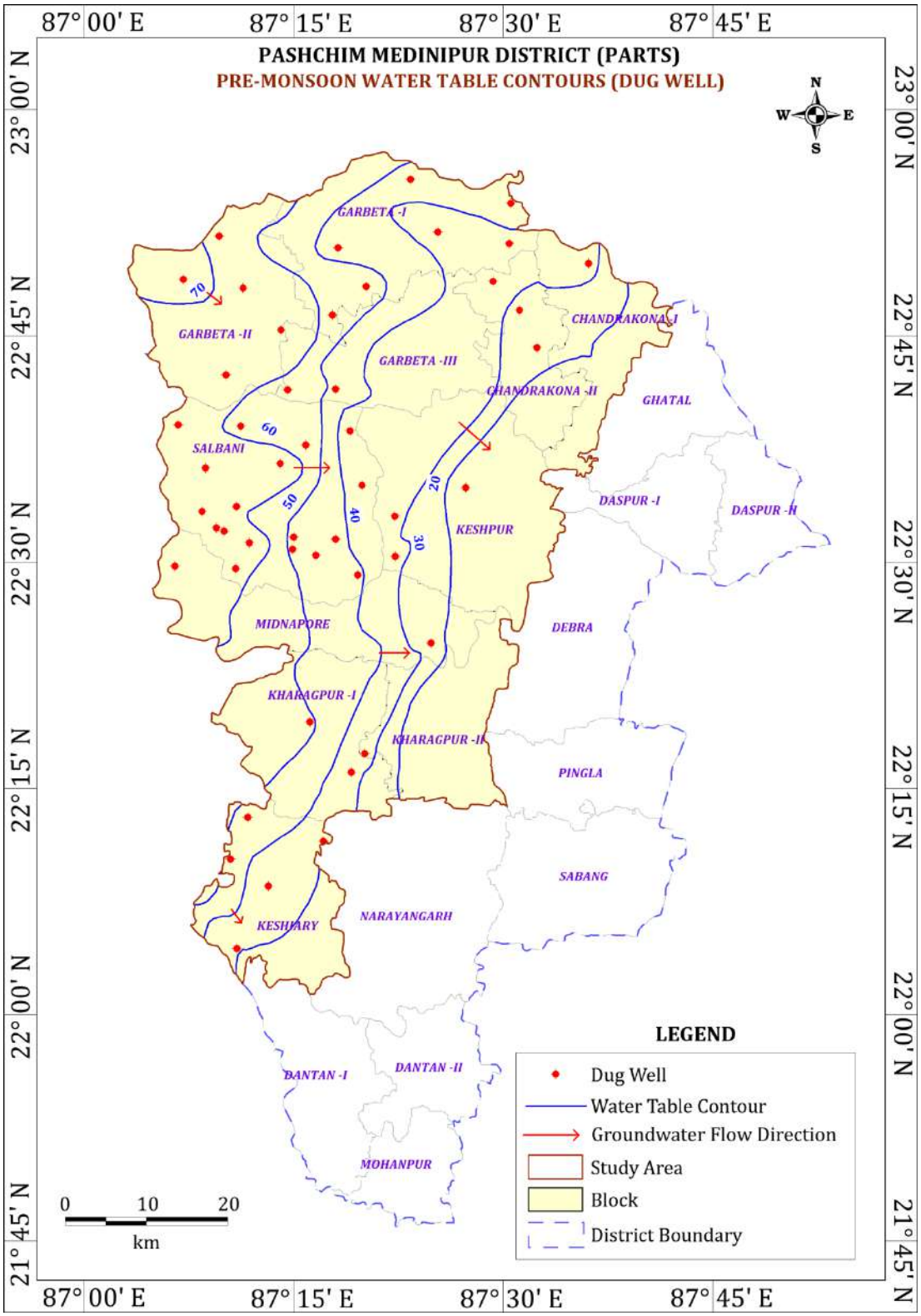


Figure 6.9.Map showing Water Table Elevation contours (Shallow Aquifers) in Paschim Medinipur, June 2022

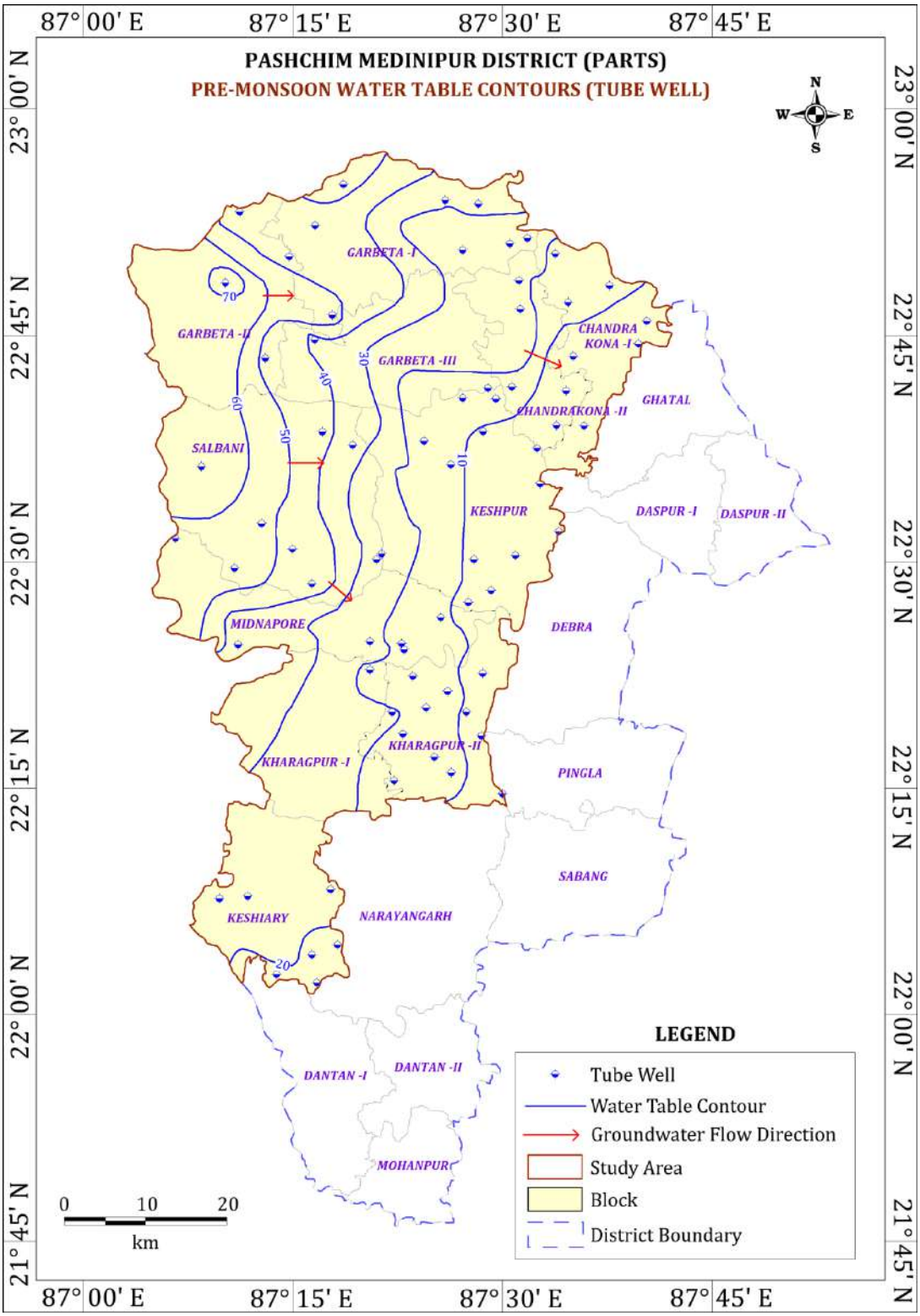


Figure 6.10.Map showing Water Table Elevation contours (Deeper Aquifers) in Paschim Medinipur, June 2022

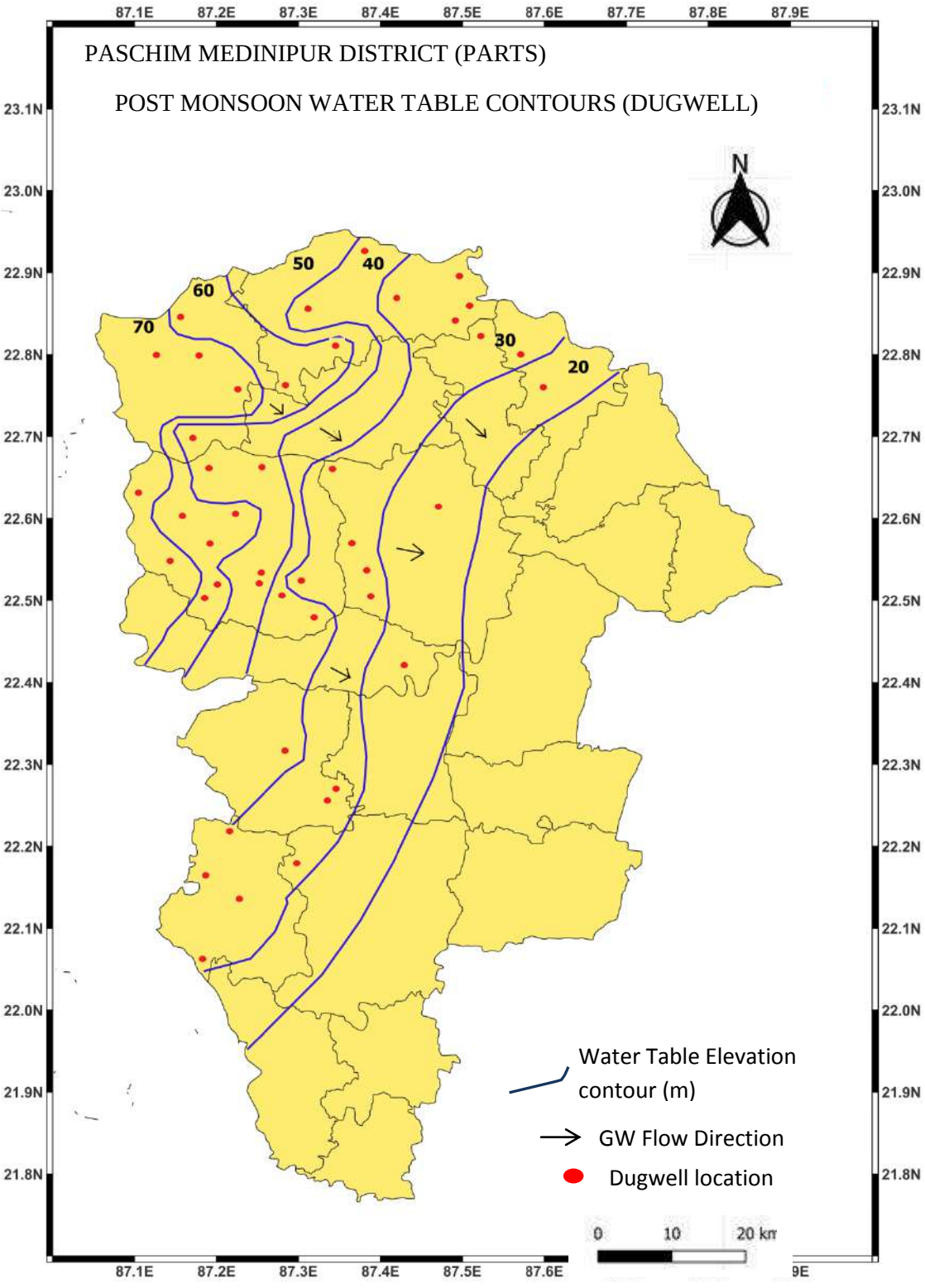


Figure 6.11.Map showing Water Table Elevation contours (Shallow Aquifers) in Paschim Medinipur, November 2022

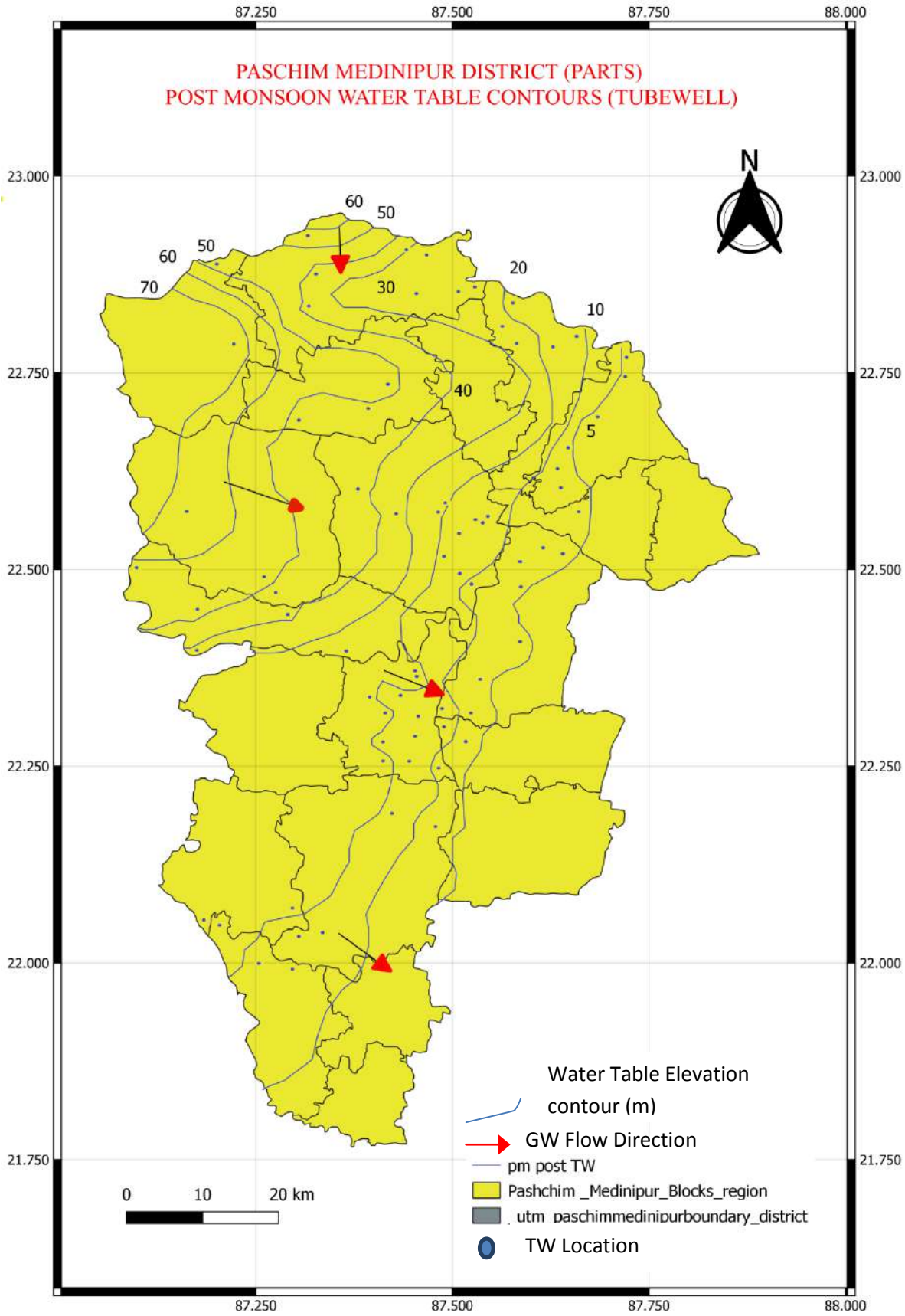


Figure 6.12. Map showing Water Table Elevation contours (Deeper Aquifers) in Paschim Medinipur, November 2022

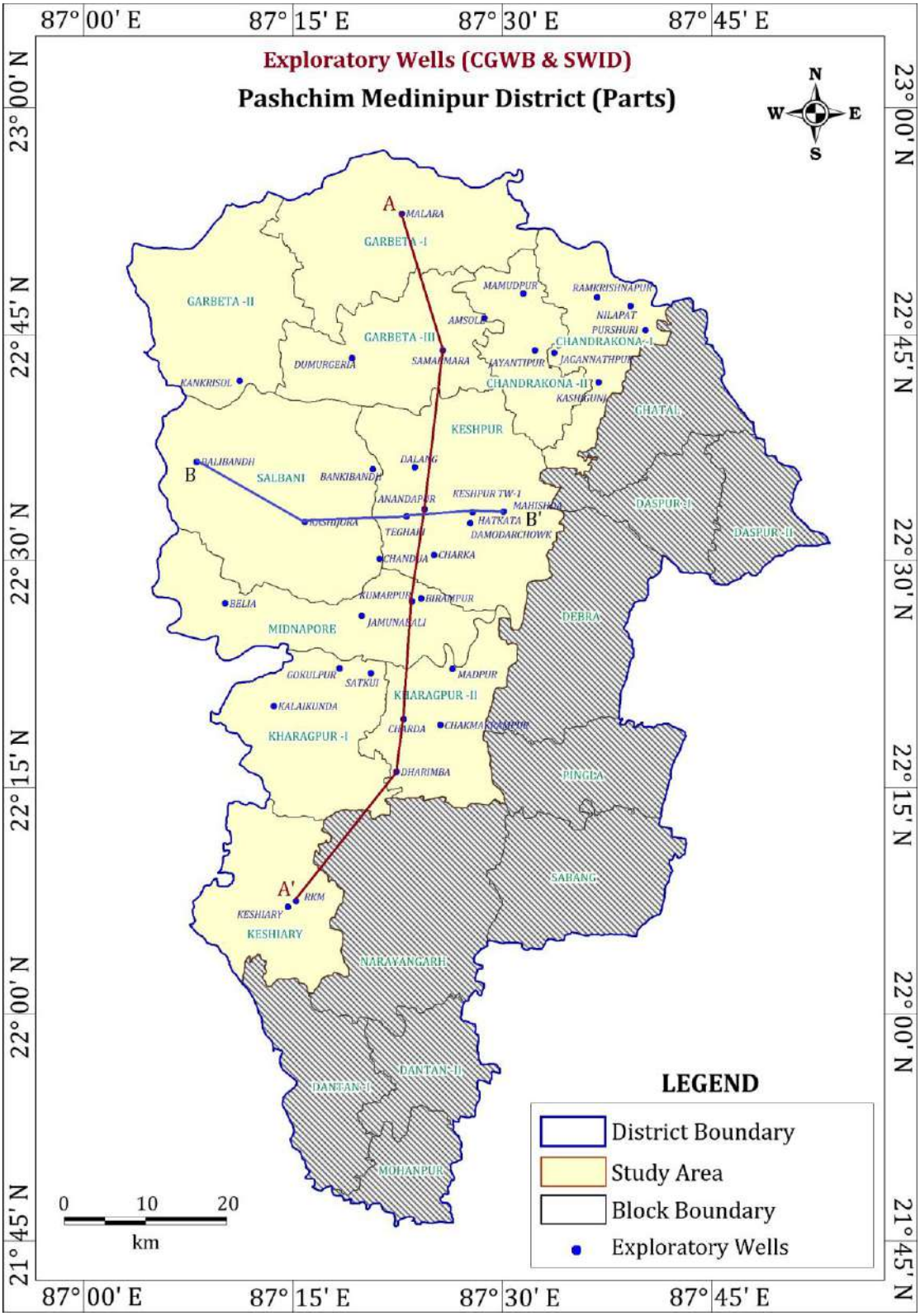


Figure 6.13.2-D section lines along the study area

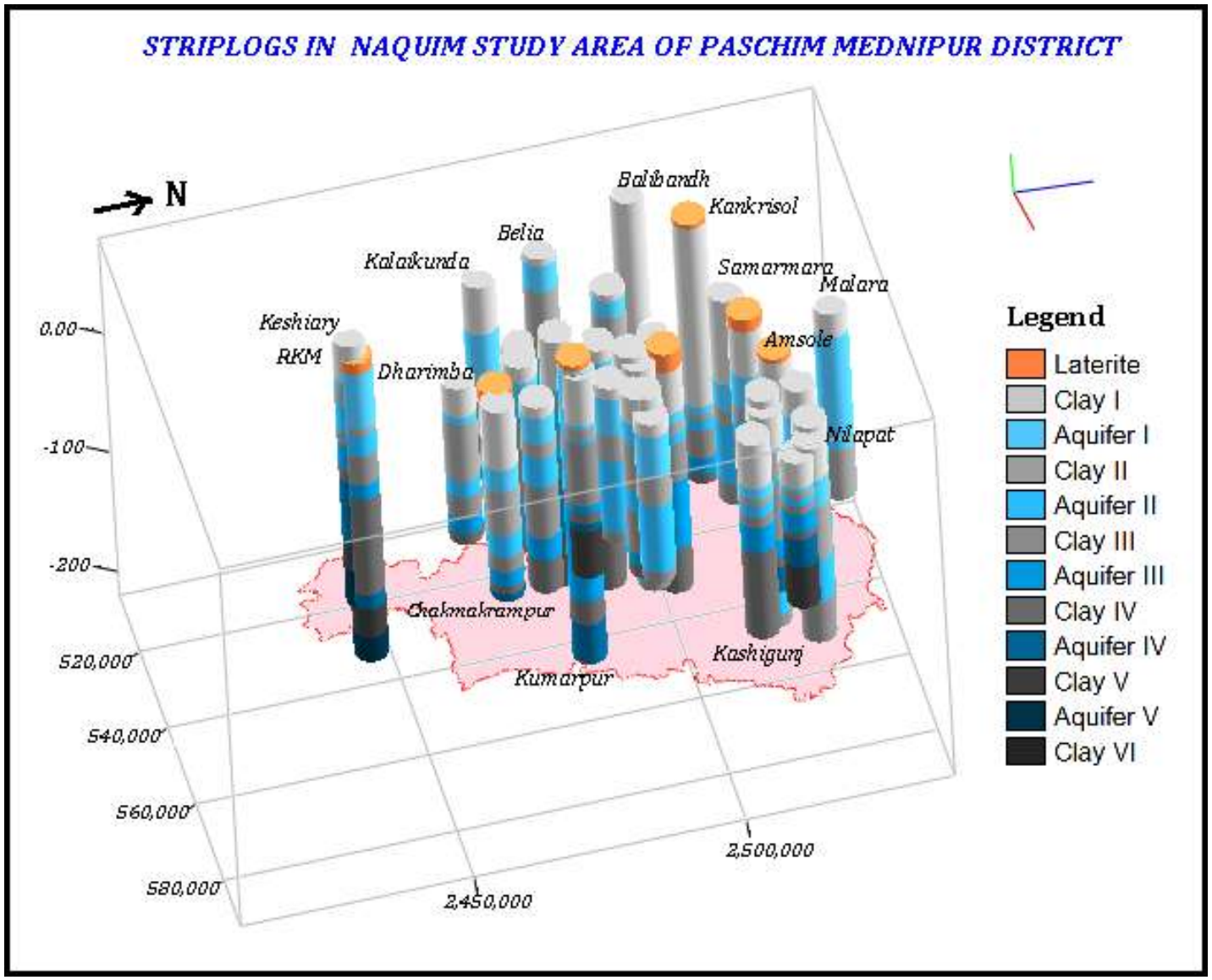


Figure 6.14.Striplogs of NAQUIM study area of Paschim Medinipur District

Aquifer Disposition Diagrams (Districtwise):-Aquifer Dispositionsection diagrams along N-S and W-E direction of the study area are shown in **Figure 6.15**and **Figure 6.16.**3D Aquifer Disposition models and Fence Diagramsare shown in **Figure 6.17**and **Figure 6.18.**

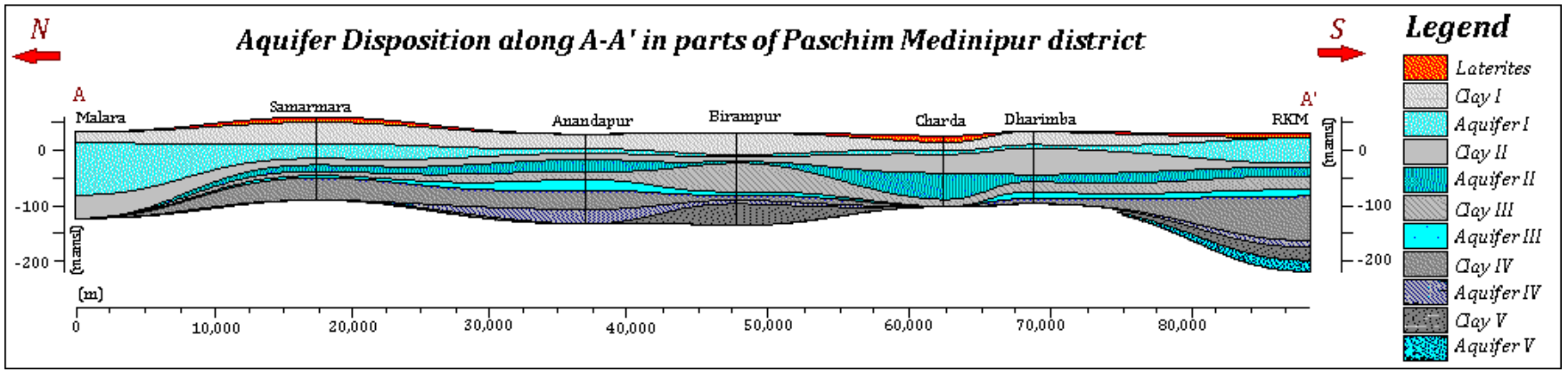


Figure 6.15.2-D Aquifer Disposition along N-S section of NAQUIM study area

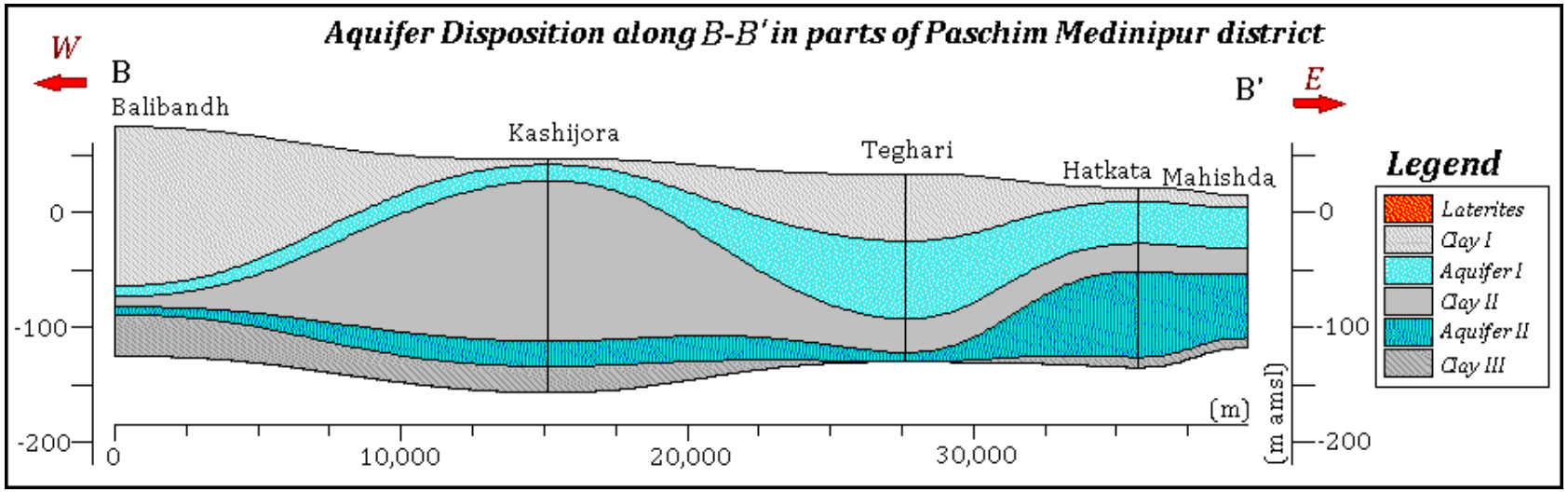


Figure6.16. 2-D Aquifer Disposition along W-E section of NAQUIM study area

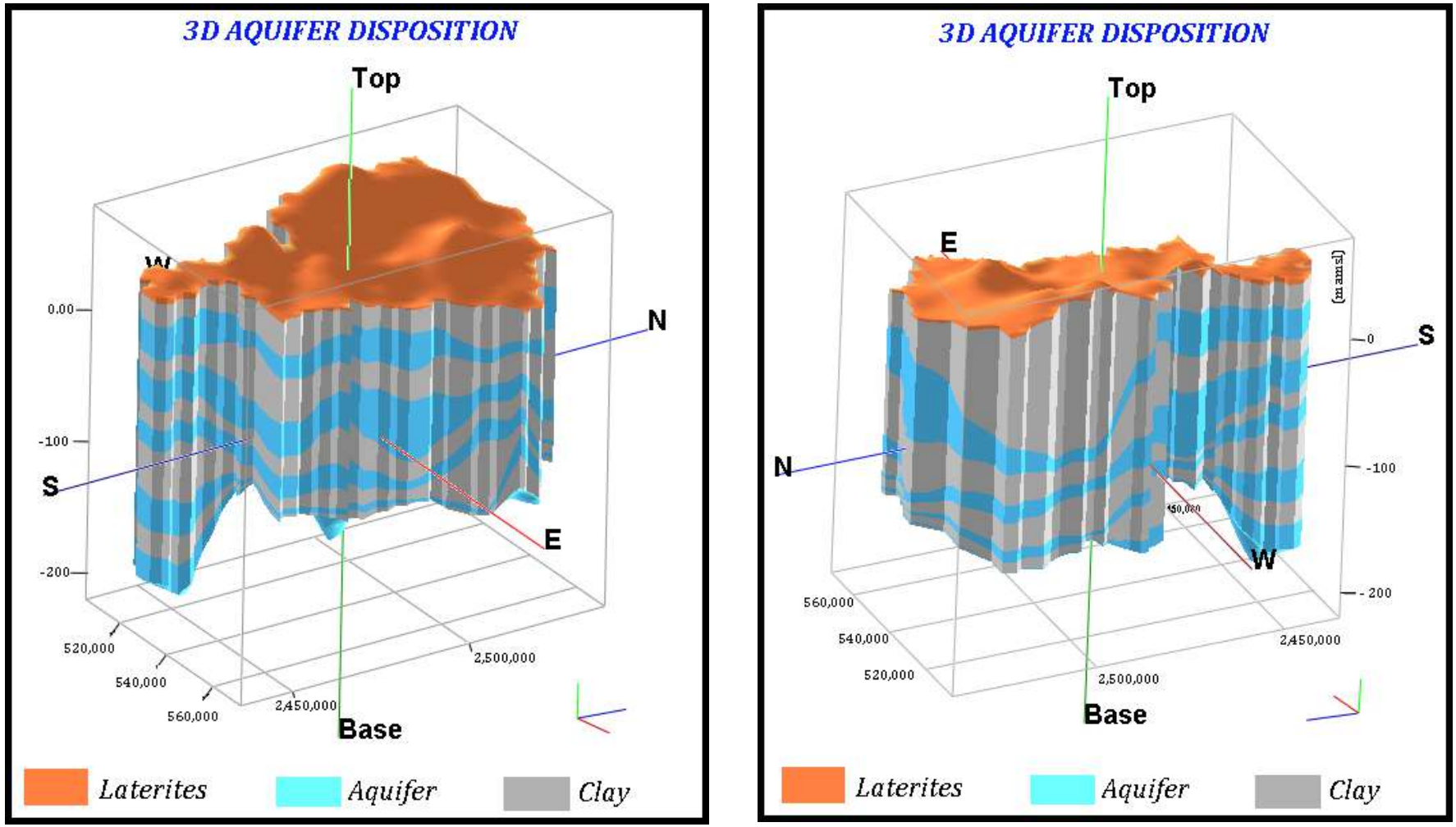
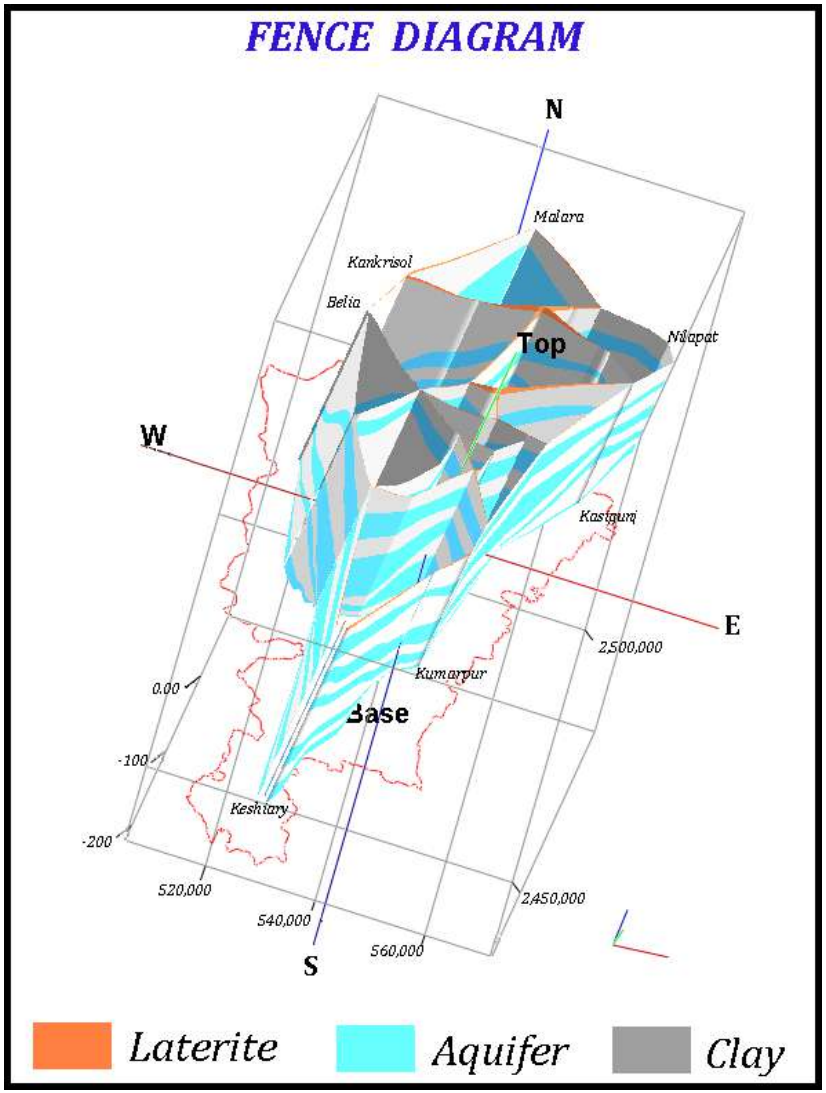


Figure 6.17: 3D Aquifer Disposition in NAQUIM study area (2022-23)



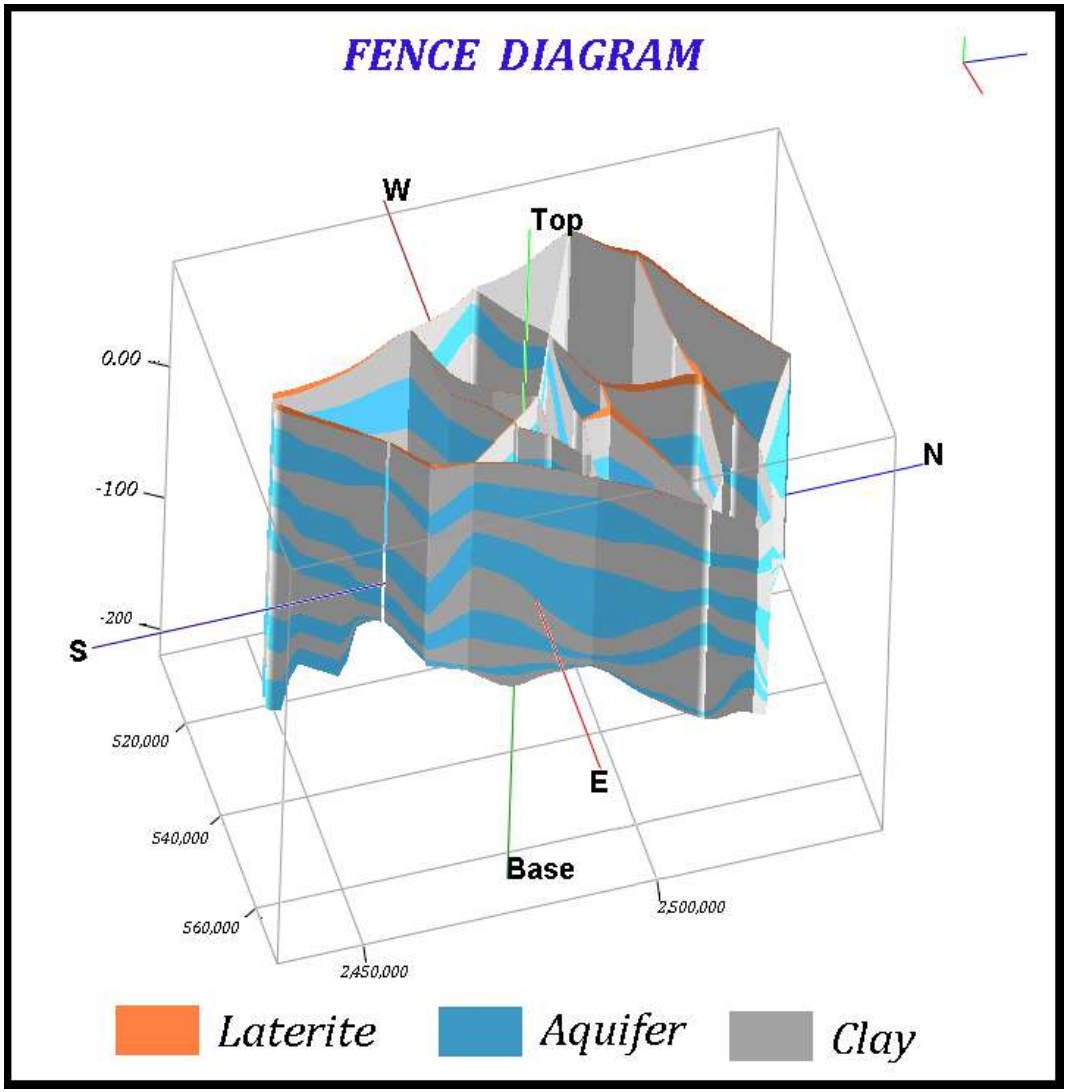


Figure 6.18.3D Fence Diagram of NAQUIM Study area of Paschim Medinipur District

CHAPTER - 7
HYDROCHEMISTRY

During the NAQUIM study of Paschim Medinipur district the water samples collected from the key wells (dug wells and tube wells) for analysis. The samples were analysed in the CGWB, Eastern Region, Kolkata, chemical laboratory and the results are given in **Table: 7.2.** The chemical constituents present in ground water in the area is presented table below.

7.1 Field Sample Chemical Quality Observations

From the perusal of the range of chemical Parameters it is obvious that Fe content is beyond permissible limit of 1 mg/l in many places of the NAQUIM study areas, Keshpur block showing the maximum Iron (Fe) concentration at Kanakhali location 15.52 mg/l, Chakla in Keshiary Block with value of 10.50 mg/l and at Baksibandh in Medinipur block showing marginal high value 4.79 mg/l. show in **Figure 7.2.**

Electrical Conductivity data for shallow aquifers in the study area is shown in **Figure 7.1.**

Nitrate beyond permissible limit (45 mg/l) is observed in North-western part of the District in Garhbeta-I, Garhbeta-II and Salboni Blocks in **Figure 7.3.**

Overall, the quality of the groundwater is found to be suitable for drinking except for fewlocations where Fe content is slightly high the permissible limit. In terms of the irrigation thequality of the water is found to be suitable, however the water could be utilised for irrigationafter treatment of the water for salinity for better production of crops.

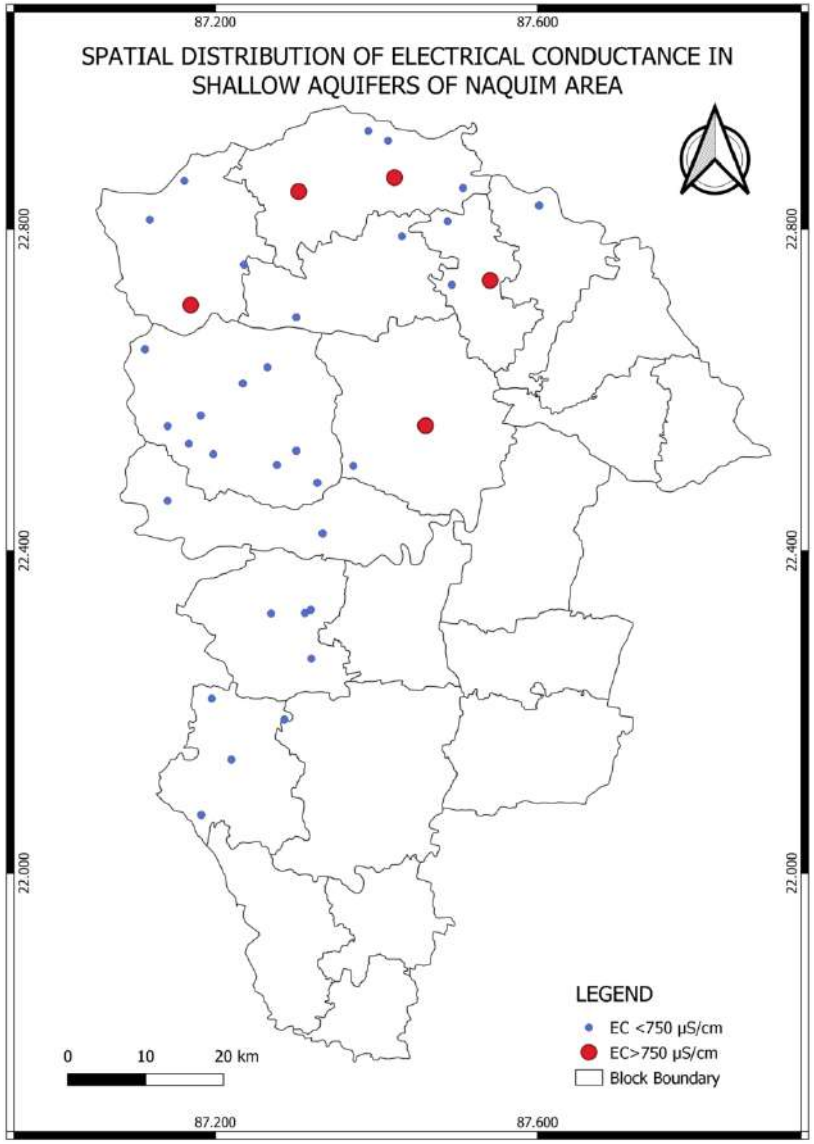


Figure: 7.1.Spatial distribution map of Electrical Conductance (Shallow Aquifers)

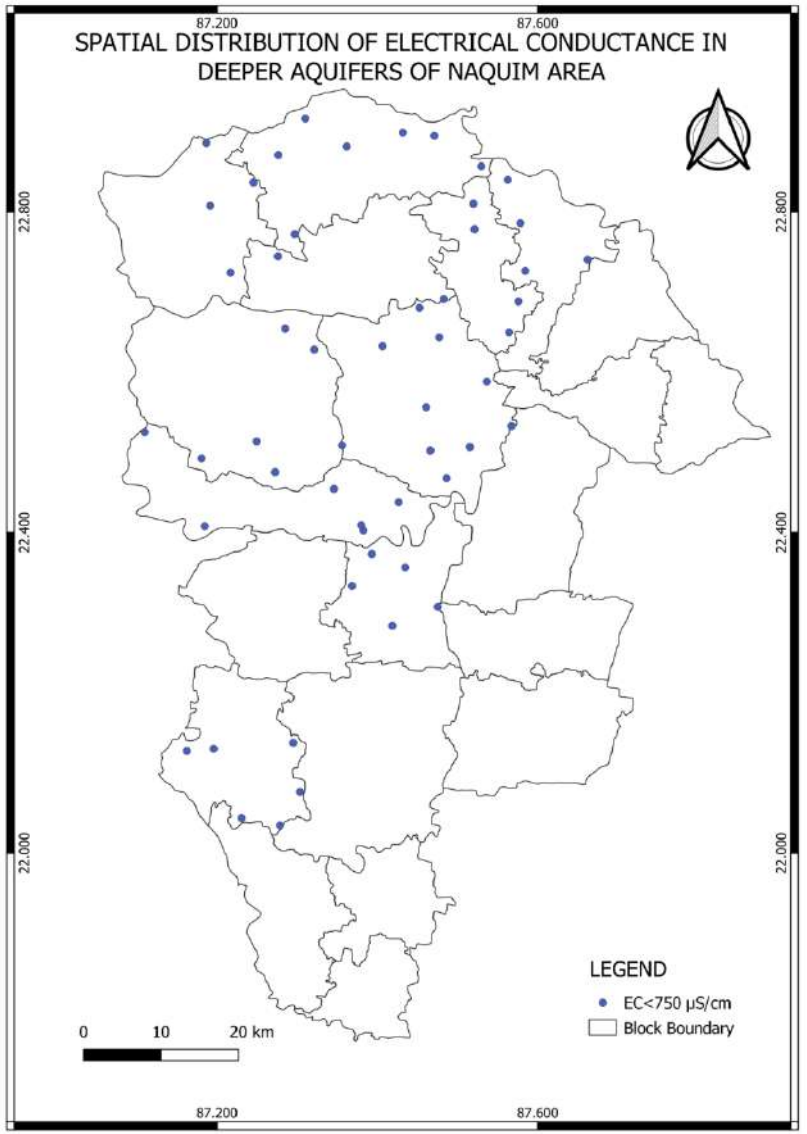


Figure: 7.2.Spatial distribution map of Electrical Conductance (Deeper Aquifers)

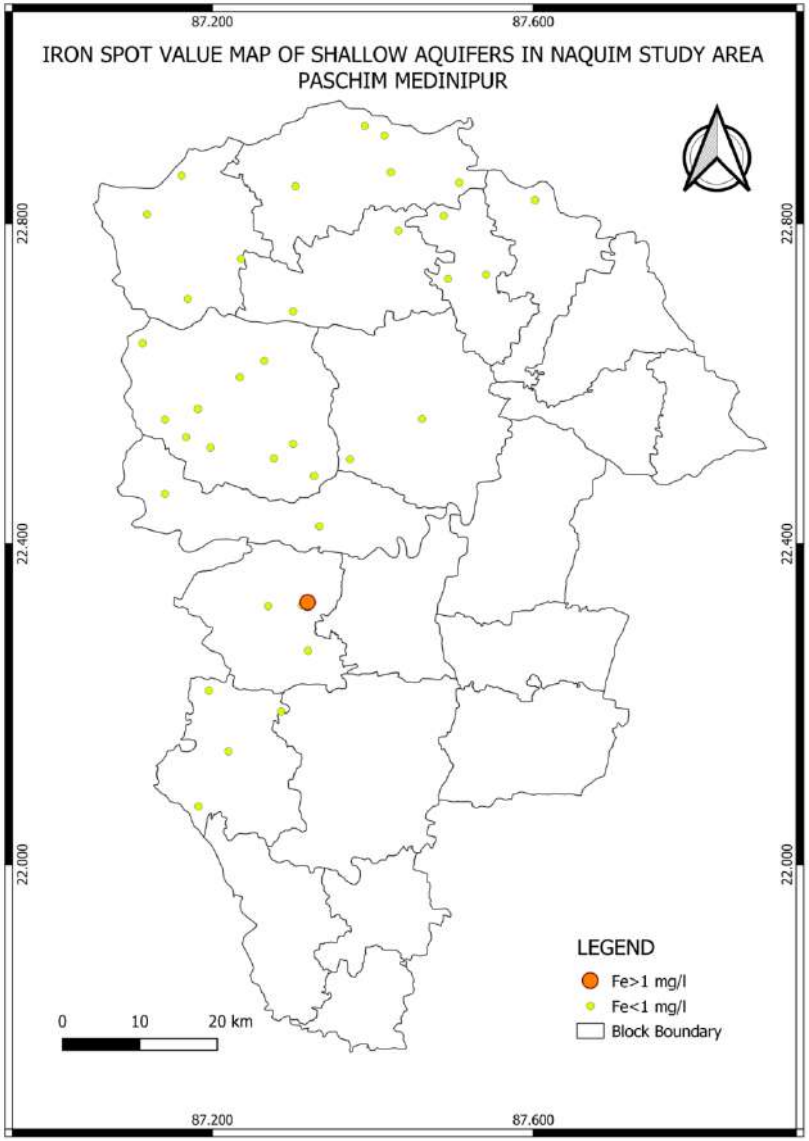


Figure: 7.3. Chemical Quality (Iron spot value map) of Shallow Aquifer

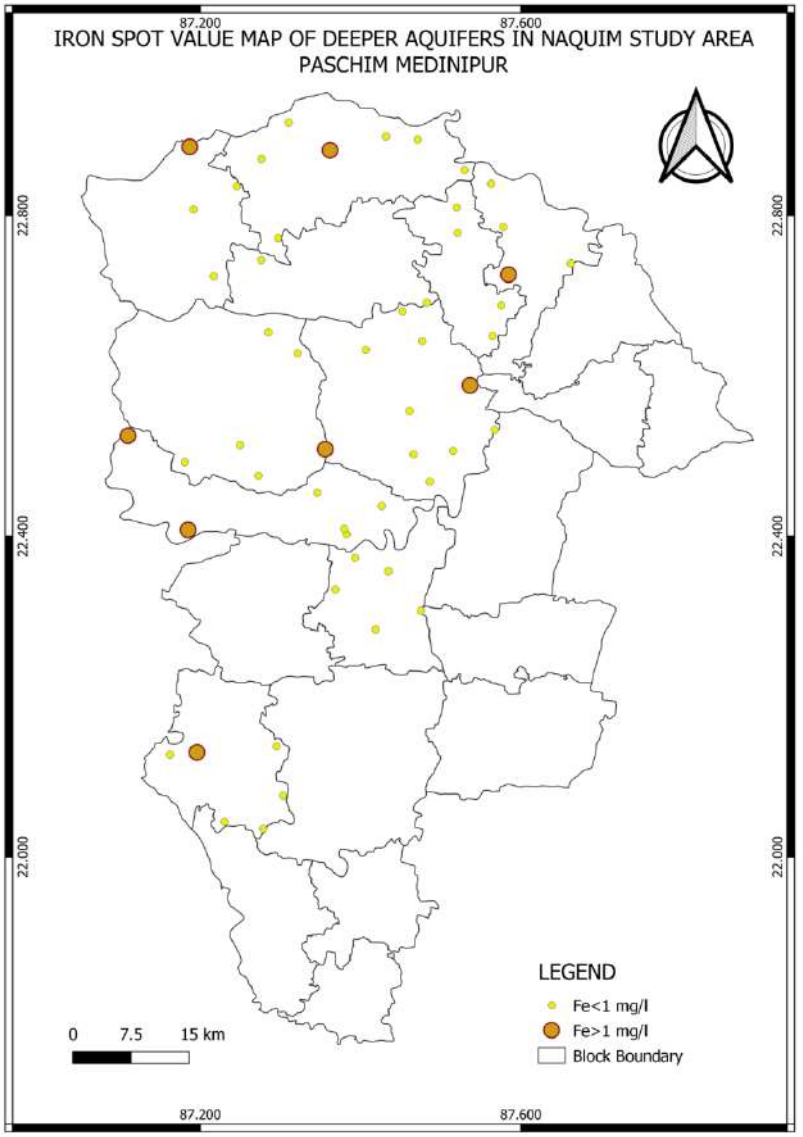


Figure: 7.4. Chemical Quality (Iron spot value map) of Deeper Aquifers

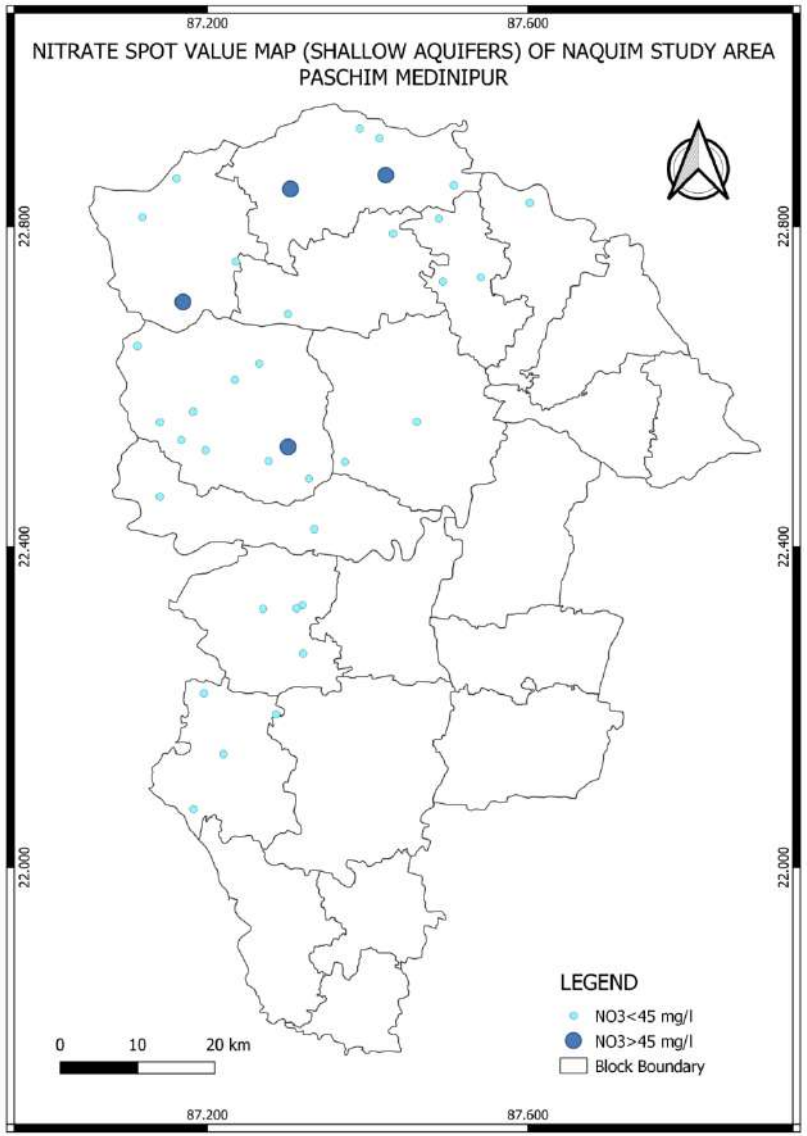


Figure: 7.5. Chemical Quality (Nitrate spot value map) of Shallow Aquifers

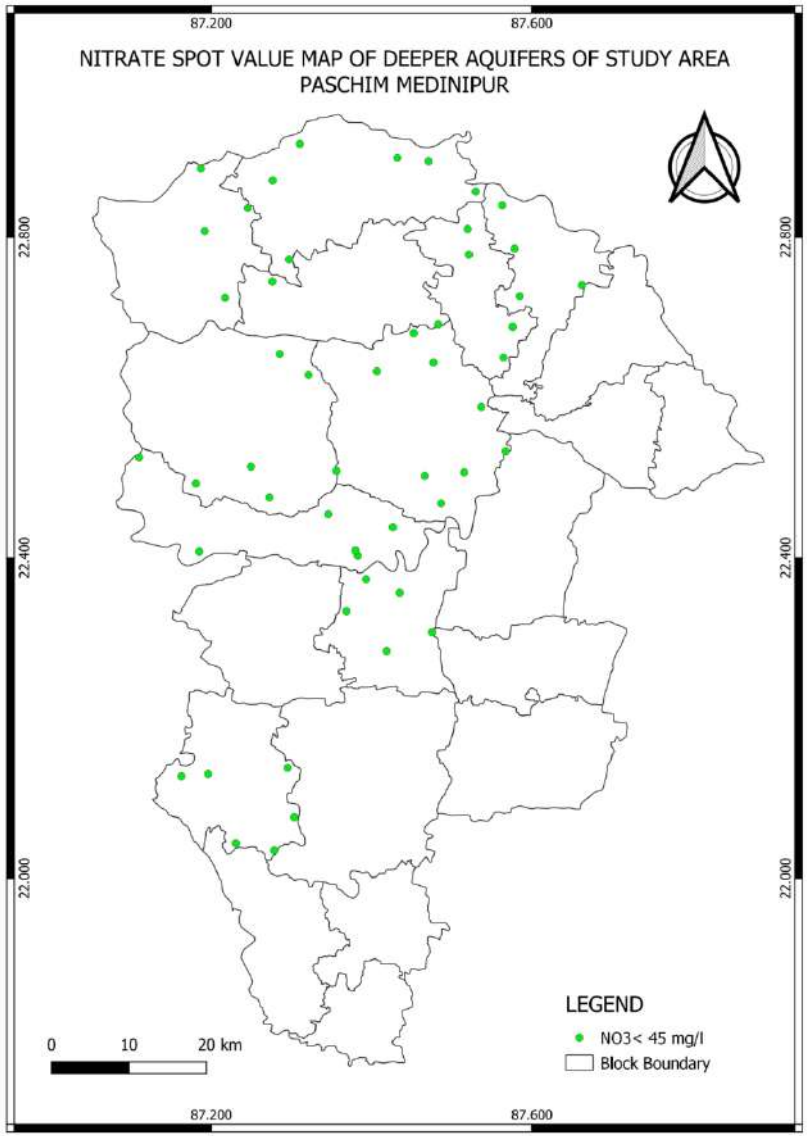


Figure: 7.6. Chemical Quality (Nitrate spot value map) of Deeper Aquifers

7.2. Suitability for drinking purpose

The statistically summarized analysed groundwater data are presented in **Table 7.1.** The data reveals that the pH of the area is within the BIS permissible range of 6.5-8.5. The average pH of the Paschim Medinipur district is 7.71 with a maximum of 8.48 and a minimum of 6.94**.** The mean conductance of the study area as evaluated was found to be 745.5 µS/cm at 25°C, the conductance varies from a minimum of 38 µS/cm at 25°C to a maximum of 1453µS/cm at 25°C **(Figure 7.1)**. The total alkalinity (TA), Cl^- SO_4^{2-} and NO_3^-concentration was found to be much below the permissible limit prescribed by the BIS. The TH varies from 10 to 255 mg/L, Cl^- varies from 4 to 262 mg/L, SO_4^{2-} varies from 0 to 103.90 mg/L and NO_3^- varies from 0 TO 58.90 mg/L.

Table 7.1Statistical summarized result of the analysis

	Unit	Min	Max	Mean	BIS Limit
pH		6.94	8.48	7.71	6.5-8.5
Conductance	µS/cm at 25°C	38	1453	745.5	–
CO_3^{2-}	mg/L	3	9	6	–
HCO3-	mg/L	6	458	232	–
TA as $CaCO_3$	mg/L	5	390	197.5	600.00
Cl^-	mg/L	4	262	133	1000.00
SO_4^{2-}	mg/L	0	103.9	51.95	400.00
NO_3^-	mg/L	0	58.9	29.45	45.00
F^-	mg/L	0.01	0.73	0.37	1.50
TH as $CaCO_3$	mg/L	10	255	132.5	600.00
Ca2+ as Ca	mg/L	0	58	29	200.00
Mg^{2+} as Mg	mg/L	0	39	19.5	100.00
Na^+	mg/L	0.2	188	94.1	–
K^+	mg/L	0.1	92.6	46.35	–
TDS	mg/L	28	836	432	2000.00
Fe	mg/L	0.01	15.52	7.765	1.00

7.3. Hydrochemical facies and Piper plot

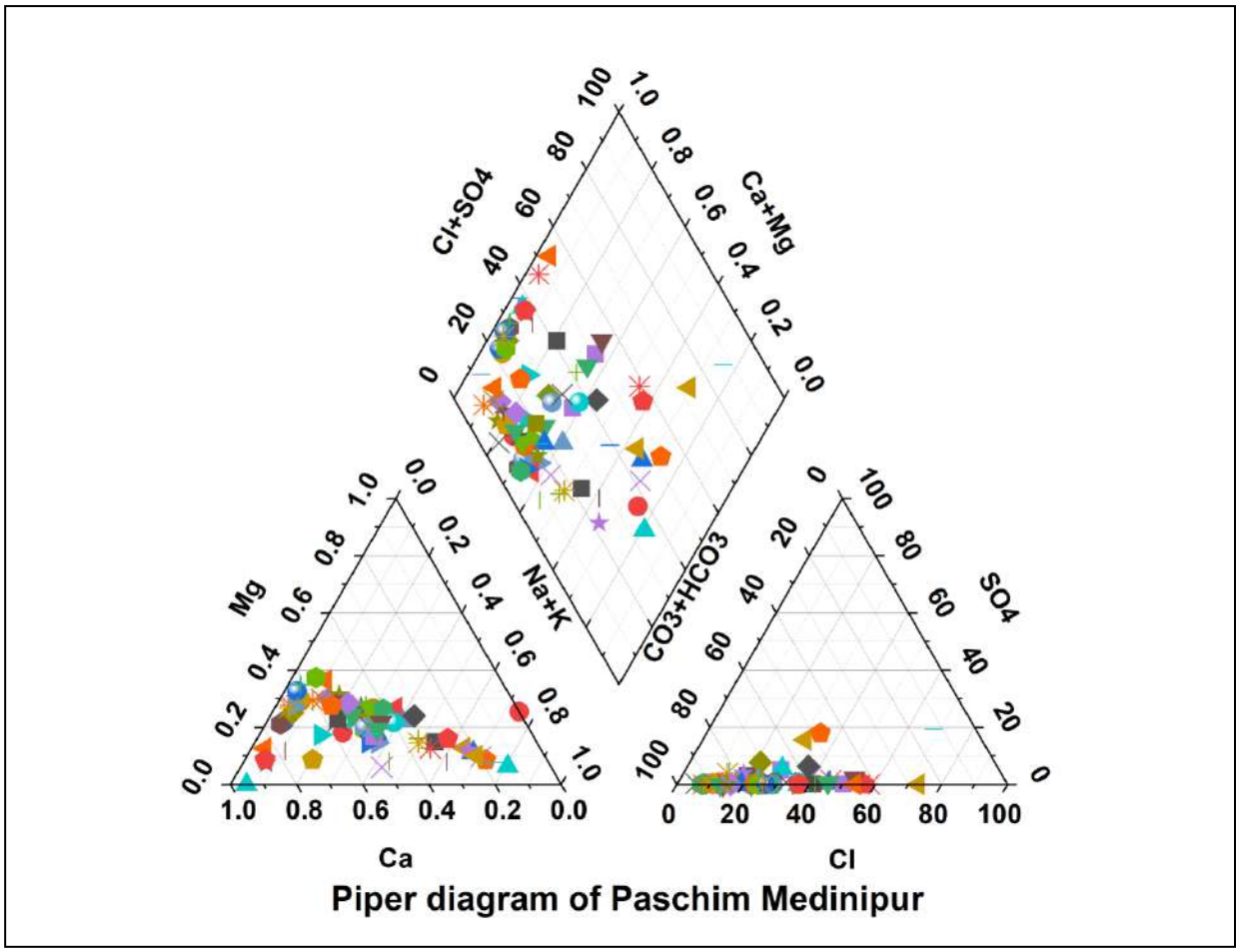


Figure 7.4. Piper diagram of analysed water samples

The plot of chemical data on diamond shaped trilinear diagram reveals that majority of the groundwater samples fall in the fields of alkaline earth which exceeds alkalis. The water is dominantly of Ca-Bicarbonate and mixed type of water. The anion constituents of weak acids (Bicarbonates) exceed the strong acids (Sulfate, Chloride etc.).

The interpretation suggests the area type to be a recharge zone and the chemical quality of the water is relatively fresh.

Chemical analysis data of Paschim Medinipur district is given in **Table 7.2.**

Table 7.2 Chemical analysis data of Paschim Medinipur district

SN	Block	Location	Wel ID	Source	pH	EC µS/cm at 25°C	TH as $CaCO_3$	Ca^{2+} as Ca	Mg^{2+} as Mg	Na^{+}	K^{+}	Cl^{-}	TA as $CaCO_3$	CO_3^{2-}*	HCO_3^{-}*	SO_4^{2-}*	NO_3^{-}*	F^{-}*	TDS*	Fe*
							← Mg/l →													
1	Salboni	Bhadutola	1	Dug	7.21	157	45	10	5	16.8	1.0	14	45	0	55	2.1	9.5	0.29	92	0.32
2	Salboni	Karnagar	2	Mark II Deep	7.69	366	145	38	12	15.7	0.9	25	160	0	195	0.7	1.9	0.32	213	13.50
3	Salboni	Benucha	3	Dug	7.60	382	75	16	9	49.8	1.8	67	65	0	79	0.6	52.7	0.06	245	0.21
4	Salboni	Birbhanpur	4	Sub TW	7.61	177	70	16	7	8.6	2.6	21	60	0	73	0.0	6.9	0.07	107	0.89
5	Salboni	Pathardaha	5	Dug	7.64	181	85	18	10	4.6	0.1	14	75	0	92	0.0	3.8	0.14	106	0.18
6	Salboni	Pirakata	6	Dug	7.37	552	115	24	13	63.5	3.4	71	100	0	122	35.6	15.7	0.03	301	0.04
7	Salboni	Mugardihi	7	Sub TW	7.73	175	70	16	7	6.6	1.4	18	65	0	79	0.0	2.5	0.03	100	0.04
8	Midnapore	Manidaha	8	Mark II Deep	7.61	477	170	36	19	22.8	2.9	21	215	0	262	0.0	0.5	0.02	263	2.37
9	Midnapore	Baksibandh	9	Sub TW	7.93	370	170	34	21	10.8	0.6	21	170	0	207	0.0	0.0	0.04	214	4.79
10	Garhbeta II	Goaltore	10	Dug	7.82	1453	255	58	27	188.0	39.7	199	225	0	275	103.9	53.7	0.03	836	0.12
11	Garhbeta II	Gotshingla	11	Sub TW	8.16	574	200	42	23	28.7	1.3	32	235	0	287	1.1	1.0	0.06	304	0.86
12	GarhbetaII I	Darkhola	12	Dug	8.05	482	140	32	15	43.6	0.5	39	185	0	226	1.4	2.3	0.13	271	0.48
13	GarhbetaII I	Nalbona	13	Sub TW	8.24	406	165	40	16	13.8	1.4	14	195	0	238	0.7	0.1	0.07	231	0.04

14	Garhbeta II	Gohaldanga	14	Dug	8.20	251	65	16	6	22.9	3.1	43	25	0	31	0.0	36.0	0.33	146	0.04
15	Garhbeta II	Aulia	15	Dug	8.00	289	75	16	9	29.4	1.2	50	65	0	79	1.3	2.3	0.41	157	0.48
16	Garhbeta II	Kantore	16	Sub TW	7.99	646	215	44	26	35.4	3.7	43	210	0	256	14.2	10.0	0.03	332	2.37
17	Garhbeta II	Patharberia	17	Sub TW	7.98	655	215	44	26	41.1	1.0	78	145	0	177	13.7	14.7	0.08	327	0.69
18	Garhbeta II	Saltora	18	Sub TW	7.98	73	35	8	4	0.7	0.2	7	20	0	24	0.0	9.8	0.34	45	0.12
19	Garhbeta II	Kunarpur	19	Dug	7.58	372	45	10	5	59.8	2.3	46	85	0	104	8.9	11.5	0.04	207	0.21
20	Keshpur	GachhGerya	20	Sub TW	7.83	301	125	26	15	8.3	1.4	25	125	0	153	0.0	0.7	0.03	169	0.10
21	Keshpur	Gopal Chak	21	Mark II Deep	7.71	470	180	38	21	21.2	1.8	46	125	0	153	16.6	9.3	0.30	247	0.24
22	Keshpur	Dhamsai	22	Sub TW	7.90	351	160	30	21	5.1	0.8	28	145	0	177	0.9	0.0	0.05	194	0.04
23	Keshpur	Kanakhali	23	Mark II Deep	7.99	398	135	36	11	25.8	2.0	32	155	0	189	0.3	4.5	0.07	228	15.52
24	Keshpur	Kanchantala	24	Sub TW	8.07	424	155	38	15	23.1	0.3	35	155	0	189	0.5	18.7	0.14	246	0.33
25	Midnapore	Bagargerya Asti	25	Sub TW	8.16	424	175	36	21	19.1	0.7	28	170	0	207	1.2	15.0	0.18	248	0.24
26	Salboni	Bagpichla	26	Dug	8.34	158	40	8	5	15.6	2.0	32	25	3	24	0.0	5.2	0.10	84	0.15
27	Salboni	Mirga	27	Sub TW	8.07	87	45	12	4	0.6	0.3	11	30	0	37	0.0	0.9	0.49	51	0.18
28	Garhbeta I	Kusumdahari	28	Sub TW	8.00	52	20	4	2	1.8	0.6	7	15	0	18	0.0	0.3	0.32	28	0.51
29	Garhbeta I	Fatehsinghpur	29	Dug	6.95	1146	210	46	23	154.3	13.5	199	240	0	293	13.4	51.7	0.04	679	0.12
30	Garhbeta I	Balarampur	30	Dug	7.55	261	75	18	7	22.4	2.5	18	90	0	110	5.2	6.2	0.17	147	0.15
31	Garhbeta I	Moulapota	31	Dug	6.99	1168	185	42	19	159.9	30.6	262	40	0	49	74.6	58.9	0.37	678	0.15

32	Keshpur	Chauki Ghata	32	Dug	7.87	58	25	8	1	0.7	0.4	11	15	0	18	0.0	0.0	0.26	32	0.48
33	Keshpur	Sholdiha	33	Sub TW	7.99	510	200	46	21	26.8	0.9	53	175	0	214	1.5	1.7	0.38	281	0.04
34	Chandrakona I	Bashberia Nonadanga	34	Sub TW	7.79	509	190	38	23	25.1	0.9	35	200	0	244	1.2	6.3	0.35	279	0.24
35	Chandrakona I	Narayanpur	35	Sub TW	7.65	513	180	36	22	38.7	1.3	60	155	0	189	3.1	0.0	0.35	277	0.07
36	Keshpur	Mohbani	36	Sub TW	7.64	502	180	36	22	21.4	1.7	32	180	0	220	0.9	11.2	0.19	259	0.18
37	Keshpur	Uttar Baharat	37	Sub TW	7.62	468	155	28	21	36.8	0.7	74	95	0	116	12.8	12.2	0.20	257	0.27
38	Chandrakona II	Damodarpur	38	Sub TW	7.51	436	165	30	22	26.3	3.6	28	190	0	232	0.1	2.8	0.33	255	0.15
39	Chandrakona II	Kenchkapur	39	Sub TW	6.94	362	125	34	10	22.4	0.4	21	165	0	201	0.0	0.3	0.29	211	0.10
40	Chandrakona I	Bhabanipur	40	PHED Deep Tubewell	7.23	466	165	32	21	25.6	0.3	21	215	0	262	0.0	0.0	0.19	260	1.37
41	Chandrakona II	Daumabari	41	Dug	7.27	816	160	34	18	96.0	4.2	74	260	0	317	15.8	1.2	0.21	438	0.18
42	Kharagpur II	Jakpur	42	Mark II DEEP	7.55	217	90	30	4	7.7	1.0	14	95	0	116	0.3	2.4	0.07	130	0.27
43	Midnapore	Paikara	43	Sub TW	7.41	554	190	40	22	37.9	0.8	99	140	0	171	1.7	2.0	0.02	308	0.72
44	Kharagpur II	Magaria	44	Sub TW	7.64	330	150	32	17	10.1	0.4	25	140	0	171	0.0	2.4	0.24	191	0.21
45	Kharagpur II	Gangarampur	45	Sub TW	7.60	401	195	42	22	9.1	0.1	28	175	0	214	0.0	3.5	0.14	235	0.12

46	Kharagpur II	Sakoalok	46	Sub TW	7.63	357	180	40	19	6.1	0.7	18	170	0	207	0.0	1.2	0.24	212	0.07
47	Midnapore	Chherua	47	Sub TW	7.53	464	240	54	26	2.6	0.7	32	190	0	232	0.5	15.6	0.23	273	0.21
48	Midnapore	Malida	48	Sub TW	7.57	403	115	36	6	31.0	2.1	18	165	0	201	0.3	15.0	0.04	242	0.10
49	Keshiary	Saibandh	49	Dug	7.92	113	50	12	5	4.0	0.6	21	25	0	31	0.0	6.6	0.46	68	0.36
50	Keshiary	Jharia	50	Dug	7.98	49	10	0	2	6.5	0.6	7	10	0	12	0.0	2.5	0.73	28	0.21
51	Keshiary	Chakla	51	Mark II Deep	7.59	180	65	16	6	11.5	0.5	18	60	0	73	0.0	0.2	0.51	99	10.50
52	Keshiary	Kharipara	52	Sub TW	7.69	425	170	38	18	17.3	0.9	32	175	0	214	0.0	2.4	0.38	242	0.07
53	Keshiary	Dainbari(Nischintapur)	53	Dug	7.88	318	145	30	17	12.4	0.4	28	120	0	146	0.0	1.8	0.48	184	0.15
54	Keshiary	Harinakhuri	54	Dug	7.79	237	45	10	5	31.6	1.9	50	15	0	18	0.0	34.2	0.82	149	0.48
55	Keshiary	Gholardanga	55	Sub TW	7.76	140	65	18	5	4.2	1.0	18	40	0	49	0.0	6.3	0.58	88	0.85
56	Keshiary	Belar	56	Sub TW	7.68	210	110	30	9	1.0	0.9	25	50	0	61	0.4	6.3	0.39	116	0.11
57	Keshiary	Kharat	57	Sub TW	7.58	194	75	18	7	12.7	1.1	14	65	0	79	0.0	5.3	0.50	115	0.11
58	Keshiary	Dakshinadiha	58	Sub TW	7.53	303	145	32	16	7.8	1.8	35	95	0	116	0.0	7.6	0.41	181	0.29
59	Garhbeta III	Fatehganj Bankati	59	Sub TW	7.66	185	75	18	7	10.3	0.8	25	50	0	61	0.0	3.7	0.32	112	0.11
60	Chandrakona II	Basanchera Chattraganj	60	Sub TW	7.34	349	120	28	12	18.7	0.8	57	65	0	79	0.0	16.5	0.41	193	0.29
61	Chandrakona II	Keshedal	61	Sub TW	7.52	379	135	32	13	19.8	1.7	57	95	0	116	1.4	0.9	0.11	209	0.47

62	Chandrakona II	Gargarighati	62	Dug	7.75	198	100	24	10	1.1	0.3	21	20	0	24	0.7	25.0	0.35	110	0.11
63	Salboni	Godamouli	63	Sub TW	7.65	60	40	16	0	0.2	0.1	7	10	0	12	0.0	0.0	0.29	45	0.68
64	Salboni	Jorakushmi	64	Dug	7.40	94	60	20	2	0.4	0.4	11	20	0	24	0.0	0.9	0.05	65	0.29
65	Salboni	Bhangabandh	65	Dug	7.23	166	55	14	5	9.0	1.2	25	20	0	24	0.0	0.7	0.41	86	0.25
66	Salboni	Golakchak	66	Sub TW	7.17	152	80	18	9	1.3	0.4	18	25	0	31	0.0	4.0	0.05	86	0.18
67	Salboni	Murakata	67	Dug	7.61	38	20	8	0	0.3	0.1	4	5	0	6	0.0	0.5	0.01	34	0.01
68	Salboni	Kadmasole	68	Dug	7.09	292	100	22	11	16.8	0.7	50	35	0	43	2.1	8.5	0.30	156	0.15
69	Salboni	Birbhanpur	69	Dug	7.16	317	110	26	11	18.3	1.4	46	45	0	55	0.6	38.4	0.44	196	0.18
70	Garhbeta I	Raikhan Indrajitpur	70	Sub TW	7.45	237	120	30	11	1.7	1.0	21	50	0	61	0.3	0.3	0.35	124	0.11
71	Garhbeta I	Sandhipur	71	Dug	7.52	147	75	24	4	1.0	0.2	21	15	0	18	0.0	0.4	0.43	84	0.22
72	Garhbeta I	Mohanpur	72	Sub TW	7.61	95	50	12	5	0.9	0.1	7	10	0	12	0.0	0.0	0.42	56	0.08
73	Garhbeta I	Namjoba	73	Sub TW	7.45	211	95	18	12	2.0	0.4	18	45	0	55	0.0	0.0	0.41	108	0.43
74	Garhbeta I	Pachadahara	74	Dug	7.64	84	40	14	1	0.7	0.4	4	5	0	6	0.0	0.0	0.05	49	0.04
75	Garhbeta I	Gilaboni	75	Sub TW	7.58	74	35	12	1	0.8	0.1	4	5	0	6	0.0	0.0	0.19	48	0.01
76	Garhbeta I	Maita	76	PHED DEEP TW	7.35	264	120	26	13	1.3	0.2	25	55	0	67	0.0	6.0	0.16	140	0.01
77	Chandrakona I	Bagchari	77	Sub TW	7.49	274	145	30	17	1.4	0.4	28	55	0	67	0.0	4.1	0.27	150	0.08

78	Chandrakona I	Ramjibanpur	78	Dug	7.55	539	155	52	6	41.2	2.1	39	175	0	214	1.3	1.0	0.05	302	0.11
79	Kharagpur I	Rangamatia	79	Dug	7.88	172	90	22	9	1.2	0.2	11	25	0	31	0.0	0.0	0.29	91	0.11
80	Kharagpur II	Paniseuli	80	Sub TW	7.82	477	160	40	15	26.5	1.5	35	135	0	165	0.4	3.8	0.23	254	0.08
81	Kharagpur I	Ambasole	81	Dug	7.87	219	50	14	4	27.5	0.7	18	40	0	49	0.0	0.7	0.25	126	0.11
82	Garbeta II	Raskunda	WBMP167	Dug Well	8.13	518	0	134	110	89	33	1	0.07	175	6	39	32	15.4	297	0.07
83	Garbeta III	Andhar Nayan	WBMP169	Dug Well	7.51	73	0	12	10	18	BDL	BDL	0.02	30	10	1	4	0.4	41	0.28
84	Garbeta-I	Dhadika	WBMP7A	Tube Well	8.10	222	0	128	105	7	1	BDL	0.21	100	20	12	7	3.6	129	3.24
85	Keshpur	Keshpur	WBMP40A	Dug Well	8.48	918	9	458	390	71	1	BDL	0.28	225	56	21	73	92.6	599	0.83
86	Keshpur	Neradeul	WBMP96A	Tube Well	7.78	708	0	171	140	167	2	BDL	0.16	220	54	21	69	2.6	419	0.12
87	Kharagpur-I	Chota Tangra	WBMP164	Dug Well	8.10	417	0	189	155	53	1	BDL	0.14	150	42	11	31	12.0	267	1.44
88	Kharagpur-I	Hijli	WBMP171	Dug Well	8.06	362	0	122	100	53	8	BDL	0.06	115	32	9	25	7.6	208	0.10
89	Medinipur	Chilgora	WBMP170	Dug Well	7.94	434	0	98	80	89	18	1	0.03	90	20	10	38	33.0	268	0.05
90	Medinipur	Jamir Ara	WBMP165	Dug Well	8.11	386	0	128	105	71	3	1	0.05	125	32	11	31	2.8	229	0.77

CHAPTER 8

GROUND WATER RESOURCES ESTIMATION

8.1. DYNAMIC RESOURCE

The present chapter deals with the resources available in the study area. The Dynamic Resource of the area for 2022 has been calculated jointly by CGWB and SWID (State Water Investigation Directorate) using GEC-2015 methodology. The irrigation data available to the 6th Minor Irrigation Census, block wise demographic data of 2011 Census, CGWB water level data, cropping pattern, annual monsoon rainfall and normal rainfall provided the basic input for calculating the resources of the state. Block wise (Groundwater assessment unit) geographical area, area under different hydrogeological sub-provinces (sub-units), area under command and non-command, poor ground water quality area and ground worthy recharge area has also been considered. Gross current draft for all uses, recharge from rainfall, recharge from other sources like tanks, ponds, canal seepages, return flow from ground water and surface irrigation has all been considered. The number of abstraction structures and their unit draft has been taken into account for computation of irrigation draft. The projected population of 2025 (based on census 2011) and per capita consumption (60 lpcd) have been considered for computation and 70 % of the obtained figure is taken as the domestic and industrial draft.

8.1.1. Recharge and Resource

Rainfall is the principal source of groundwater recharge in the area and a very minor part of it comes from seepage through irrigation canals, rivers and return flow from irrigation. The present utilization of groundwater in the study area is mainly for agriculture use and domestic.

8.1.2. Groundwater Draft

Groundwater draft has been computed on the basis of quantum of water likely to be used for domestic, irrigation and industrial purposes. The estimate is done by projecting the population and the number of ground water abstraction structures.The total extraction for all the blocks is 113548.97ham with Keshpur being the highest with 13408.57 Ham.

8.1.3. Stage of Development and Category

The unit of assessment is categorized based on the Stage of Groundwater development. The level of ground water development in Paschim Medinipur district (56%) is comparatively higher to the state average of 47%.Out of 21 blocks, Chandrakona-II and Garhbeta- I block falls under critical category, Keshpur and Kharagpur-II falls under semi-critical category. The safe category blocks offer a scope for further exploitation of available un-utilized resource in future. The stage of groundwater development map is shown in figure below. The following table gives an account of the groundwater recharge, their draft, and allocation of resource for future use, stage of development and categorization of the blocks in Paschim Medinipur district.

Table 8.1.Ground water Recharge, Resource and Stage of Development for Paschim Medinipur district.

Assessment Units Name/ Block	Annual Extractable GW resource (Ham)	Total Availability of Ground Water Resources (Ham)	Gross Ground Water Abstraction for all uses (Draft) (Ham)	Stage of Ground Water Extraction (%)	Category
Chandrakona-I	8776.19	8776.19	5282.11	60.2	Safe
Chandrakona-II	5747.37	5747.37	5306.66	92.3	Critical
Dantan-I	9015.23	9015.23	4327.18	48.0	Safe
Dantan-II	6678.41	6678.41	3640	54.5	Safe
Daspur-I	6182.33	6182.33	3104.15	50.2	Safe
Daspur-II	5824.18	5824.18	1167.63	20.0	Safe
Debra	12878.14	12878.1	8893.88	69.1	Safe
Garbeta-I	7336.94	7336.94	7016.02	95.6	Critical
Garbeta-II	7257.94	7257.94	4003.89	55.2	Safe
Garbeta-III	5832.52	5832.52	3863.27	66.2	Safe
Ghatal	8768.3	8768.3	4357.25	49.7	Safe
Keshiary	10066.99	10067	2788.89	27.7	Safe
Keshpur	18346.15	18346.2	13408.6	73.1	Semi_Critical

Kharagpur-I	12977.47	12977.5	4048.93	31.2	Safe
Kharagpur-II	9273.7	9273.7	7797.36	84.1	Semi_Critical
Midnapore	8056.37	8056.37	3841.55	47.7	Safe
Mohanpur	5001.83	5001.83	2837.04	56.7	Safe
Narayangarh	18677.53	18677.5	11898.5	63.7	Safe
Pingla	7997.84	7997.84	4242.42	53.0	Safe
Sabang	11227.33	11227.3	6758.05	60.2	Safe
Salbani	14781.71	14781.7	4965.59	33.6	Safe
Total	**200704.47**	**200704**	**113549**	**56.6**	

8.1.4. Irrigation Potential created and utilized

The net ground water availability for future irrigation use in the district is estimated at 88367.71 Ham. Depending upon the feasibility of the area, the availability of the resource can be properly managed and utilised. Presently, irrigation in the district is practiced through both surface flows and ground water flows. Total number of groundwater abstraction structures stands at 27225 nos (1023 Dugwells, 6280 Shallow Tubewells, 18664 Medium Tubewells and 1258 nos. of Deep Tubewells). Total numbers of surface flow schemes are 278, surface lift schemes of 745, contributing to total number of surface schemes of 1023.The blocks under ‘Safe’ categoryhave further scope for expansion of ground water irrigation through additional irrigation potential with available resource, whereas in the ‘Critical’ and ‘Semi-critical’ blocks, irrigation can be practiced by surface flows, micro-irrigation, changing the cropping pattern to less water intensive crops.The irrigation potential created and the net irrigated area through means of various abstraction structures are given below in Table 6.2.

Table 8.2. Irrigation potential created and actual area irrigated with groundwater in Paschim Medinipur district.

(Source: 6th MI census)

Block	Irrigationpotential Created(HaM)	Actual/netarea irrigated (Ha)	Achievement (%)
Chandrakona I	12847.40	11673.67	91
Chandrakona II	11775.73	10932.35	93
Daspur I	4963.55	4352.982	88
Daspur II	1624.39	1450.154	89
Dantan I	8786.84	8109.385	92
Dantan II	7946.96	7231.27	91
Debra	16714.26	12601.38	75
Garbeta I	12620.81	10351.82	82
Garbeta II	8816.46	7478.407	85
Garbeta III	7479.17	5954.575	80
Ghatal	9450.74	8023.724	85
Keshiary	7758.88	7280.917	94
Keshpur	38518.45	36738.64	95
Kharagpur I	6840.62	5971.72	87
Kharagpur II	17244.58	14855.99	86
Medinipur	5820.38	5506.445	95
Mohanpur	5985.33	4798.417	80
Narayangarh	22635.67	20202.61	89
Pingla	5632.68	4165.041	74
Sabang	55646.14	52481.75	94
Salbani	8698.85	7239.727	83
Total	**277807.89**	**247401**	**89**

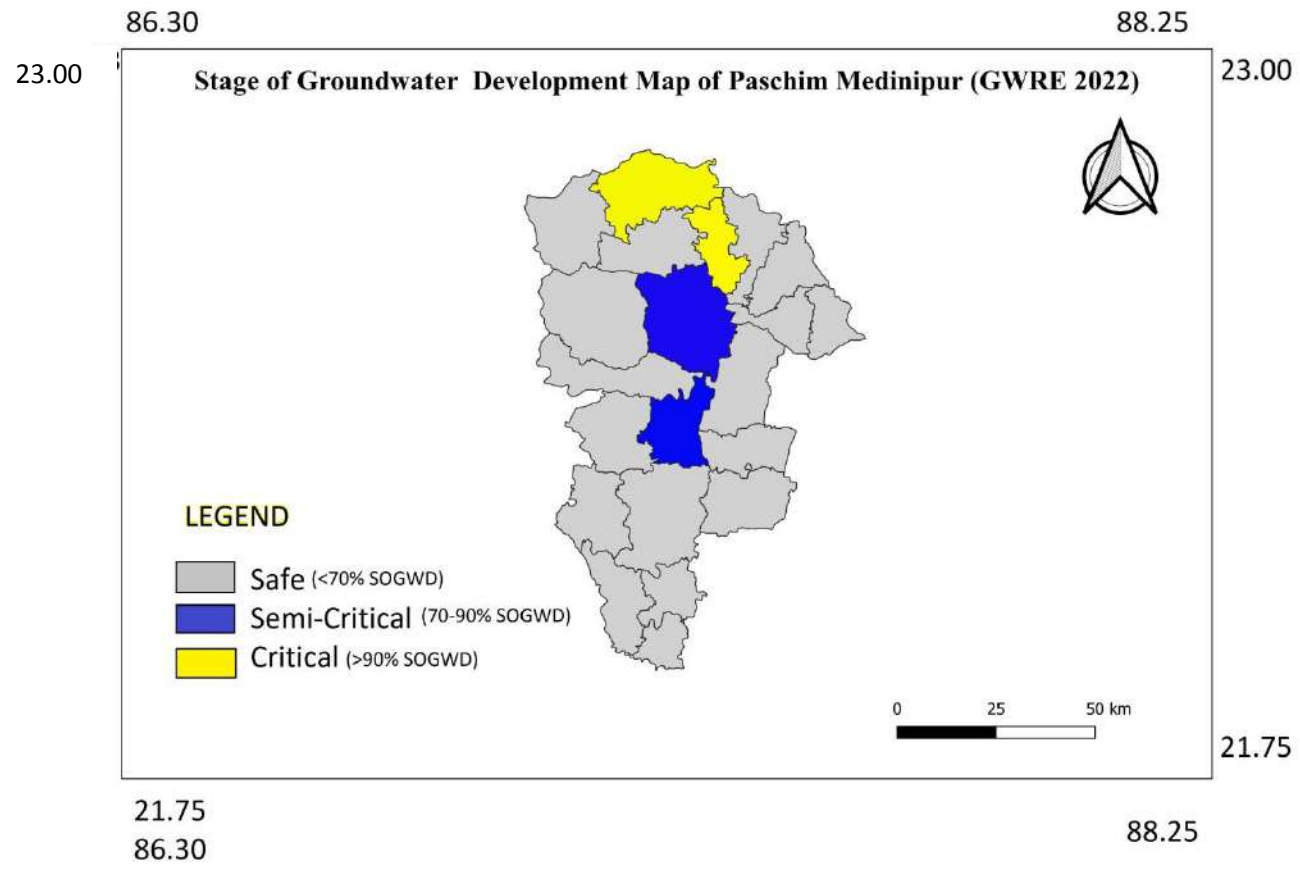


Figure 8.1: Stage of Groundwater Development in different CD blocks in Paschim Medinipur

CHAPTER 9
GROUNDWATER ISSUES AND CHALLENGES

The General Geology of the study area is mainly Tertiary/Quaternary Alluvium with Lateritic crust in some areas (North-Western and Western parts of the District). Groundwater plays a vital role for human consumption, irrigation purpose, livestock demands and many others. The main issues are mainly long term (decadal) declining water level trends in pre-monsoon and post-monsoon season along with Quality issues in some parts of the District. The gradual declining trend of water level during pre-monsoon is about 0.571 m in parts of Garhbeta-I block, 0.099-0.233 m in Medinipur Block, 0.757 m in parts of Keshpur Block. During post-monsoon period, the rate of long term water level decline ranges from 0.195 m in parts of Garhbeta-I block, 0.083-2 m in parts of Medinipur block, 0.027 m in parts of Kharagpur-I block and 0.006 m in parts of Garhbeta-III block.

Groundwater quality issues include the ranges of the parameters of Iron and Nitrate in some parts of the study area.

High concentration of Fe was detected in Bhabanipur in Chandrakona-I Block, Manidaha in Medinipur Block, Kantore in Garhbeta-II Block, Baksibandh in Midnapore Block, Chakla in Keshiary Block, Karnagar in Salboni Block, Kanakhali in Keshpur Block, ranging from 2.37 mg/l to 15.52 mg/l.

Higher concentration of Nitrate (NO3) was detected in North-Western and Western parts of the study area as in Benucha in Salboni Block, Goaltore in Garhbeta-II Block, Fatesinghpur in Garhbeta-I Block, and Moulapota in Garhbeta-I Block.

9.1 Water conservation and artificial recharge:

In modern days water conservation and artificial recharge through rain water harvesting is essential mainly in Paschim Medinipur district where North-Western and western part of the district faces water scarcity during lean period. The average annual rainfall is 1485 mm and which is sufficient to design suitable rainwater harvesting structures.

9.2 Conservation of Water:

In the areas along the western boundary and northwestern part of the district, where lateritic formation along with older alluvium is prevalent, there are quality issues and declining water

level trend. Dug wells and shallow to medium tube-wells are the main ground water abstraction structures in this part of the district. Therefore, conservation through rainwater harvesting practices is a viable option. Conservation of Rainwater can be done through the water which is available from both rooftops and also from the land.

- Water available from roofs can be stored giving considerations of all types of loses in cemented tanks or in PVC tanks. Before conserving the water should be passed through a filter media.
- Rainwater available from the surrounding land surface can be stored in any ponds and in this case designs of ponds are to be finalized considering local hydrogeological condition.
- In the areas of first order streams nallah bunds are to be constructed and in areas of second and third order streams checkdams are to be constructed for conservation of surface runoff water and enhance soil moisture.
- Vegetation in upland areas prevents surface runoff and thus also enhances soil moisture.

CHAPTER 10

GROUNDWATER DEVELOPMENT AND MANAGEMENT

Groundwater development in an area is regarded as an index of groundwater use in different sectors like domestic, agricultural, industrial and mining, etc. Chronic water scarcity prevents expansion of agricultural and economic growth. Strategic use of groundwater is required to ensure its proper sustainability. In this sector, the role of water management is necessary for proper regulation of the water resource.

For assessing development potentialities of an aquifer, the following information is required:-

i. Geometry of the reservoir defining dimensions and boundaries.
ii. Condition at the boundaries in particular the source of recharge;
iii. Lithology and the aquifer characteristics;
iv. Hydrodynamic condition- whether phreatic, confined or semi-confined;
v. Order of magnitude of the reservoirs;
vi. Average natural recharge and discharge;
vii. Quality of water.

10.1. Rural and Urban Water Supply Schemes

Groundwater based piped water supply has been provided by PHED Dte, Government of West Bengal in blocks Chandrakona-I, Chandrakona-II, Garhbeta-I, Garhbeta-III, Kharagpur-II, Medinipur and in Salboni block in the NAQUIM area **(Details in Annexure-VII).** As from PHED Dte, number of households where functional tap water connection has been provided through Jal Jeevan Mission are 2, 26,638 in number out of 11, 11, 029 which accounts to 20.40 % of the progress, out of 5819 number of schools, 5736 schools have been provided with functional tap water connection which accounts to 98.57% of the progress, out of 5250 Anganwadi Centres (AWCs) 1444 have been provided with functional tap connection which accounts to 27.50 % of the progress. 29 community centres, 3 community toilets, 212 community building/Panchayet Ghars, 704 health centres, 7 other Govt. Offices are provided with functional tap connection through JJM.

10.2. Ground water for irrigation:-

Groundwater development for irrigation in the study area is carried out by Shallow Tubewells, Medium Tubewells, and Deep Tubewells and through Dugwells. Of these, majority of the groundwater irrigation is practised through medium depth tube-wells. As per 6thminor irrigation census, culturable command area (CCA) through groundwater source is maximum in Sabang block, covering an area of 28774.36 Ha; followed by Keshpur block; covering an area of 19929.40 Ha. Least CCA through ground water was in Daspur-II block, covering net irrigated area of 1313.13 Ha.

10.2.1. Additional Shallow Borewells construction possibility

Based on the Dynamic groundwater resource estimation, the current stage of development was calculated. The projected stage of development (SOD) of each block was taken as 65%. Additional resources available was calculated based on the projected stage of development. The unit draft for each shallow depth tubewell is 3 Ham. Hence, total **8194** number of additional shallow tubewells to be constructed based onprojected SOD and additional resources **(Table 10.1).**

Table 10.1. Feasible number of additional Tubewells

Block	Annual Extractable Resource	Gross GW Draft	Present SOD	Projected SOD	Additional GW Res Available	Unit Draft	Additional TW feasible
	(ham)	(ham)	%	%	(ham)	(ham)	
Chandrakona-I	8776.19	5282.11	60.2	65	422	3	141
Chandrakona-II	5747.37	5306.66	92.3	65	0	3	0
Dantan-I	9015.23	4327.18	48.0	65	1533	3	511
Dantan-II	6678.41	3640	54.5	65	701	3	234
Daspur-I	6182.33	3104.15	50.2	65	914	3	305
Daspur-II	5824.18	1167.63	20.0	65	2618	3	873
Debra	12878.14	8893.88	69.1	65	0	3	0
Garbeta-I	7336.94	7016.02	95.6	65	0	3	0
Garbeta-II	7257.94	4003.89	55.2	65	714	3	238
Garbeta-III	5832.52	3863.27	66.2	65	0	3	0
Ghatal	8768.3	4357.25	49.7	65	1342	3	447
Keshiary	10066.99	2788.89	27.7	65	3755	3	1252
Keshpur	18346.15	13408.6	73.1	65	0	3	0
Kharagpur-I	12977.47	4048.93	31.2	65	4386	3	1462
Kharagpur-II	9273.7	7797.36	84.1	65	0	3	0
Midnapore	8056.37	3841.55	47.7	65	1395	3	465
Mohanpur	5001.83	2837.04	56.7	65	414	3	138
Narayangarh	18677.53	11898.5	63.7	65	242	3	81
Pingla	7997.84	4242.42	53.0	65	956	3	319
Sabang	11227.33	6758.05	60.2	65	540	3	180
Salbani	14781.71	4965.59	33.6	65	4643	3	1548
Total	**200704**	**113549**			**24575**		**8194**

10.3. Future Ground water Development and Management:-

The district has net available ground water resource of 20074 Ham and the average Stage of Development is 56.57%.

In deciding the mode of future groundwater development in the study area, the following aspects have been taken into consideration:

The western part of the district as Medinipur, Garhbeta I,Garhbeta II, Garhbeta III, Chandrakona II, Salboni, Keshpur, Kharagpur I, Kharagpur II which have lateritic top soil and older alluvium are suitable for construction of Dugwells and shallow depth tubewells. The eastern and south eastern part of the district consists of sand beds alternating with thick clay beds and medium depth tubewells are feasible in those areas.

The feasibility of a particular groundwater structure depends on the local hydrogeological setup and requirement of water to be used. Dugwells and Shallow tubewells are suitable for private purpose as it involves farmer's participation in a cooperative manner and also requires less expenditure on maintenance.

Groundwater development through medium depth tubewells may be done in the safe blocks where the underlying lithology is unconsolidated alluvium. The deep tube wells involve high cost for construction and maintenance and thus may be maintained by the Government / Co-Op Societies.

10.4. Scope for Artificial Recharge to Groundwater

Artificial recharge is always site specific. The site selected for artificial recharge should have the proper geological and hydrogeological setup and should have ample scope for groundwater development. The non-committed rainwater should be used for Recharge. Care should be taken so that the recharge water does not drain out into streams and nallas. The post-monsoon depth to groundwater level should be more than 6 mbgl.

In the study area, the feasible blocks for Artificial Recharge and their cost of constructions, utilisable surface run-offs for the blocks under study are given in the table below:-

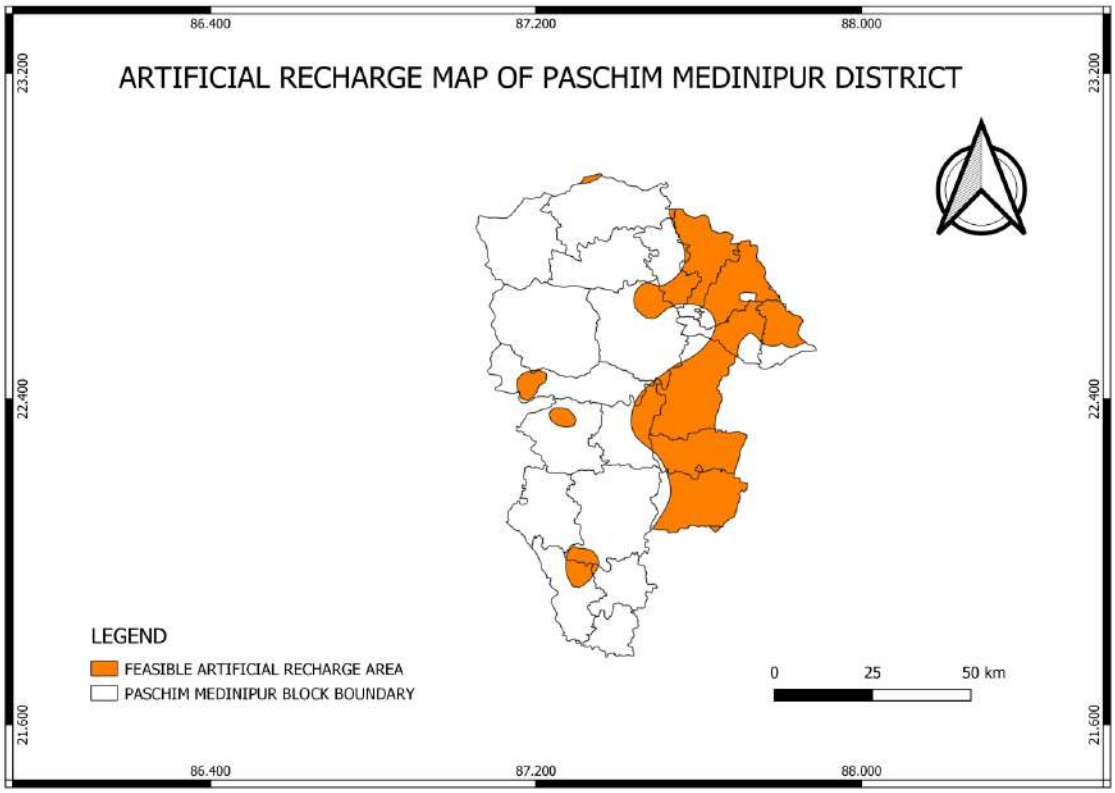


Figure 10.1 Artificial Recharge map of Paschim Medinipur District

Table 10.2 Artificial Recharge structures in the study area

District	Block	Formation type	Area feasible for AR (Sq.km)	Number of Proposed Recharge Structures							Cost of Recharge structures (Rs. In lakhs)							Availability of surface non committed monsoon run off (MCM)
				Percolation Tanks	REET with RS	Injection Well	Check Dam	Gabion/ Contour Bund	Sub surface dykes	Dug Well Recharge	Percolation Tanks	REET with RS	Injection Well	Check Dam	Gabion/ Contour Bund	Sub surface dykes	Dug Well Recharge	
Paschim Medinipur	Chandrakona-I	Alluvium	209.48817	73	147	73	0	0	0	0	584.00	588.00	219.00	0.00	0.00	0.00	0.00	73.314
Paschim Medinipur	Chandrakona-II	Alluvium	65.01380	23	46	23	0	0	0	0	184.00	184.00	69.00	0.00	0.00	0.00	0.00	22.753
Paschim Medinipur	Garhbeta-I	Alluvium	10.11032	4	7	4	0	0	0	0	32.00	28.00	12.00	0.00	0.00	0.00	0.00	3.538
Paschim Medinipur	Garhbeta-III	Alluvium	0.00347	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.001
Paschim Medinipur	Keshpur	Alluvium	73.10590	26	51	26	0	0	0	0	208.00	204.00	78.00	0.00	0.00	0.00	0.00	25.585
Paschim Medinipur	Kharagpur-I	Alluvium	26.21810	9	18	9	0	0	0	0	72.00	72.00	27.00	0.00	0.00	0.00	0.00	9.175
Paschim Medinipur	Kharagpur-II	Alluvium	81.26230	28	57	28	0	0	0	0	224.00	228.00	84.00	0.00	0.00	0.00	0.00	28.439
Paschim Medinipur	Medinipur	Alluvium	46.26789	16	32	16	0	0	0	0	128.00	128.00	48.00	0.00	0.00	0.00	0.00	16.192
Paschim Medinipur	Salboni	Alluvium	0.93452	0	1	0	0	0	0	0	0.00	4.00	0.00	0.00	0.00	0.00	0.00	0.327
Total			**512.4045**	**179**	**359**	**179**	**0**	**0**	**0**	**0**	**1432**	**1436**	**537**	**0**	**0**	**0**	**0**	**179.324**

PART-II

BLOCKWISE AQUIFER MANAGEMENT PLAN

11.1 SALIENT INFORMATION

Block Name: *Chandrakona-I*

Geographical area (sq. km): 193.5

Mappable area (sq. km): 185

District: Paschim Medinipur

State: West Bengal

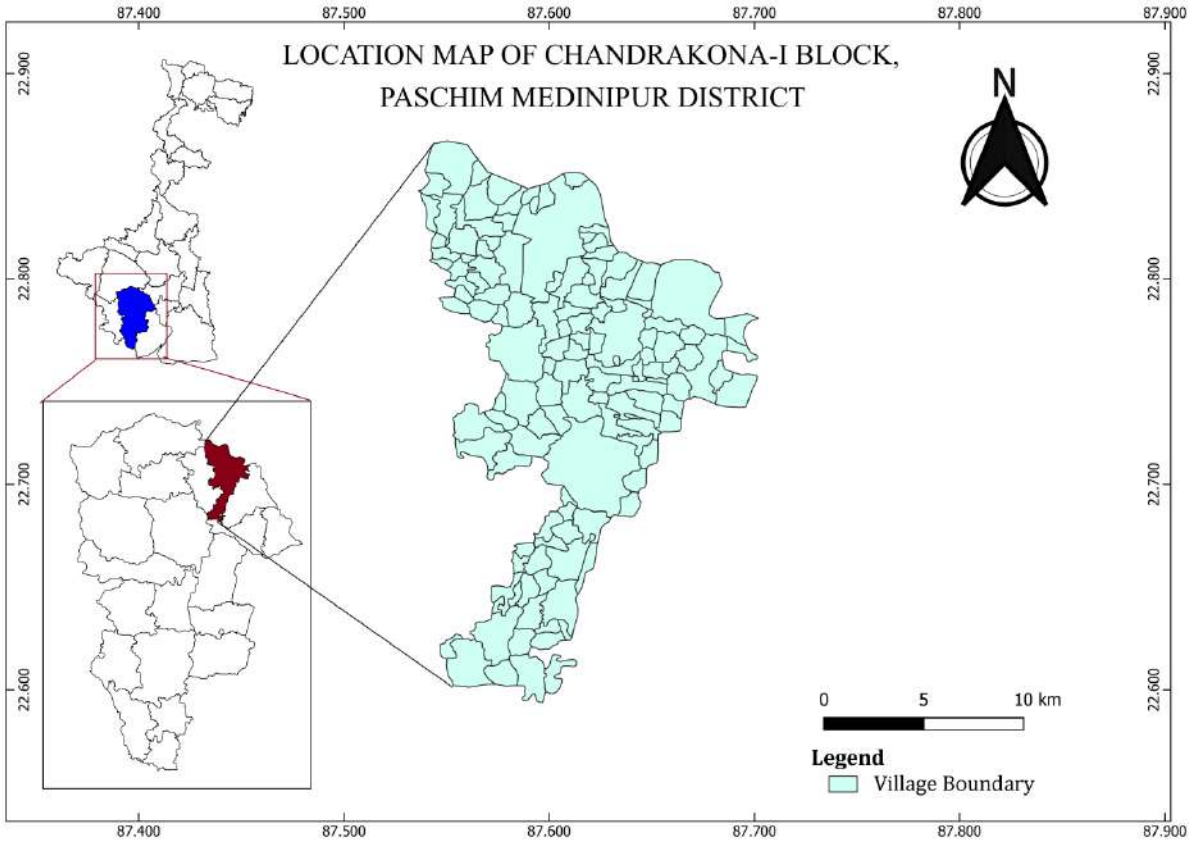


Figure11.1.1: Location Map of *Chandrakona-I* Block

Population (as on 2011):

Table 11.1.1: *Details of population in Chandrakona-I block.*

Rural	Urban	Total	Population Density per Sq.km
136006	0	136006	703

Rainfall: Total annual rainfall for the block is 2282 mm.

Table *11.*1.2: Rainfall Details

Block	District Normal (mm)	District Actual (Annual) in mm				
		2018	2019	2020	2021	2022
Chandrakona-I	1626.8	2191.9	6457.6	5716.58	3519.08	5238.07

Agriculture& Irrigation (area in ha):

Table *11.*1.3: Salient Land use features of *Chandrakona-I*block

Block	Reporting Area	Forest Area	Area Under Non-Agricultural Waste	Gross cropped area	Net Sown Area	Area sown more than once	Area under undue uses
Chandrakona-I	19354	5823	2348	26790	19462	7328	4731

Table *11.1.*4: Crop water requirement of *Chandrakona-I*block

Block	Crops	Areasown (ha)	Irrigated area (ha)	Crop water demand (BCM)	Area to be irrigated (ha)	Water potential required (BCM)	Existing Water potential (BCM)	Water potential to be created (BCM)
Chandrakona-I	Cereals	20300	4702	0.07523		0.07523	0.07523	0.00000
	Coarse Cereals	0	0	0.00000		0.00000	0.00000	0.00000
	Pulses	160	160	0.00040	500	0.00165	0.00040	0.00125
	Oil Seeds	8845	8845	0.02211	500	0.02336	0.02211	0.00125
	Fibre	90	90	0.00036		0.00036	0.00036	0.00000
	Other crops	11055	11055	0.06633	1800	0.07713	0.06633	0.01080

Table *11.1.5* Command area (ha) of *Chandrakona-I* block

Block Name	Dug well		Shallow Tube well		Medium Tube well		Deep Tube well		Surface Flow		Surface Lift		CCA (ha.)		Total CCA (ha.)
	No.	CCA (ha.)	No.	CCA (ha.)	No.	CCA (ha.)	No.	CCA (ha.)	No.	CCA (ha.)	No.	CCA (ha.)	Ground Water	Surface Water	
Chandrakona-I	0	0	362	1522.25	803	6108.23	15	343.92	0	0	11	252.13	7974.40	252.13	8227

Disposition of Aquifers:

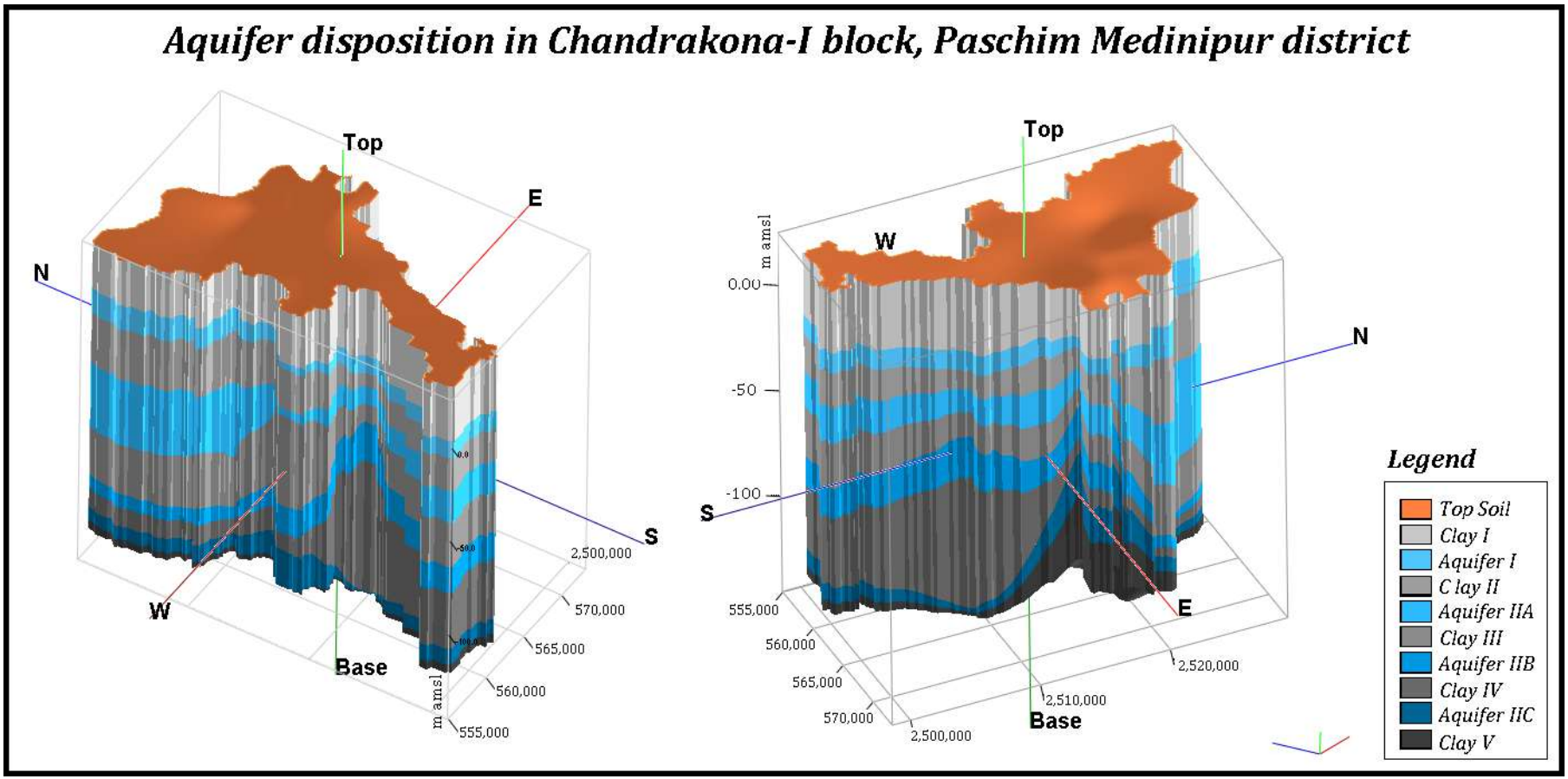
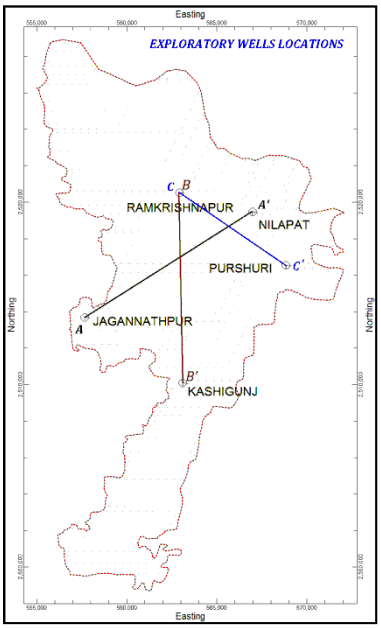


Figure. 11.1.2.3D Model of Aquifer Disposition of Chandrakona-I Block



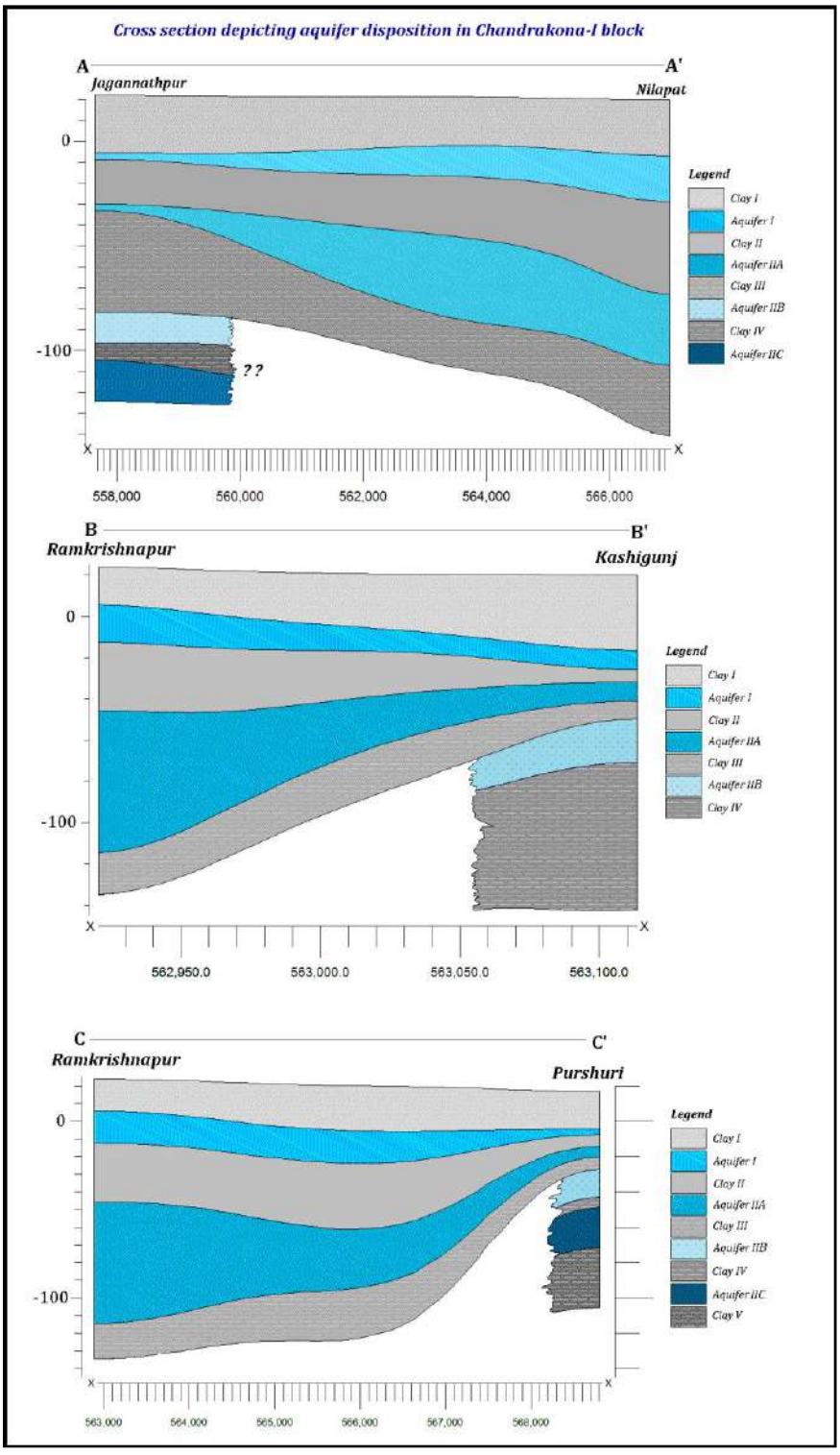


Figure. 11.1.3.2D Model of Aquifer Disposition of Chandrakona-I Block

The principal aquifer systems encountered in this block is alluvium.

The **shallow aquifers (Aquifer-I)** range from 27 mbgl to 61 mbgl. The water bearing zone varies between 27-45.73 mbgl, 52-61 mbgl.

The range of **deeper aquifers (Aquifer-IIA and Aquifer-IIB)** is from 82 m bgl to 118 mbgl.The water bearing zone varies between 82-94 mbgl and 103-118 mbgl.

Table *11.15*.6: Details of aquifer disposition inChandrakona-IBlock

Blocks (dominant in soft rock)	No. of Aquifers	Water bearing zone (mbgl)	Aquifer Thickness (m)			Discharge (lpm)	T (m^2/day)	SWL (mbgl)	Draw down (mbgl)	S
			Aquifer-I	Aquifer-II A	Aquifer-II B					
Chandrakona-I	2	27-45.73,52-61, 82-94, 103-118	27-45.73,52-61	82-94	103-118	--	--	--	--	--

Table 11.1.7: Details of Aquifer Wise Water Level Ranges & seasonal long term water level trends

Block	Pre-monsoon Trend			Post-monsoon Trend		
	WL Range (mbgl)	Rise (m/year)	Fall (m/year)	WL Range (mbgl)	Rise (m/year)	Fall (m/year)
Chandrakona-I	5-22	--	0.346	1.16-14.81	0.586	--

Ground water quality and issues: The range of chemical parameter for the block is given below.

Table 11.1.8: Range of chemical parameters in Chandrakona-I Block

Block	Aquifer Type	pH	EC (µS/cm)	Na (mg/l)	Cl (mg/l)	F (mg/l)	NO_3 (mg/l)	Fe (mg/l)	Measured Hardness (mg/l)
Chandrakona-I	Aquifer-I	7.55	539	41.2	39	0.35	1.0	0.11	155
	Aquifer-II	7.23-7.79	274-513	1.4-38.7	21-60	0.19-0.35	4.1-6.3	0.07-1.37	145-190

Ground Water Resource:

Table *11*.1.9: Details of Ground Water Resource Availability and Utilization in *Chandrakona-I* Block.

Name of the Block	**CHANDRAKONA-I**
Total Annual Ground Water Recharge (Ham)	9751.32
Total Natural Discharges (Ham)	975.13
Annual Extractable Ground Water Recharge (Ham)	8776.19
Total Extraction	5282.11
Annual GW Allocation for Domestic Use as on 2025	426.35
Net Ground Water Availability for future use	3469.34
Stage of Ground Water Extraction (%)	60.18
Categorization (OE/CRITICAL/ SEMI-CRITICAL/ SAFE)	Safe

Aquifer Management Plan:

Ground Water Management Plan for drinking purpose:

The block has three reported public water supply schemes by PHED in Bhabanipur, Kasanda and Srinagar. However, there should be a general practice of conservation through rainwater harvesting, considering an adequate normal monsoon rainfall of 1582.8 mm which the block receives. The conserved rainwater can be utilized for drinking purpose by filtering through Horizontal Roughing Filters. The water from the lands can be channeled to ponds for recharge in the water bodies and this water can be tapped through shallow tube wells and dug wells for domestic and drinking purpose.

Ground Water Management Plan for irrigation purposes:

- Although the block falls in safe category with stage of ground water development at 60.18%, further development should be done in planned manner to harness the additional available resource for site specific sustainable development.

- Micro-irrigation techniques like drip and sprinkler methods need to be adopted. Owing to its distinct hydrogeology, it is evident that cultivable command area is created by both surface as well as groundwater.
- Crops with low water requirement should be preferred.
- In view of adequate rainfall in the area, excavation of tanks with large catchment areas, construction of check dams on second and third order streams, nallah bunds, gabion structures on first order streams, sub-surface dykes along the stream channels at suitable locations can be implemented to raise ground water level as well as to augment irrigation facilities. Irrigation by surface water may be increased. In addition to surface lift from canal & surface flows, rain water harvesting may also be considered.

Management Intervention through Harvesting of Surface Runoff and Artificial Recharge:

It has been estimated that the utilizable surface runoff produced in the block is **73.314** MCM. This surface runoff is proposed to be utilized for Artificial Recharge in the block. The number of AR structures to be constructed in the block are recommended in the table below:-

Table *11*.1.10: Details of structures recommended in feasible area of artificial recharge for Chandrakona-I Block.

		Allocation of Utilizable Recourse (MCM)							Structures Feasible							Cost of Structures (in lakhs)							
	Utilizable Surface Run Off	Percolation Tank	REET with RS	Injection Well	Check Dam	Gabion/ Contour Bund	Sub-Surface Dyke	Dug Well Recharge	Percolation Tank	REET with RS	Injection Well	Check Dam	Gabion/ Contour Bund	Sub-Surface Dyke	Dug Well Recharge	Percolation Tank	REET with RS	Injection Well	Check Dam	Gabion/ Contour Bund	Sub-Surface Dyke	Dug Well Recharge	TOTAL
Chandrakona-I	73.314	36.657	14.663	21.994	0	0	0	0	73	147	73	0	0	0	0	584	588	219	0	0	0	0	1391

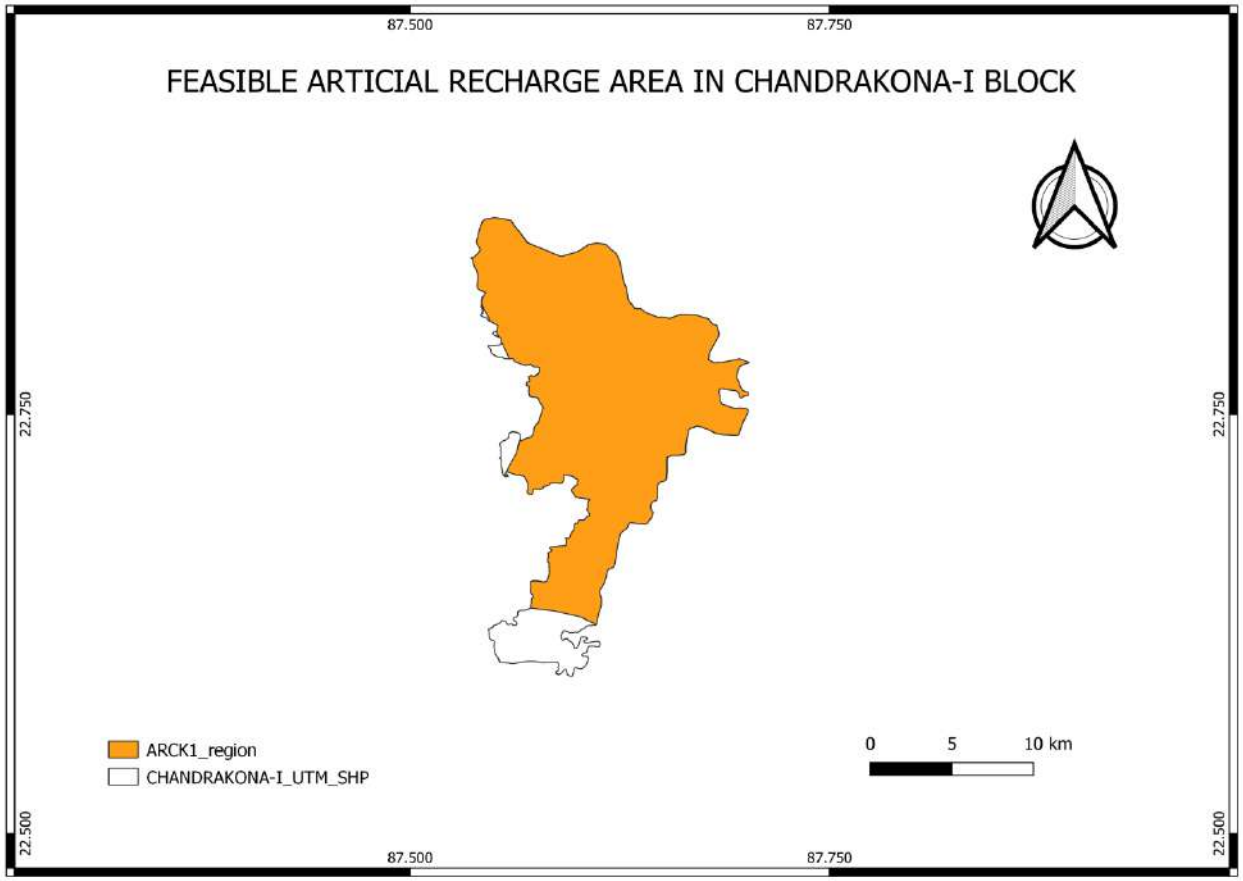


Figure11.1.4: Area Feasible for Artificial Recharge of groundwater for *Chandrakona-I*Block

11.2 SALIENT INFORMATION

Block Name: ***Chandrakona-II***

Geographical area (sq. km): 150.43

Mappable area (sq. km): 150.43

District: Paschim Medinipur

State: West Bengal

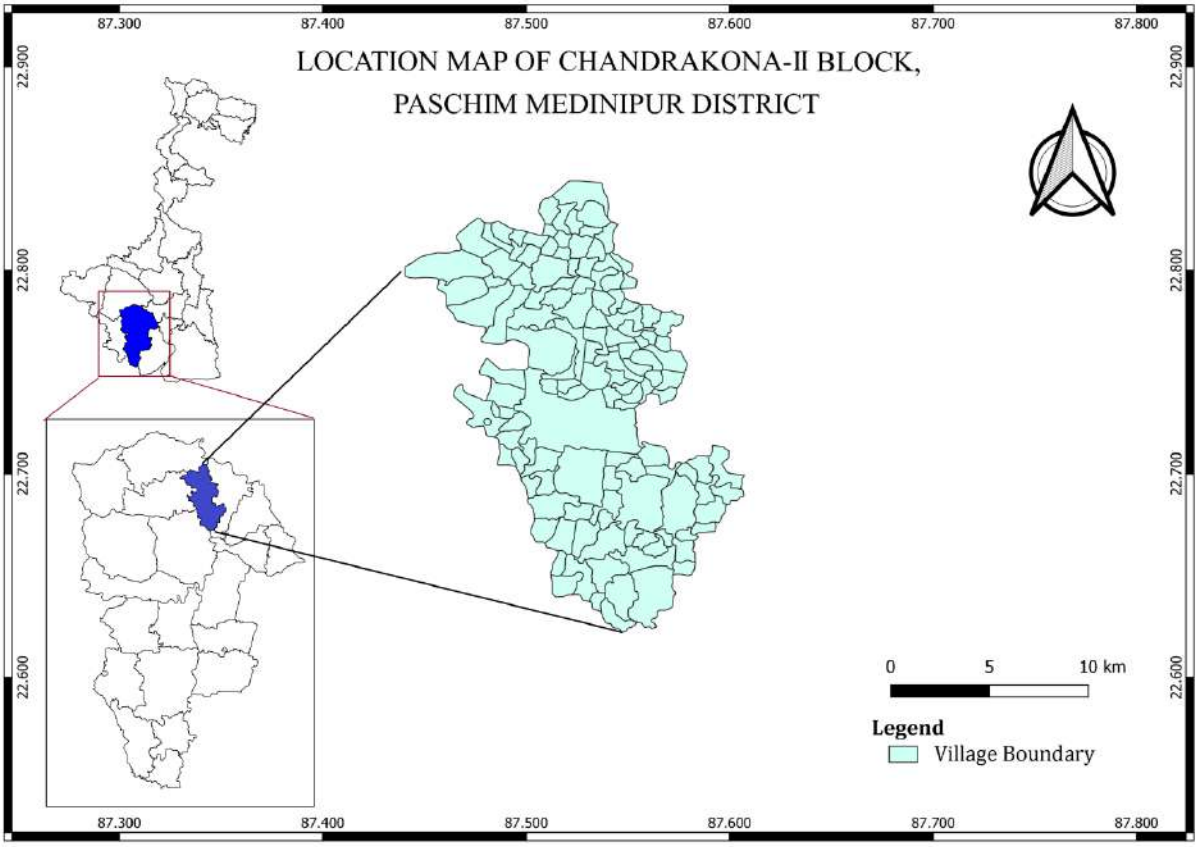


Figure11.2.1: Location Map of *Chandrakona-II* Block

Population (as on 2011):

Table 11.2.1: *Details of population in Chandrakona-II block.*

Rural	Urban	Total	Population Density per Sq.km
63180	60089	123269	819

Rainfall: Total annual rainfall for the block is 2282 mm.

Table *11*.2.2: Rainfall Data

Block	District Normal (mm)	District Actual (Annual) in mm				
		2018	2019	2020	2021	2022
Chandrakona-II	1626.8	2191.9	6457.6	5716.58	3519.08	5238.07

Agriculture& Irrigation (area in ha):

Table *11*.2.2: Salient Land use features of *Chandrakona-II* block

Block	Reporting Area	Forest Area	Area Under Non-Agricultural Waste	Gross cropped area	Net Sown Area	Area sown more than once	Area under undue uses
Chandrakona-II	15043	361	593	33027	12659	20368	1430

Table *11.2*.4: Crop water requirement of *Chandrakona-II* block

Block	Crops	Areasown (ha)	Irrigated area (ha)	Crop water demand (BCM)	Area to be irrigated (ha)	Water potential required (BCM)	Existing Water potential (BCM)	Water potential to be created (BCM)
Chandrakona-II	Cereals	14070	7393	0.11829		0.11829	0.11829	0.00000
	Coarse Cereals	0	0	0.00000		0.00000	0.00000	0.00000
	Pulses	87	87	0.00022	300	0.00097	0.00022	0.00075
	Oil Seeds	8305	8305	0.02076	300	0.02151	0.02076	0.00075
	Fibre	110	110	0.00044		0.00044	0.00044	0.00000
	Other crops	10455	10455	0.06273	1159	0.06968	0.06273	0.00695

Table *11.2.5* Command area (ha) of *Chandrakona-II* block

Block Name	Dug well		Shallow Tube well		Medium Tube well		Deep Tube well		Surface Flow		Surface Lift		CCA (ha.)		Total CCA (ha.)
	No.	CCA (ha.)	No.	CCA (ha.)	No.	CCA (ha.)	No.	CCA (ha.)	No.	CCA (ha.)	No.	CCA (ha.)	Ground Water	Surface Water	
Chandrakona-II	5	13.30	266	1058	893	4644.22	24	524.61	4	10.14	49	326.07	6240.13	336.21	6576

Disposition of Aquifers:

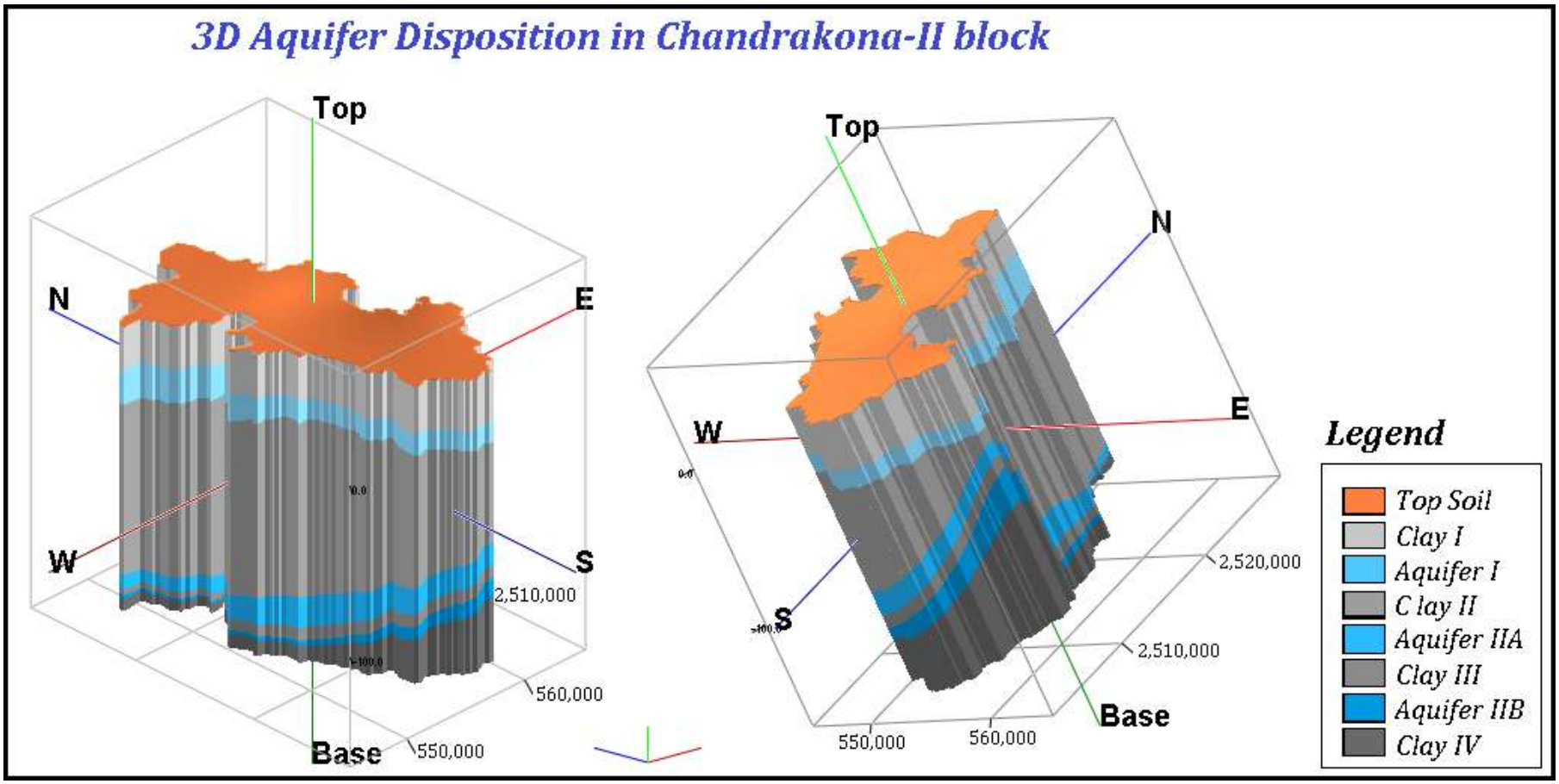


Fig. 11.2.2.3D Model of Aquifer Disposition of Chandrakona-II Block

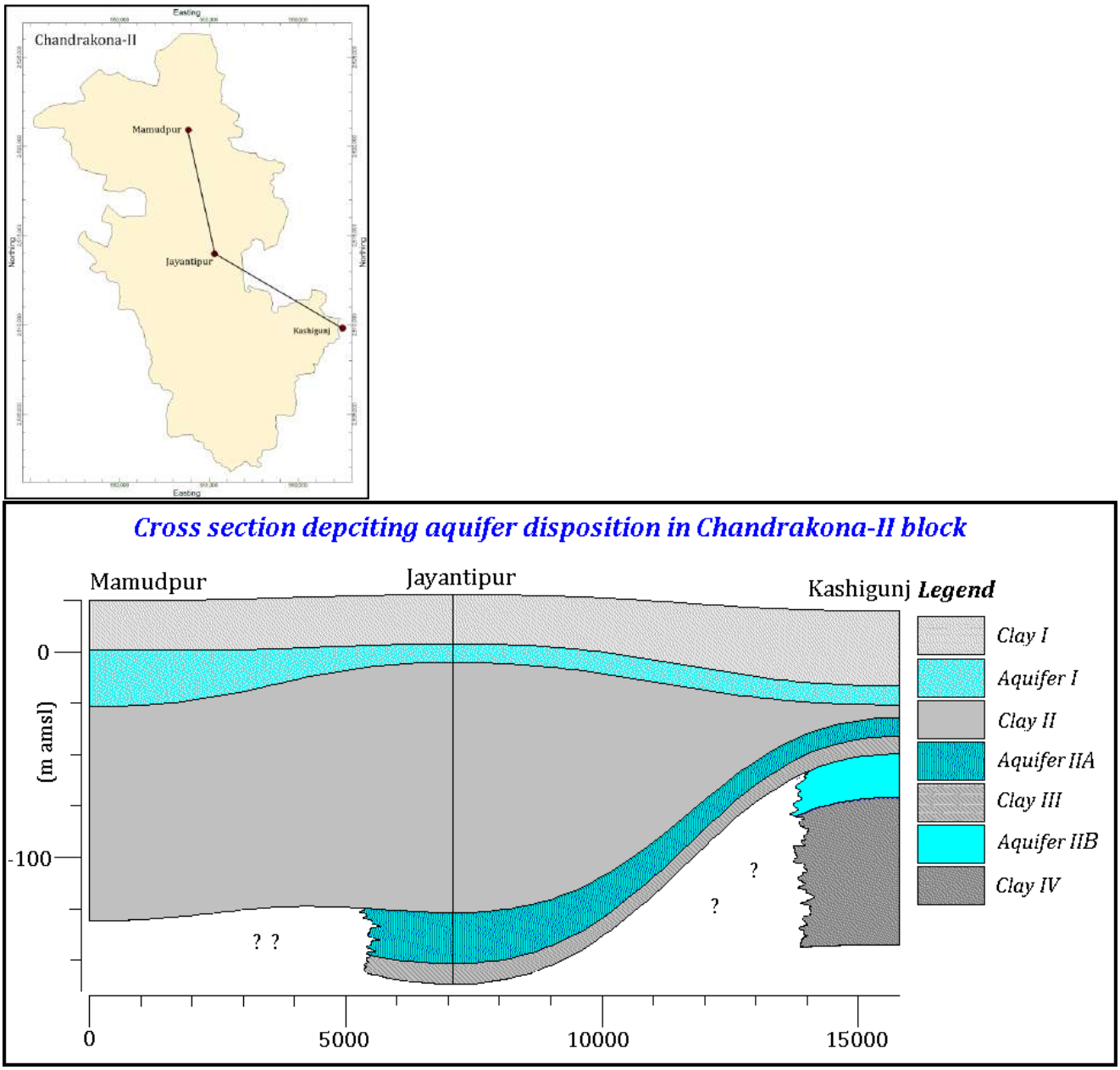


Fig. 11.2.3.2D Cross section of Aquifer Disposition

The principal aquifer systems encountered in this block is alluvium with laterite cappings in some areas.

The **shallow aquifers (Aquifer-I)**range from 24 to 51.5 m bgl. The water bearing zone varies between 24-33 m bgl and 24.2-51.5 m bgl.

The range of **deeper aquifers (Aquifer-II)** is from 125 to 145 mbgl.

Table *11.2.6*: Details of aquifer disposition in Chandrakona-II Block

Blocks (dominant in soft rock)	No. of Aquifers	Water bearing zone (mbgl)	Aquifer Thickness (m)			Discharge (lpm)	T (m^2/day)	SWL (mbgl)	Draw down (mbgl)	S
			Aquifer-I	Aquifer-II	Aquifer-III					
Chandrakona-II	2	24-33, 24.2-51.5, 155-180	24-33, 24.2-51.5	125-145		--	--	--	--	--

Table 11.2.7: Details of Aquifer Wise Water Level Ranges & seasonal long term water level trends

Block	Pre-monsoon Trend			Post-monsoon Trend		
	WL Range (mbgl)	Rise (m/year)	Fall (m/year)	WL Range (mbgl)	Rise (m/year)	Fall (m/year)
Chandrakona-II	10.85-21.30			13.92-19.90		--

Ground water quality and issues:

The range of chemical parameter for the block is given below.

Table 11.2.8: Range of chemical parameters in Chandrakona-II Block

Block		pH	EC (µS/cm)	Na (mg/l)	Cl (mg/l)	F (mg/l)	NO_3 (mg/l)	Fe (mg/l)	Measured Hardness (mg/l)
Chandrakona-II	Aquifer-I	7.27-7.75	198-816	1.1-96	21-74	0.21-0.35	1.2-25	0.11-0.18	100-160
	Aquifer-II	6.94-7.52	349-436	18.7-26.3	21-57	0.11-0.41	0.3-16.5	0.10-0.47	120-165

Ground Water Resource:

Table *11*.2.9: Details of Ground Water Resource Availability and Utilization in *Chandrakona-II*Block.

Name of the Block	CHANDRAKONA-II
Total Annual Ground Water Recharge (Ham)	6385.97

Total Natural Discharges (Ham)	638.6
Annual Extractable Ground Water Recharge (Ham)	5747.37
Total Extraction	5282.11
Annual GW Allocation for Domestic Use as on 2025	374.73
Net Ground Water Availability for future use	418.12
Stage of Ground Water Extraction (%)	92.33
Categorization (OE/CRITICAL/ SEMI-CRITICAL/ SAFE)	Critical

Aquifer Management Plan:

Ground Water Management Plan for drinking purpose:

The block has commissioned public water supply schemes by PHED in Chandrakona-II block of Srinagar Water Supply Scheme. The block falls in Critical Category with 92.33% Stage of Development. There should be a general practice of conservation through rainwater harvesting, considering an adequate normal monsoon rainfall of 1582.8 mm which the block receives. The conserved rainwater can be utilized for drinking purpose by filtering through Horizontal Roughing Filters. The water from the lands can be channeled to ponds for recharge in the water bodies and this water can be tapped through shallow tube wells and dug wells for domestic and drinking purpose. In urban areas roof top rain water harvesting structure can be constructed for proper utilization of rainfall runoff.

Ground Water Management Plan for irrigation purposes:

- The block falls in critical category with stage of ground water development at 92.33%, exploitation of groundwater should be regulated to harness the additional available resource for site specific sustainable development.
- Micro-irrigation techniques like drip and sprinkler methods need to be adopted. Owing to its distinct hydrogeology, it is evident that cultivable command area is created by both surface as well as groundwater.
- Crops with low water requirement should be preferred.
- Construction of Farm ponds.
- In view of adequate rainfall in the area, excavation of tanks with large catchment areas, construction of check dams on second and third order streams, nallah bunds, gabion

structures on first order streams, sub-surface dykes along the stream channels at suitable locations can be implemented to raise ground water level as well as to augment irrigation facilities. Irrigation by surface water may be increased. In addition to surface lift from canal & surface flows, rain water harvesting may also be considered.

Management Intervention through Harvesting of Surface Runoff and Artificial Recharge:

It has been estimated that the utilizable surface runoff produced in the block is **22.753** MCM. This surface runoff is proposed to be utilized for Artificial Recharge in the block. The number of AR structures to be constructed in the block are recommended in the table below:-

Table *11.*2.10: Details of structures recommended in feasible area of artificial recharge for Chandrakona-II Block.

		Allocation of Utilizable Recourse (MCM)							Structures Feasible							Cost of Structures (in lakhs)							
	Utilizable Surface Run Off	Percolation Tank	REET with RS	Injection Well	Check Dam	Gabion/ Contour Bund	Sub-Surface Dyke	Dug Well Recharge	Percolation Tank	REET with RS	Injection Well	Check Dam	Gabion/ Contour Bund	Sub-Surface Dyke	Dug Well Recharge	Percolation Tank	REET with RS	Injection Well	Check Dam	Gabion/ Contour Bund	Sub-Surface Dyke	Dug Well Recharge	TOTAL
Chandrakona-II	22.753	11.377	4.551	6.826	0	0	0	0	23	46	23	0	0	0	0	184.00	184.00	69.00	0.00	0.00	0.00	0.00	437.00

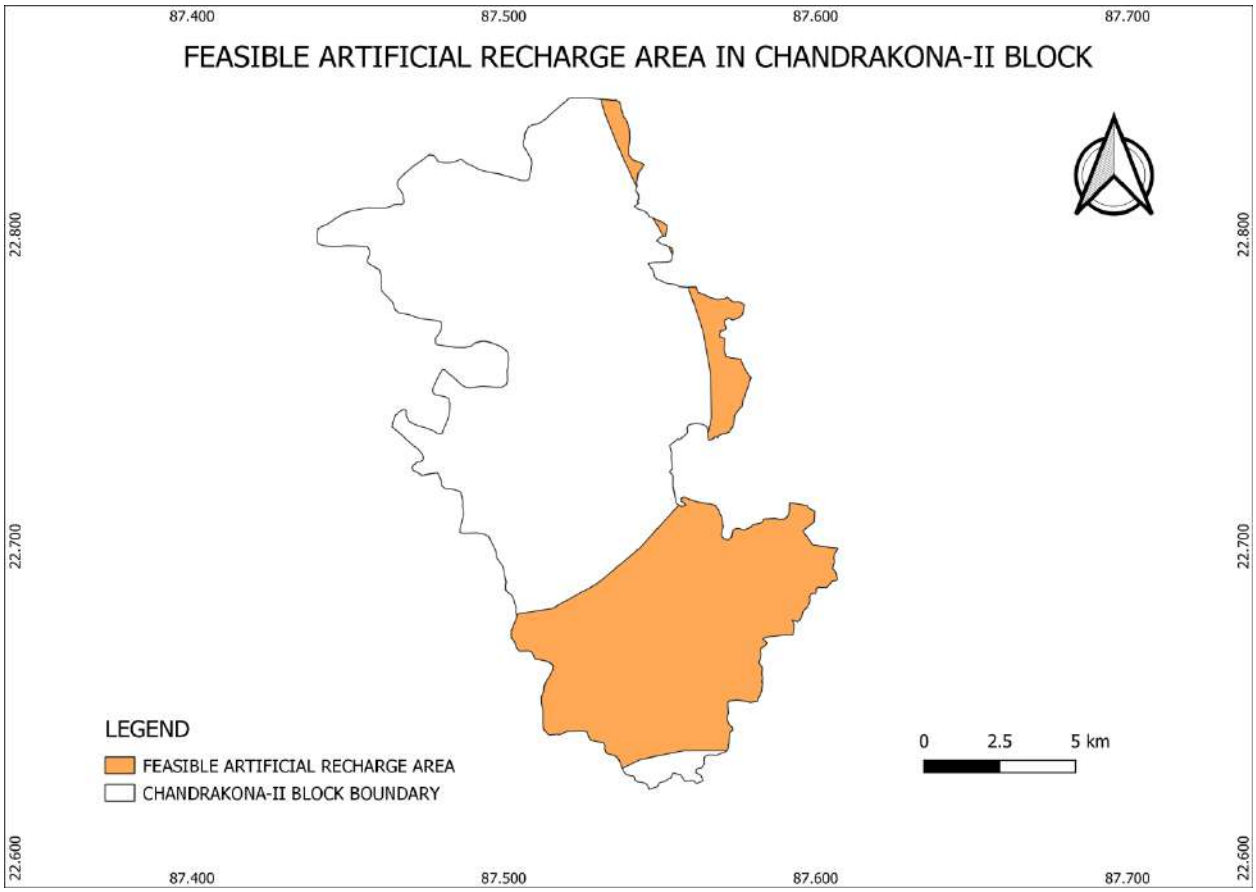


Figure11.2.4: Area Feasible for Artificial Recharge of groundwater for Chandrakona-IIBlock

11.3 SALIENT INFORMATION

Block Name: ***Medinipur***

Geographical area (sq. km): 323.64

Mappable area (sq. km): 206

District: Paschim Medinipur

State: West Bengal

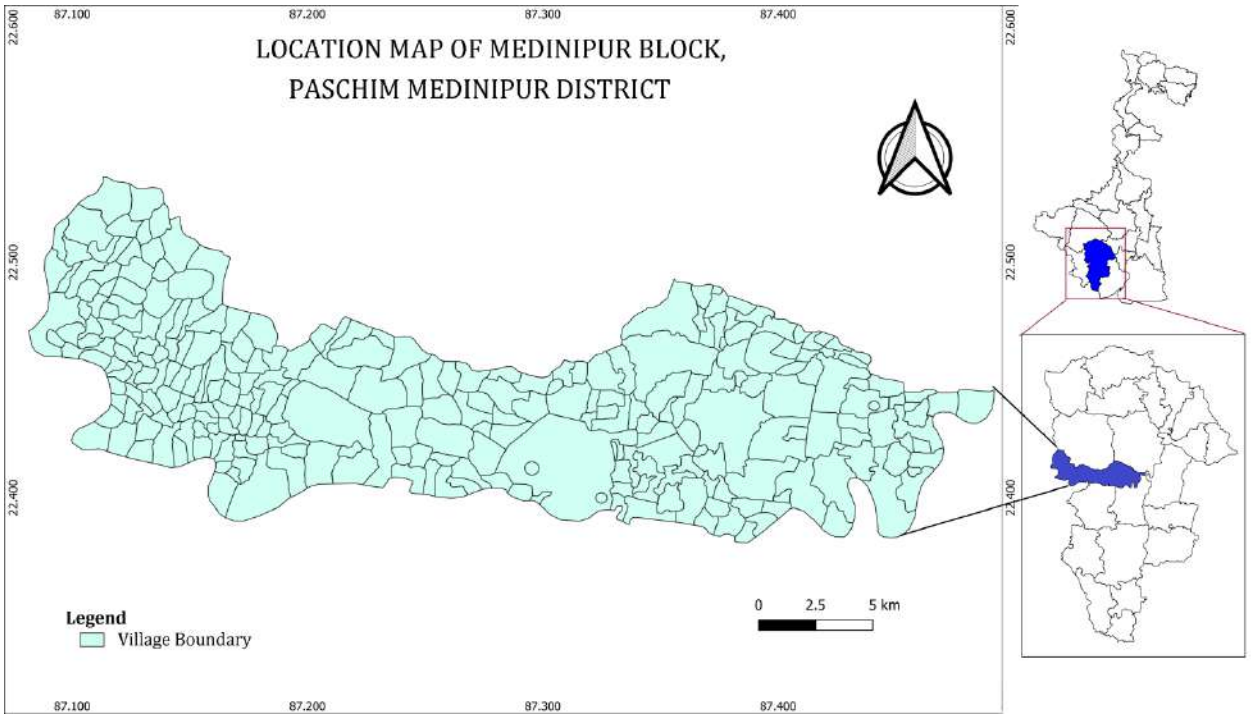


Figure11.3.1: Location Map of *Medinipur* Block

Population (as on 2011):

Table 11.3.1: *Details of population in Medinipur block.*

Rural	Urban	Total	Population Density per Sq.km
97490	94215	191705	592

Rainfall: Total annual rainfall for the block is 2411.62 mm.

Table 11.3.2: *Rainfall Details*

Block	District Normal (mm)	District Actual (Annual) in mm				
		2018	2019	2020	2021	2022
Medinipur	1626.8	2191.9	6457.6	5716.58	3519.08	5238.07

Agriculture& Irrigation (area in ha):

Table *11.*3.3: Salient Land use features of *Medinipur* block

Block	Reporting Area	Forest Area	Area Under Non-Agricultural Waste	Gross cropped area	Net Sown Area	Area sown more than once	Area under undue uses
Medinipur	32364	5823	2348	26790	19462	7328	4731

Table *11.3.*4: Crop water requirement of *Medinipur*block

Block	Crops	Areasown (ha)	Irrigated area (ha)	Crop water demand (BCM)	Area to be irrigated (ha)	Water potential required (BCM)	Existing Water potential (BCM)	Water potential to be created (BCM)
Medinipur	Cereals	21685	9196	0.14714	2000	0.17914	0.14714	0.03200
	Coarse Cereals	30	20	0.00010	500	0.00260	0.00010	0.00250
	Pulses	40	40	0.00010	2000	0.00510	0.00010	0.00500
	Oil Seeds	1480	1480	0.00370	2000	0.00870	0.00370	0.00500
	Fibre	0	0	0.00000	200	0.00080	0.00000	0.00080
	Other crops	3555	3555	0.02133	2632	0.03712	0.02133	0.01579

Table *11.3.5* Command area (ha) of *Medinipur* block

Block Name	Dug well		Shallow Tube well		Medium Tube well		Deep Tube well		Surface Flow		Surface Lift		CCA (ha.)		Total CCA (ha.)
	No.	CCA (ha.)	No.	CCA (ha.)	No.	CCA (ha.)	No.	CCA (ha.)	No.	CCA (ha.)	No.	CCA (ha.)	Ground Water	Surface Water	
Medinipur	227	417.3	616	1821.69	160	1174.68	18	399.09	2	33.87	21	479.16	3813.29	513.03	4326

Disposition of Aquifers:

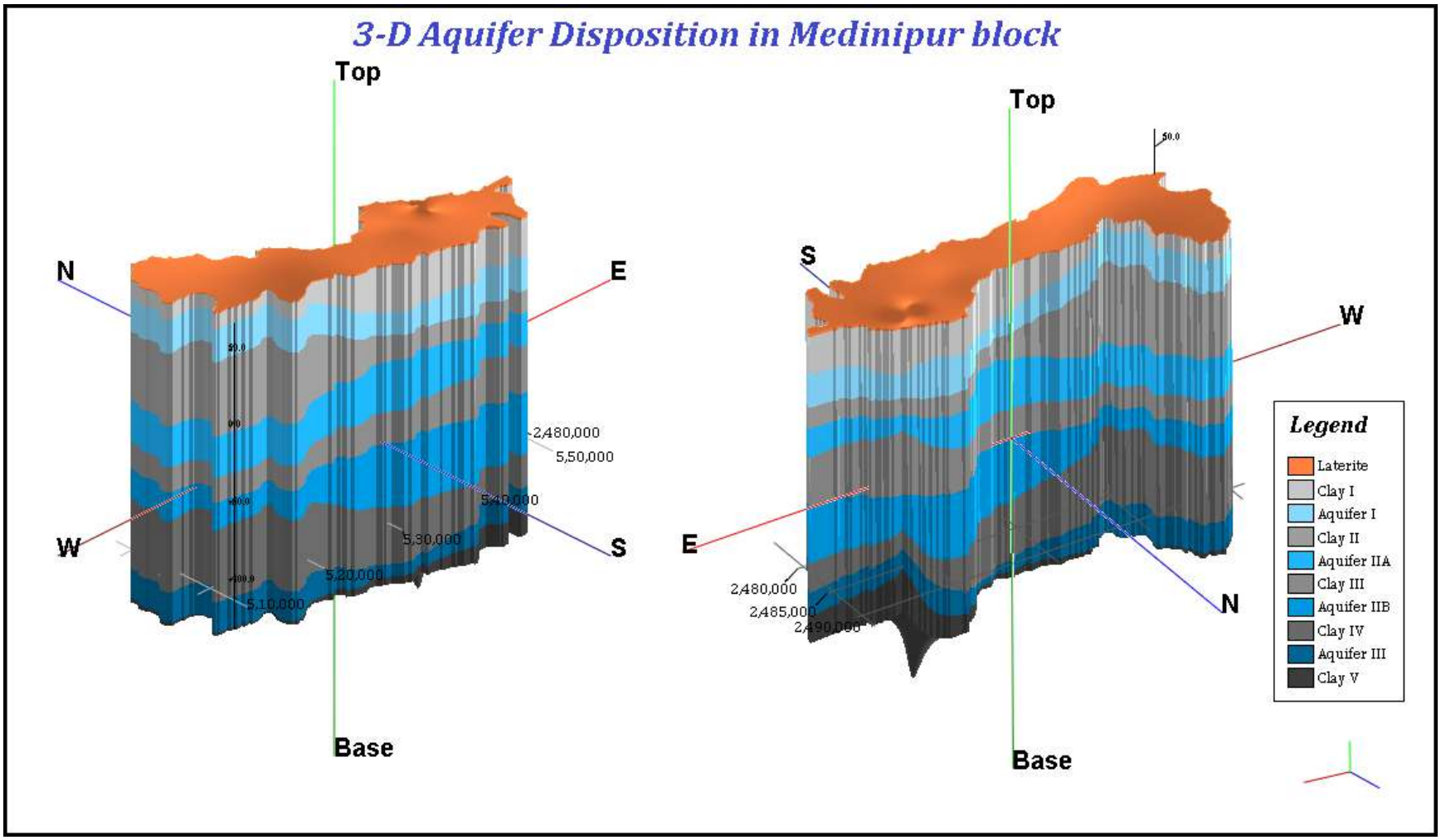
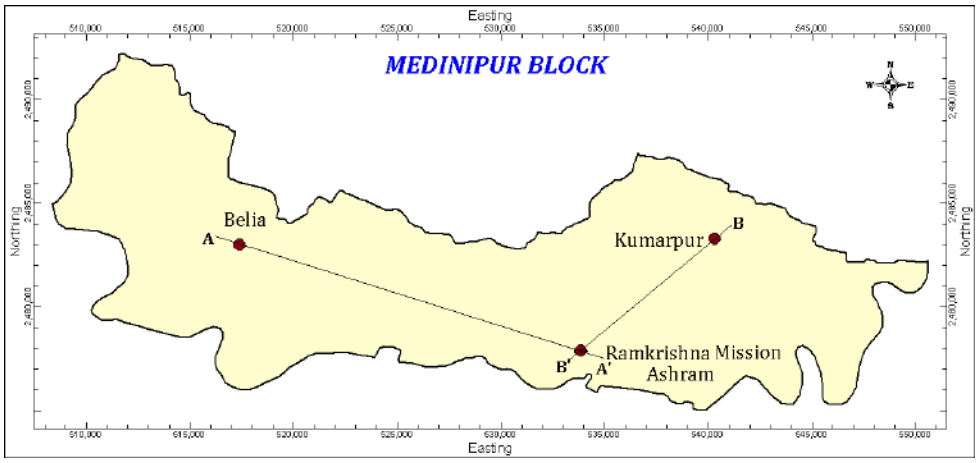


Figure. 11.3.2.3D Model of Aquifer Disposition of Medinipur Block



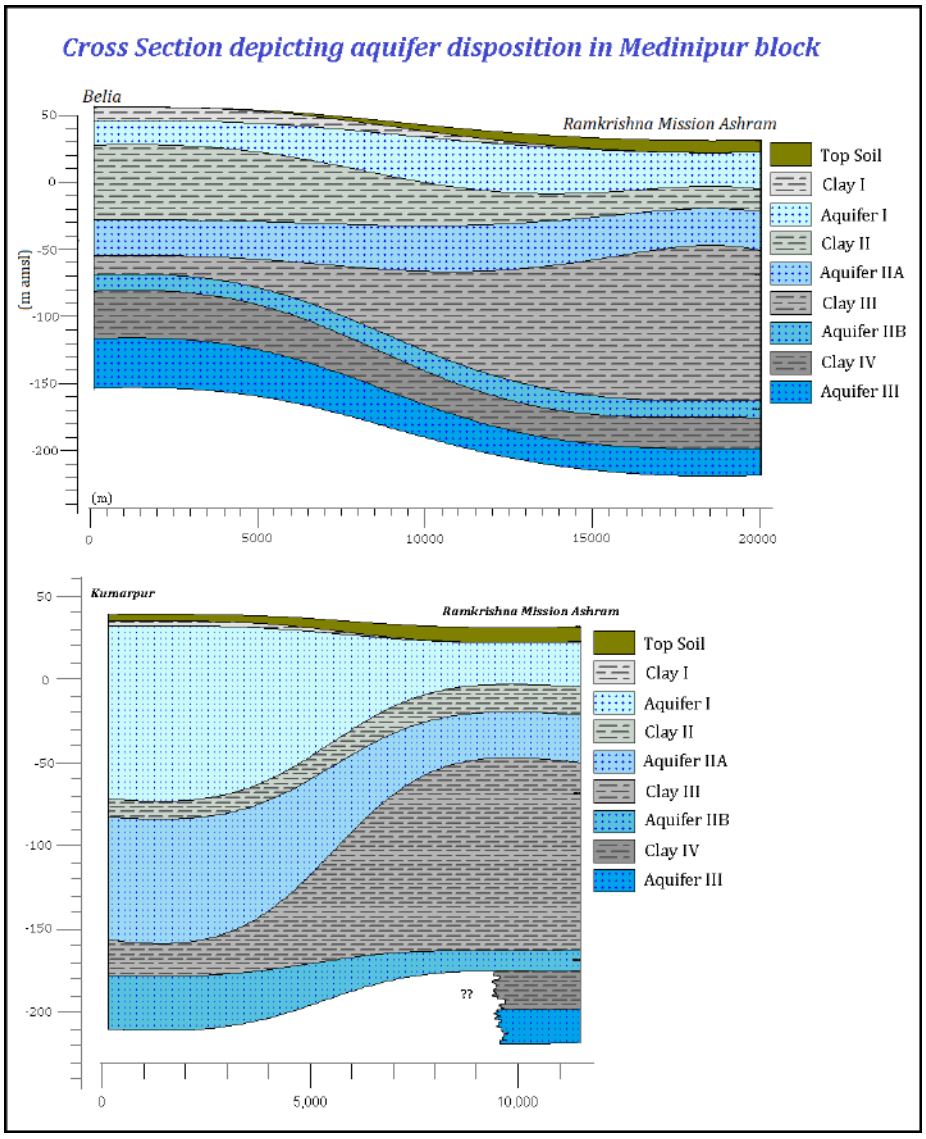


Fig. 11.3.3.2D Cross section of Aquifer Disposition along Belia-Birampur

The principal aquifer systems encountered in this block is alluvium with laterite cappings in some areas.

The **shallow aquifers (Aquifer-I)** range from 26.90 mbgl to 58 mbgl. The water bearing zone varies between 26.90-30.18 mbgl, 54.79-58.07 mbgl.

The range of **medium aquifers (Aquifer-IIA and Aquifer-IIB)** is from 69 m bgl to 110 mbgl. The water bearing zone varies between 69.22-79.72 mbgl, 86.28-96.78 mbgl, 97.00 –103.00 mbgl, 106 -110.00 mbgl.

The range of **deeper aquifers (Aquifer-III)** is from 157 m bgl to 188 mbgl. The water bearing zone varies between 157.00 –169.00 mbgl. 172.00 –175.00 mbgl, 182.00 – 188.00 mbgl.

Table *11.3.6*: Details of aquifer disposition inMedinipurBlock

Blocks (dominant in soft rock)	No. of Aquifers	Water bearing zone (mbgl)	Aquifer Thickness (m)				Discharge (lpm)	T (m^2/day)	SWL (mbgl)	Draw down (mbgl)	S
			Aquifer-I	Aquifer-II A	Aquifer-IIB	Aquifer III					
Medinipur	3	26.90-30.18,54.79-58.07,69.22-79.72, 86.28-96.78,97.00 – 103.00,106.00 110.00,157.00 – 169.00,172.00 – 175.00,182.00 – 188.00	26.90-30.18,54.79-58.07	69.22-79.72, 86.28-	96.78,97.00 – 103.00,106.00 110.00	157.00 – 169.00,172.00 – 175.00,182.00 – 188.00	--	--	--	--	--

Table 11.3.7: Details of Aquifer Wise Water Level Ranges & seasonal long term water level trends

Block	Pre-monsoon Trend			Post-monsoon Trend		
	WL Range (mbgl)	Rise (m/year)	Fall (m/year)	WL Range (mbgl)	Rise (m/year)	Fall (m/year)
Medinipur	0.3-19.18	0.202-1.208	0.099-0.233	0.5-12.86	0.019-0.029	0.018-2.0

Ground water quality and issues:

The range of chemical parameter for the block is given below.

Table 11.3.8: Range of chemical parameters in Medinipur Block

Block		pH	EC (µS/cm)	Na (mg/l)	Cl (mg/l)	F (mg/l)	NO_3 (mg/l)	Fe (mg/l)	Measured Hardness (mg/l)
Medinipur	Aquifer-I	7.53-7.93	370-554	2.6-37.9	18-99	0.02-0.23	0-15.6	0.10-4.79	115-240
	Aquifer-II	7.94-8.11	386-434	31-38	71-89	0.03-0.05	1-1	0.05-0.77	90-125

Ground Water Resource:

Table *11*.3.9: Details of Ground Water Resource Availability and Utilization in *Medinipur*Block.

Name of the Block	MEDINIPUR
Total Annual Ground Water Recharge (Ham)	8951.52
Total Natural Discharges (Ham)	895.15
Annual Extractable Ground Water Recharge (Ham)	8056.37
Total Extraction	3841.55
Annual GW Allocation for Domestic Use as on 2025	834.99
Net Ground Water Availability for future use	4152.71
Stage of Ground Water Extraction (%)	47.68
Categorization (OE/CRITICAL/ SEMI-CRITICAL/ SAFE)	Safe

Aquifer Management Plan:

Ground Water Management Plan for drinking purpose:

The block has ten commissioned public water supply schemes by PHED in Medinipur block. The block falls in Safe Category with 47.68% Stage of Development, However, there should be a general practice of conservation through rainwater harvesting, considering an adequate normal monsoon rainfall of 1751.7 mm which the block receives. The conserved rainwater can be utilized for drinking purpose by filtering through Horizontal Roughing Filters. The water from the lands can be channeled to ponds for recharge in the water bodies and this water can be tapped through

shallow tube wells and dug wells for domestic and drinking purpose. In urban areas roof top rain water harvesting structure can be constructed for proper utilization of rainfall runoff.

Ground Water Management Plan for irrigation purposes:

- The block falls in safe category with stage of ground water development at 47.68%, further development should be done in planned manner to harness the additional available resource for site specific sustainable development.
- Micro-irrigation techniques like drip and sprinkler methods need to be adopted. Owing to its distinct hydrogeology, it is evident that cultivable command area is created by both surface as well as groundwater.
- Crops with low water requirement should be preferred.
- Construction of Farm ponds.
- In view of adequate rainfall in the area, excavation of tanks with large catchment areas, construction of check dams on second and third order streams, nallah bunds, gabion structures on first order streams, sub-surface dykes along the stream channels at suitable locations can be implemented to raise ground water level as well as to augment irrigation facilities. Irrigation by surface water may be increased. In addition to surface lift from canal & surface flows, rain water harvesting may also be considered.

Management Intervention through Harvesting of Surface Runoff and Artificial Recharge:

It has been estimated that the utilizable surface runoff produced in the block is **16.192** MCM. This surface runoff is proposed to be utilized for Artificial Recharge in the block. The number of AR structures to be constructed in the block is recommended in the table below:-

Table *11*.3.10: Details of structures recommended in feasible area of artificial recharge for Medinipur Block.

		Allocation of Utilizable Recourse (MCM)							Structures Feasible							Cost of Structures (in lakhs)							
	Utilizable Surface Run Off	Percolation Tank	REET with RS	Injection Well	Check Dam	Gabion/ Contour Bund	Sub-Surface Dyke	Dug Well Recharge	Percolation Tank	REET with RS	Injection Well	Check Dam	Gabion/ Contour Bund	Sub-Surface Dyke	Dug Well Recharge	Percolation Tank	REET with RS	Injection Well	Check Dam	Gabion/ Contour Bund	Sub-Surface Dyke	Dug Well Recharge	TOTAL
Medinipur	16.192	8.096	3.238	4.858	0	0	0	0	16	32	16	0	0	0	0	128.00	128.00	48.00	0.00	0.00	0.00	0.00	304.00

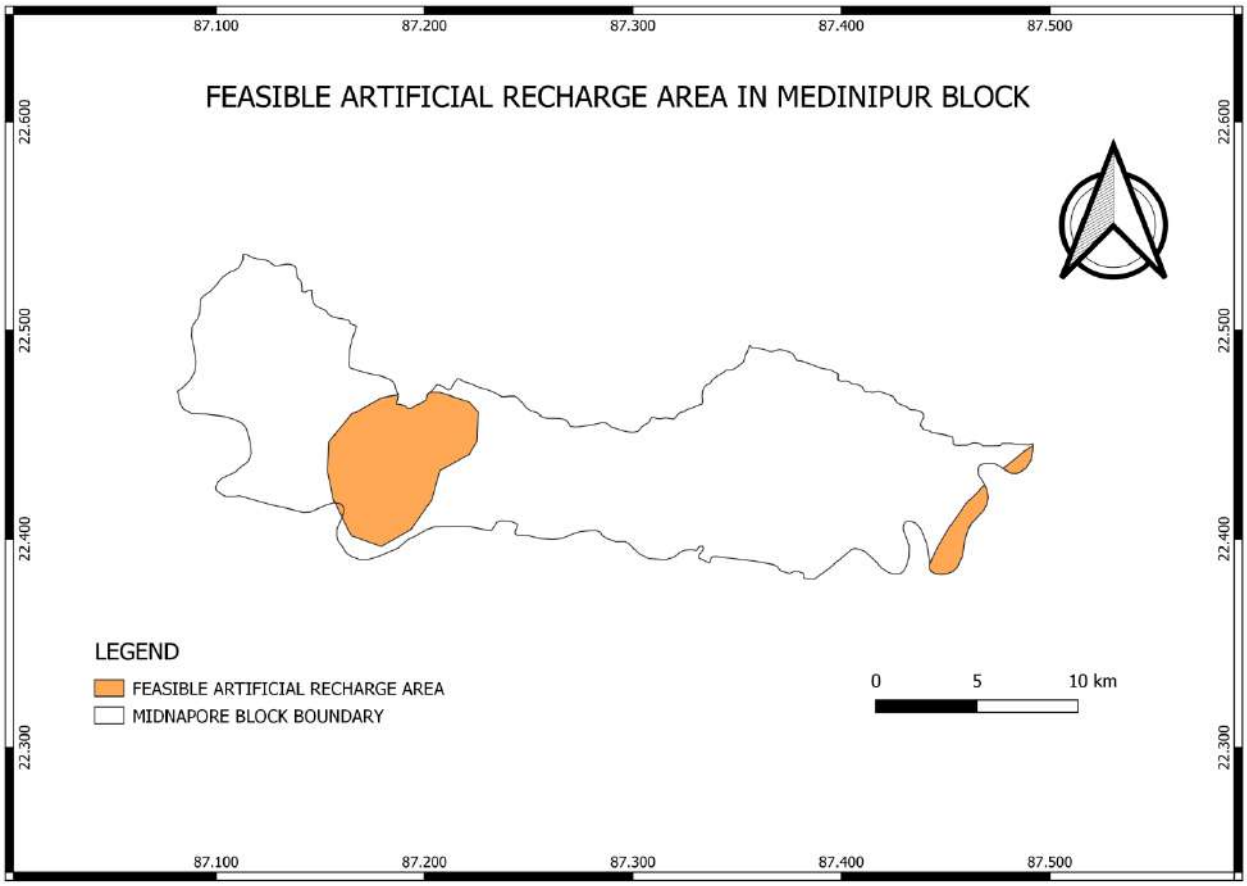


Figure11.3.4: Area Feasible for Artificial Recharge of groundwater for *Medinipur* Block

11.4 SALIENT INFORMATION

Block Name: ***Kharagpur-I***

Geographical area (sq. km): 483

Mappable area (sq. km): 161

District: Paschim Medinipur

State: West Bengal

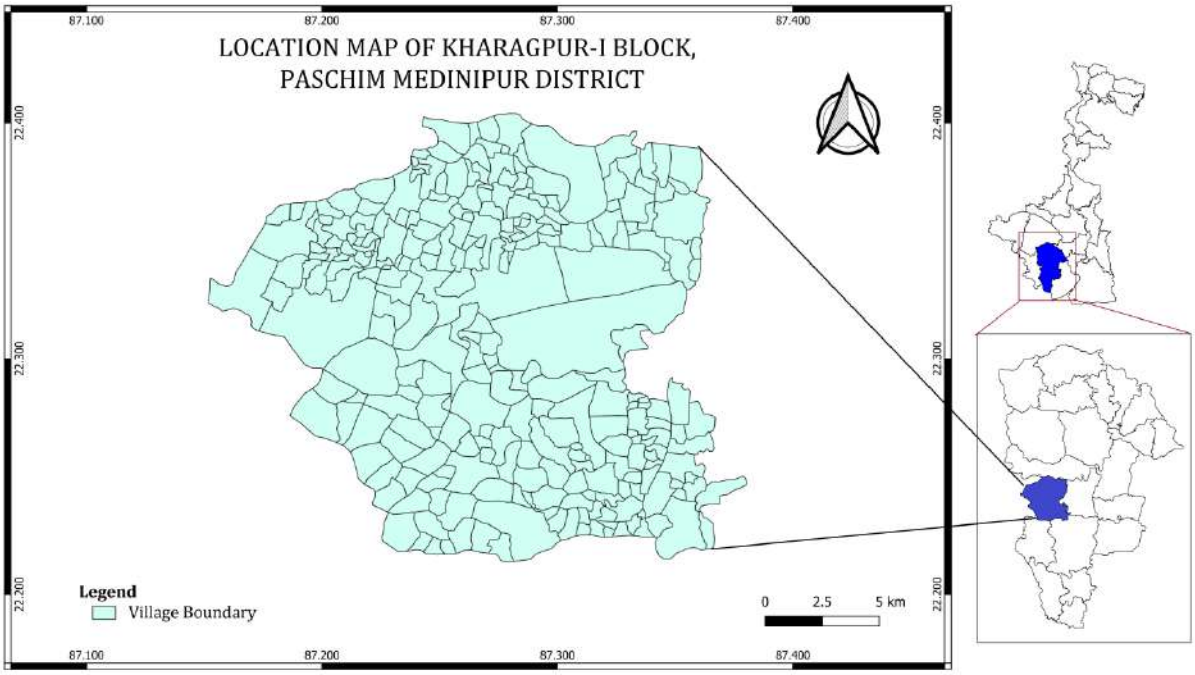


Figure11.4.1: Location Map of *Kharagpur-I* Block

Population (as on 2011):

Table 11.4.1: *Details of population in Kharagpur-I block.*

Rural	Urban	Total	Population Density per Sq.km
84889	81472	165961	344

Rainfall: Total annual rainfall for the block is 2411.62 mm.

Table *11*.4.2: Rainfall Data

Block	District Normal (mm)	District Actual (Annual) in mm				
		2018	2019	2020	2021	2022
Kharagpur-I	1626.8	2191.9	6457.6	5716.58	3519.08	5238.07

Agriculture& Irrigation (area in ha):

Table *11*.4.3: Salient Land use features of *Kharagpur-I* block

Block	Reporting Area	Forest Area	Area Under Non-Agricultural Waste	Gross cropped area	Net Sown Area	Area sown more than once	Area under undue uses
Kharagpur-I	28037	3306	1987	16492	12053	4439	5626

Table *11.4*.4: Crop water requirement of *Kharagpur-I*block

Block	Crops	Areasown (ha)	Irrigated area (ha)	Crop water demand (BCM)	Area to be irrigated (ha)	Water potential required (BCM)	Existing Water potential (BCM)	Water potential to be created (BCM)
Kharagpur-I	Cereals	13840	2080	0.03328	2000	0.06528	0.03328	0.03200
	Coarse Cereals	15	15	0.00008	1000	0.00508	0.00008	0.00500
	Pulses	65	65	0.00016	3500	0.00891	0.00016	0.00875
	Oil Seeds	635	635	0.00159	3500	0.01034	0.00159	0.00875
	Fibre	0	0	0.00000	200	0.00080	0.00000	0.00080
	Other crops	1937	1581	0.00949	3203	0.02870	0.00949	0.01922

Table *11.4.5* Command area (ha) of *Kharagpur-I* block

Block Name	Dug well		Shallow Tube well		Medium Tube well		Deep Tube well		Surface Flow		Surface Lift		CCA (ha.)		Total CCA (ha.)
	No.	CCA (ha.)	No.	CCA (ha.)	No.	CCA (ha.)	No.	CCA (ha.)	No.	CCA (ha.)	No.	CCA (ha.)	Ground Water	Surface Water	
Kharagpur-I	6	12.74	465	1633.09	192	1382.36	11	283.77	10	97.20	26	395.99	3311.96	493.19	3805

Disposition of Aquifers:

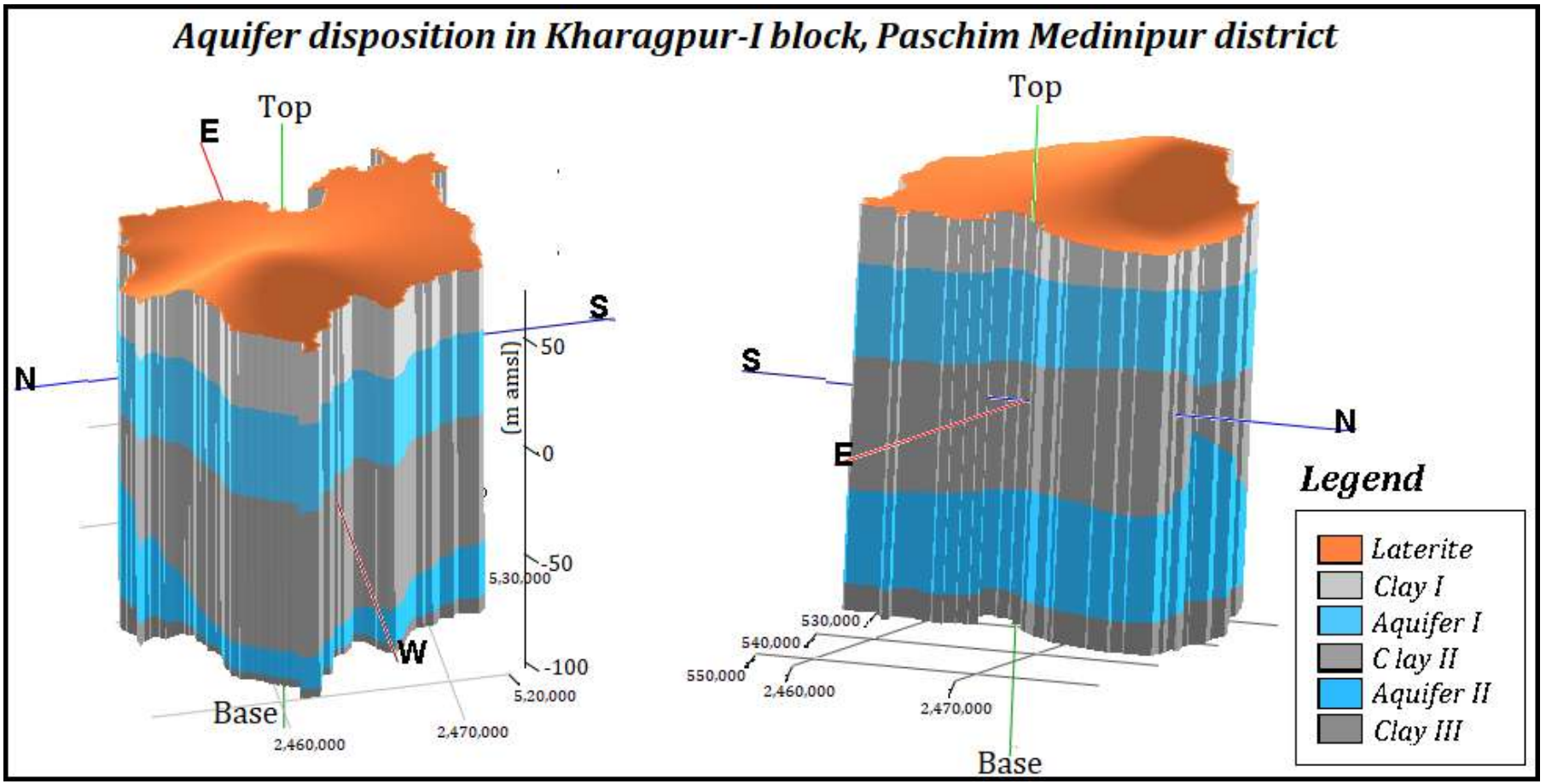
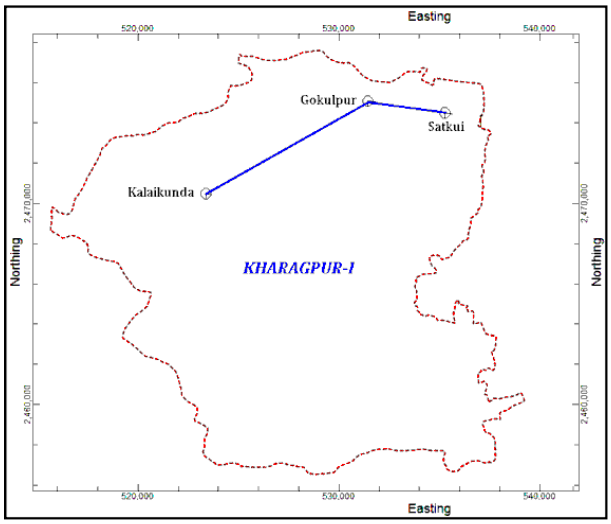


Fig. 11.4.2.3D Model of Aquifer Disposition of Kharagpur-I Block



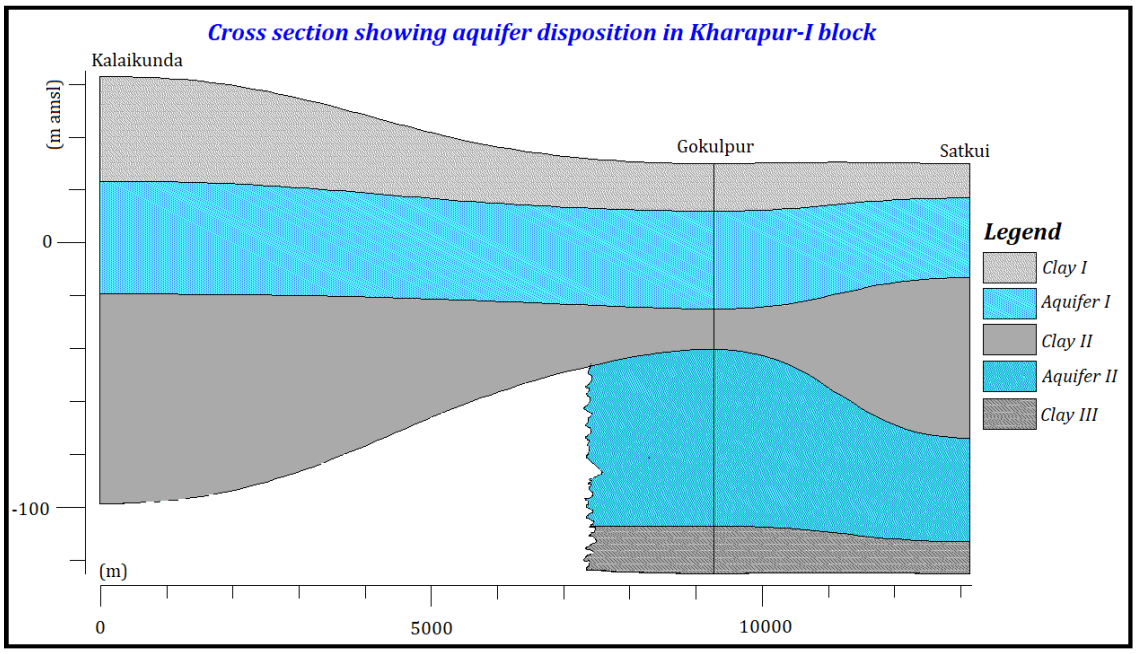


Fig. 11.4.3.2D Cross section of Aquifer Disposition along Kalikunda-Gokulpur-Satkui

The principal aquifer systems encountered in this block is alluvium with laterite cappings in some areas.

The **shallow aquifers (Aquifer-I)** range from 38 mbgl to 82.32 mbgl. The water bearing zone varies between 39.63 mbgl to 43 m bgl, 52-55 mbgl, 60-74 mbgl.

The range of **deeper aquifers (Aquifer-IIA and Aquifer-IIB)** is from 70 m bgl to 143 mbgl. The water bearing zone varies between 87-102 mbgl, 120-142 mbgl.

Table *11.4.6*: Details of aquifer disposition in*Kharagpur*-/Block

Blocks (dominant in soft rock)	No. of Aquifers	Water bearing zone (mbgl)	Aquifer Thickness (m)			Discharge (lpm)	T (m^2/day)	SWL (mbgl)	Draw down (mbgl)	S
			Aquifer-I	Aquifer-II A	Aquifer-IIB					
Kharagpur-I	2	39.63-43, 52-55, 60-74, 87-102, 120-142	39.63-43, 52-55, 60-74	87-102	120-142	--	--	--	--	--

Table 11.4.7.: Details of Aquifer Wise Water Level Ranges & seasonal long term water level trends

Block	Pre-monsoon Trend			Post-monsoon Trend		
	WL Range (mbgl)	Rise (m/year)	Fall (m/year)	WL Range (mbgl)	Rise (m/year)	Fall (m/year)
Kharagpur-I	0.25-19.06	0.172-0.672		0.25-15.34	0.043-0.181	0.027

Ground water quality and issues:

The range of chemical parameter for the block is given below.

Table 11.4.8: Range of chemical parameters in Kharagpur-I Block

Block	Aquifer Type	pH	EC (µS/cm)	Na (mg/l)	Cl (mg/l)	F (mg/l)	NO_3 (mg/l)	Fe (mg/l)	Measured Hardness (mg/l)
Kharagpur-I	Aquifer-I	7.87-7.88	127-219	1.2-27.5	11-18	0.25-0.29	0-0.7	0.11	50-90
	Aquifer-II	7.57-7.81	218-475	6.1-26.5	15-32	0.08-0.22	1.3-3.4	0.08-0.21	92-192

Ground Water Resource:

Table *11*.4.9: Details of Ground Water Resource Availability and Utilization in *Kharagpur-I* Block.

Name of the Block	KHARAGPUR-I
Total Annual Ground Water Recharge (Ham)	13660.50

Total Natural Discharges (Ham)	683.03
Annual Extractable Ground Water Recharge (Ham)	12977.47
Total Extraction	4048.93
Annual GW Allocation for Domestic Use as on 2025	863.93
Net Ground Water Availability for future use	8897.88
Stage of Ground Water Extraction (%)	31.19
Categorization (OE/CRITICAL/ SEMI-CRITICAL/ SAFE)	Safe

Aquifer Management Plan:

Ground Water Management Plan for drinking purpose:

The block has four commissioned public water supply schemes by PHED in Kharagpur-I block. Although the block falls in Safe Category with 31.19% Stage of Development, However, there should be a general practice of conservation through rainwater harvesting, considering an adequate normal monsoon rainfall of 1751.7 mm which the block receives. The conserved rainwater can be utilized for drinking purpose by filtering through Horizontal Roughing Filters. The water from the lands can be channeled to ponds for recharge in the water bodies and this water can be tapped through shallow tube wells and dug wells for domestic and drinking purpose. In urban areas roof top rain water harvesting structure can be constructed for proper utilization of rainfall runoff.

Ground Water Management Plan for irrigation purposes:

- The block falls in safe category with stage of ground water development at 31.19%,regulated groundwater extraction should be carried out to harness the additional available resource for site specific sustainable development.
- Micro-irrigation techniques like drip and sprinkler methods need to be adopted. Owing to its distinct hydrogeology, it is evident that cultivable command area is created by both surface as well as groundwater.
- Crops with low water requirement should be preferred.
- Construction of Farm ponds.
- In view of adequate rainfall in the area, excavation of tanks with large catchment areas, construction of check dams on second and third order streams, nallah bunds, gabion

structures on first order streams, sub-surface dykes along the stream channels at suitable locations can be implemented to raise ground water level as well as to augment irrigation facilities. Irrigation by surface water may be increased. In addition to surface lift from canal & surface flows, rain water harvesting may also be considered.

Management Intervention through Harvesting of Surface Runoff and Artificial Recharge:

It has been estimated that the utilizable surface runoff produced in the block is **9.175** MCM. This surface runoff is proposed to be utilized for Artificial Recharge in the block. The number of AR structures to be constructed in the block are recommended in the table below:-

Table *11*.4.10: Details of structures recommended in feasible area of artificial recharge for Kharagpur-I Block.

		Allocation of Utilizable Recourse (MCM)							Structures Feasible							Cost of Structures (in lakhs)							
	Utilizable Surface Run Off	Percolation Tank	REET with RS	Injection Well	Check Dam	Gabion/ Contour Bund	Sub-Surface Dyke	Dug Well Recharge	Percolation Tank	REET with RS	Injection Well	Check Dam	Gabion/ Contour Bund	Sub-Surface Dyke	Dug Well Recharge	Percolation Tank	REET with RS	Injection Well	Check Dam	Gabion/ Contour Bund	Sub-Surface Dyke	Dug Well Recharge	TOTAL
Kharagpur-I	9.175	4.588	1.835	2.753	0	0	0	0	6	18	9	0	0	0	0	72.00	72.00	27.00	0.00	0.00	0.00	0.00	171.00

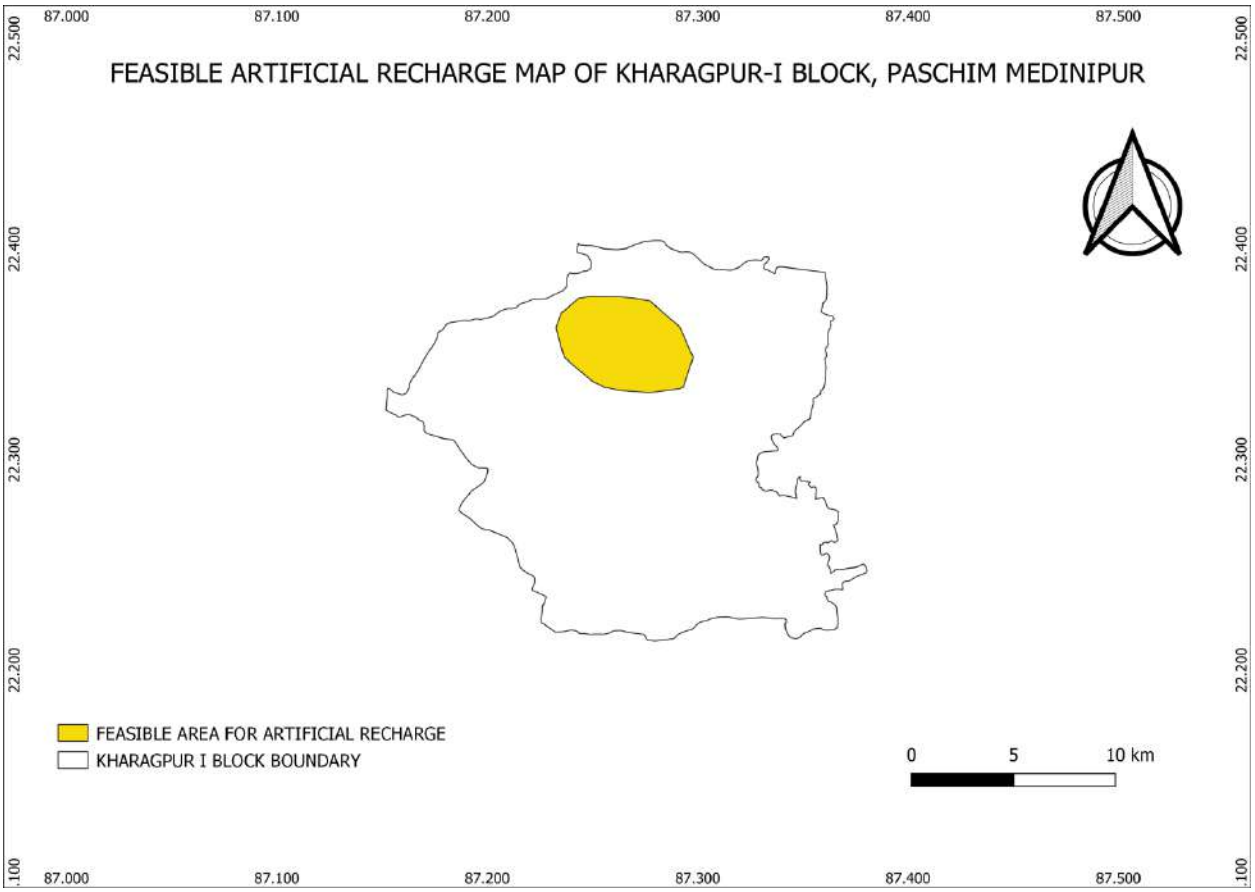


Figure11.4.4: Area Feasible for Artificial Recharge of groundwater for *Kharagpur-I* Block

11.5 SALIENT INFORMATION

Block Name: ***Kharagpur-II***

Geographical area (sq. km): 265.60

Mappable area (sq. km): 159

District: Paschim Medinipur

State: West Bengal

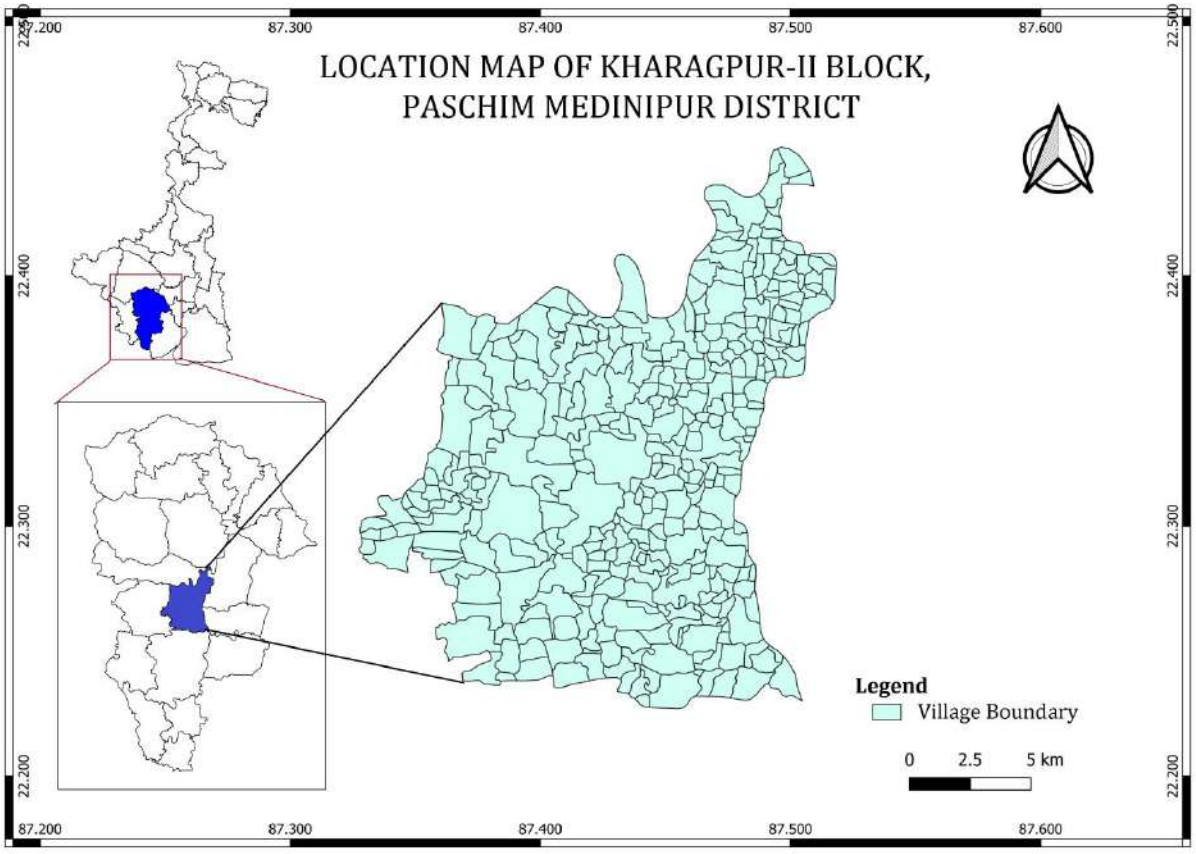


Figure11.5.1: Location Map of *Kharagpur-II* Block

Population (as on 2011):

Table 11.5.1: *Details of population in Kharagpur-II block.*

Rural	Urban	Total	Population Density per Sq.km
92456	90894	184330	691

Rainfall: Total annual rainfall for the block is 2411.62 mm.

Table *11*.5.2: Rainfall Data

Block	District Normal (mm)	District Actual (Annual) in mm				
		2018	2019	2020	2021	2022
Kharagpur-II	1626.8	2191.9	6457.6	5716.58	3519.08	5238.07

Agriculture& Irrigation (area in ha):

Table *11*.5.3: Salient Land use features of *Kharagpur-II* block

Block	Reporting Area	Forest Area	Area Under Non-Agricultural Waste	Gross cropped area	Net Sown Area	Area sown more than once	Area under undue uses
Kharagpur-II	26563	144	549	31235	22328	8907	3542

Table *11.5*.4: Crop water requirement of *Kharagpur-II*block

Block	Crops	Areasown (ha)	Irrigated area (ha)	Crop water demand (BCM)	Area to be irrigated (ha)	Water potential required (BCM)	Existing Water potential (BCM)	Water potential to be created (BCM)
Kharagpur-II	Cereals	27040	15180	0.24288		0.24288	0.24288	0.00000
	Coarse Cereals	60	60	0.00030	200	0.00130	0.00030	0.00100
	Pulses	265	265	0.00066	500	0.00191	0.00066	0.00125
	Oil Seeds	1585	1585	0.00396	500	0.00521	0.00396	0.00125
	Fibre	5	5	0.00002	100	0.00042	0.00002	0.00040
	Other crops	2280	2280	0.01368	508	0.01673	0.01368	0.00305

Table *11.5.5* Command area (ha) of *Kharagpur-II* block

Block Name	Dug well		Shallow Tube well		Medium Tube well		Deep Tube well		Surface Flow		Surface Lift		CCA (ha.)		Total CCA (ha.)
	No.	CCA (ha.)	No.	CCA (ha.)	No.	CCA (ha.)	No.	CCA (ha.)	No.	CCA (ha.)	No.	CCA (ha.)	Ground Water	Surface Water	
Kharagpur-II	3	6.15	1115	4402.92	720	4214.43	19	431.11	0	0	12	201.68	9054.61	201.68	9256

Disposition of Aquifers:

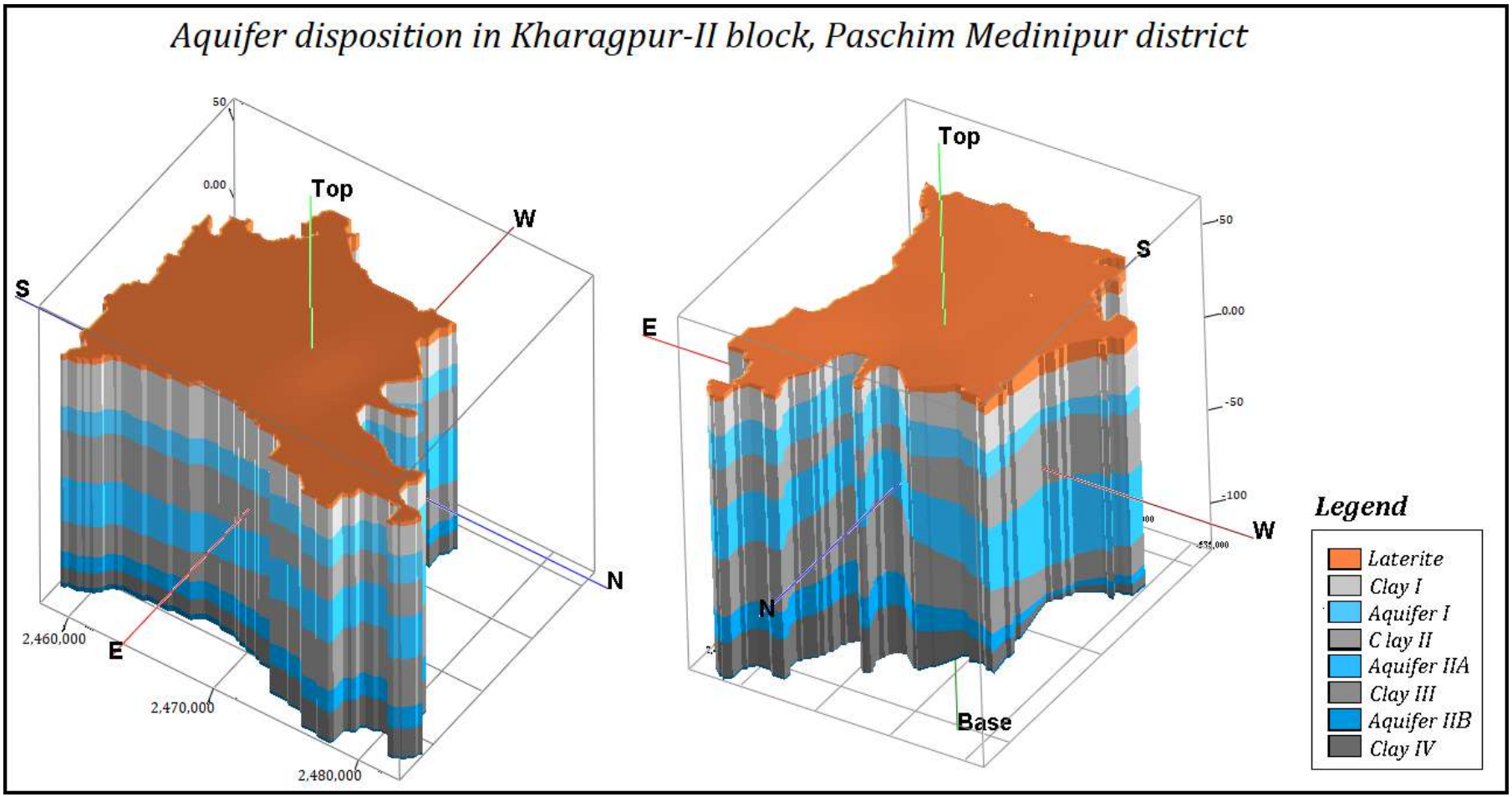
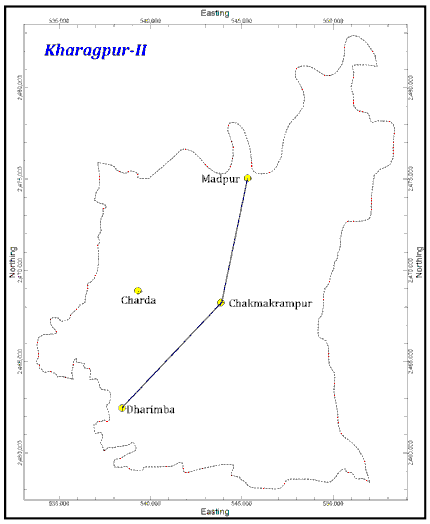


Figure. 11.5.2.3D Model of Aquifer Disposition of Kharagpur-II Block



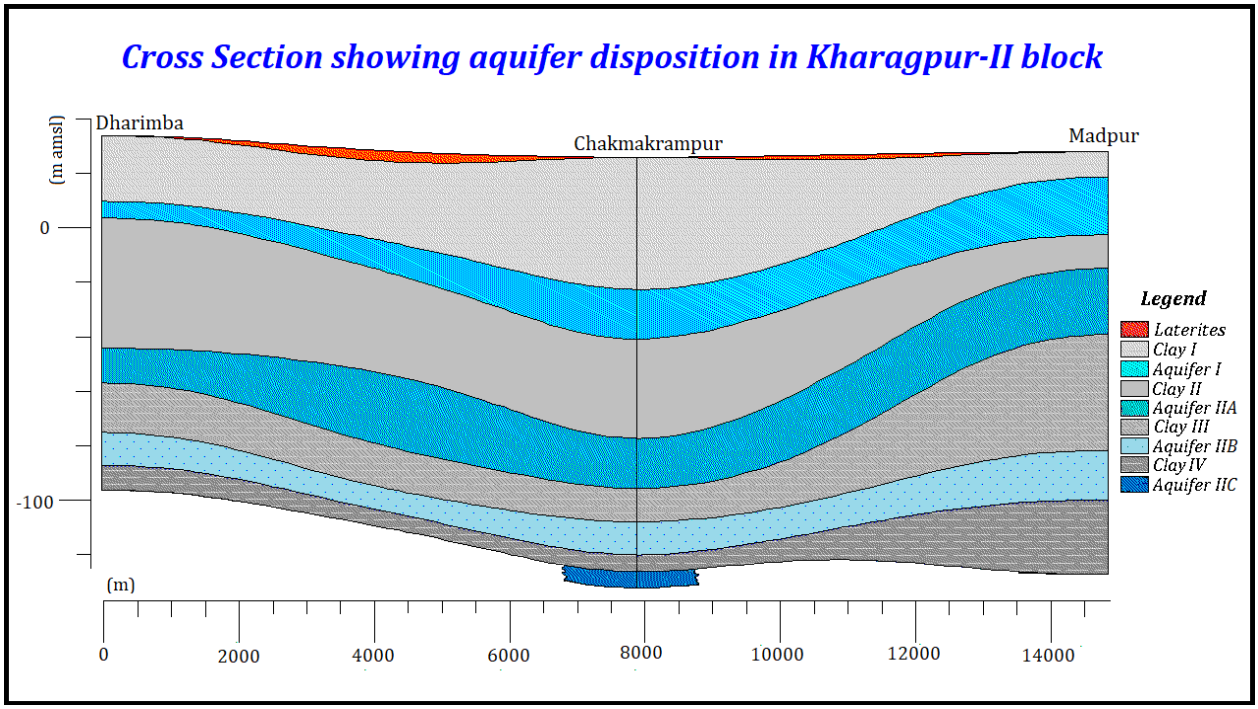


Figure. 11.5.3.2D Cross section of Aquifer Disposition along Dharimba-Chakmakrampur-Madpur

The principal aquifer systems encountered in this block is alluvium with laterite cappings in some areas.

The **shallow aquifers (Aquifer-I)** range from 32 m bgl to 58 mbgl with clay layers in between. The water bearing zone varies between 31 mbgl to 37 m bgl, and 52 mbgl to 58 mbgl.

The range of **medium aquifers (Aquifer-IIA and Aquifer-IIB)**is from 60 m bgl to 145 mbgl. The water bearing zones varies from 60-74 mbgl, 85-105 mbgl and 115-145 mbgl.

The range of **deeper aquifers (Aquifer-III)**is from 150 m bgl to 220 mbgl. The water bearing zones varies from 150-166 mbgl and 190-220 mbgl.

Table *11.5.6*: Details of aquifer disposition in*Kharagpur-II*Block

Blocks (dominant in soft rock)	No. of Aquifers	Water bearing zone (mbgl)	Aquifer Thickness (m)				Discharge (lpm)	T (m^2/day)	SWL (mbgl)	Draw down (mbgl)	S
			Aquifer-I	Aquifer-II		Aquifer-III					
				Aq IIA	AqIIB						
Kharagpur-II	3	31-37, 52-58, 60-74, 85-105, 115-145, 150-166, 190-220	31-37,52-58	60-74,	85-105,115-145,	150-166,190-220	--	--	--	--	--

Table 11.5.7: Details of Aquifer Wise Water Level Ranges & seasonal long term water level trends

Block	Pre-monsoon Trend			Post-monsoon Trend		
	WL Range (mbgl)	Rise (m/year)	Fall (m/year)	WL Range (mbgl)	Rise (m/year)	Fall (m/year)
Kharagpur-II	0.27-19.08	0.17-0.67		0.26-15.38	0.04-0.18	0.027

Ground water quality and issues:

The range of chemical parameter for the block is given below.

Table 11.5.8: Range of chemical parameters in Kharagpur-II Block

Block	Aquifer Type	pH	EC (µS/cm)	Na (mg/l)	Cl (mg/l)	F (mg/l)	NO_3 (mg/l)	Fe (mg/l)	Measured Hardness (mg/l)
Kharagpur-II	Aquifer-I	8.06-8.10	362-417	25-31	53	0.06-0.14	BDL	0.10-1.44	115-150
	Aquifer-II	7.55-7.82	217-477	6.1-26.5	14-35	0.07-0.24	1.2-3.5	0.07-0.24	90-195

Ground Water Resource:

Table *11*.5.9: Details of Ground Water Resource Availability and Utilization in *Kharagpur-II*Block.

Name of the Block	**KHARAGPUR-II**
Total Annual Ground Water Recharge (Ham)	10304.12
Total Natural Discharges (Ham)	1030.42
Annual Extractable Ground Water Recharge (Ham)	9273.70
Total Extraction	7797.36
Annual GW Allocation for Domestic Use as on 2025	540.30
Net Ground Water Availability for future use	3266.87
Stage of Ground Water Extraction (%)	84.08
Categorization (OE/CRITICAL/ SEMI-CRITICAL/ SAFE)	Semi-Critical

Aquifer Management Plan:

Ground Water Management Plan for drinking purpose:

The block has six commissioned public water supply schemes by PHED in Kharagpur-II block. The block falls in Semi-Critical Category with 84.09% Stage of Development, However, there should be a general practice of conservation through rainwater harvesting, considering an adequate normal monsoon rainfall of 1751.7 mm which the block receives. The conserved rainwater can be utilized for drinking purpose by filtering through Horizontal Roughing Filters. The water from the lands can be channeled to ponds for recharge in the water bodies and this water can be tapped through shallow tube wells and dug wells for domestic and drinking purpose. In urban areas roof top rain water harvesting structure can be constructed for proper utilization of rainfall runoff.

Ground Water Management Plan for irrigation purposes:

- The block falls in semi-critical category with stage of ground water development at 84.09%,regulated groundwater extraction should be carried out to harness the additional available resource for site specific sustainable development.
- Micro-irrigation techniques like drip and sprinkler methods need to be adopted. Owing to its distinct hydrogeology, it is evident that cultivable command area is created by both surface as well as groundwater.

- Crops with low water requirement should be preferred.
- Construction of Farm ponds.
- In view of adequate rainfall in the area, excavation of tanks with large catchment areas, construction of check dams on second and third order streams, nallah bunds, gabion structures on first order streams, sub-surface dykes along the stream channels at suitable locations can be implemented to raise ground water level as well as to augment irrigation facilities. Irrigation by surface water may be increased. In addition to surface lift from canal & surface flows, rain water harvesting may also be considered.

Management Intervention through Harvesting of Surface Runoff and Artificial Recharge:

It has been estimated that the utilizable surface runoff produced in the block is **28.439** MCM. This surface runoff is proposed to be utilized for Artificial Recharge in the block. The number of AR structures to be constructed in the block are recommended in the table below:-

Table *11*.5.10: Details of structures recommended in feasible area of artificial recharge for Kharagpur-II Block.

		Allocation of Utilizable Recourse (MCM)							Structures Feasible							Cost of Structures (in lakhs)							
	Utilizable Surface Run Off	Percolation Tank	REET with RS	Injection Well	Check Dam	Gabion/ Contour Bund	Sub-Surface Dyke	Dug Well Recharge	Percolation Tank	REET with RS	Injection Well	Check Dam	Gabion/ Contour Bund	Sub-Surface Dyke	Dug Well Recharge	Percolation Tank	REET with RS	Injection Well	Check Dam	Gabion/ Contour Bund	Sub-Surface Dyke	Dug Well Recharge	TOTAL
Kharagpur-II	28.439	14.22	5.688	8.532	0	0	0	0	28	57	28	0	0	0	0	224.00	228.00	84.00	0.00	0.00	0.00	0.00	536.00

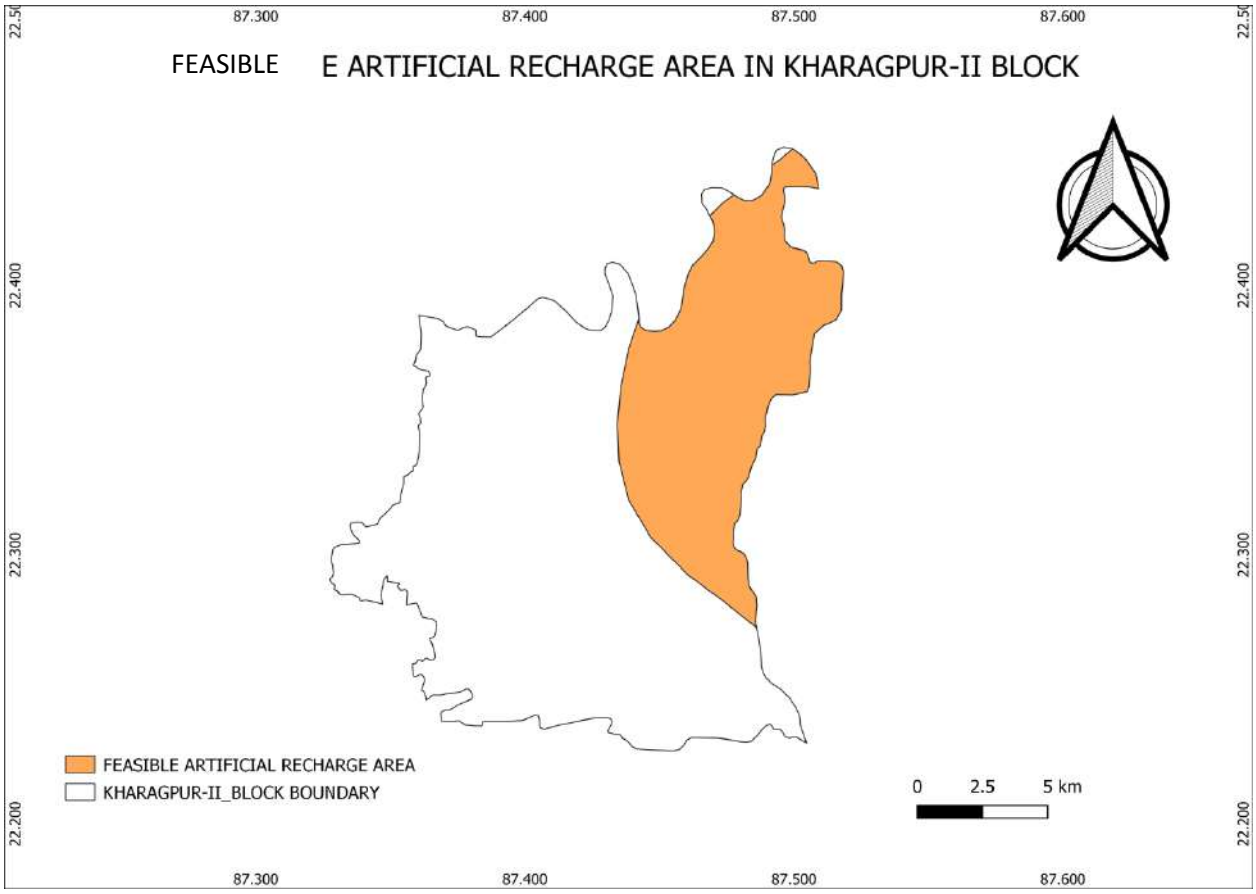


Figure11.5.4: Area Feasible for Artificial Recharge of groundwater for *Kharagpur-II* Block

11.6 SALIENT INFORMATION

Block Name: ***Garhbeta-I***

Geographical area (sq. km): 361.9

Mappable area (sq. km): 191

District: Paschim Medinipur

State: West Bengal

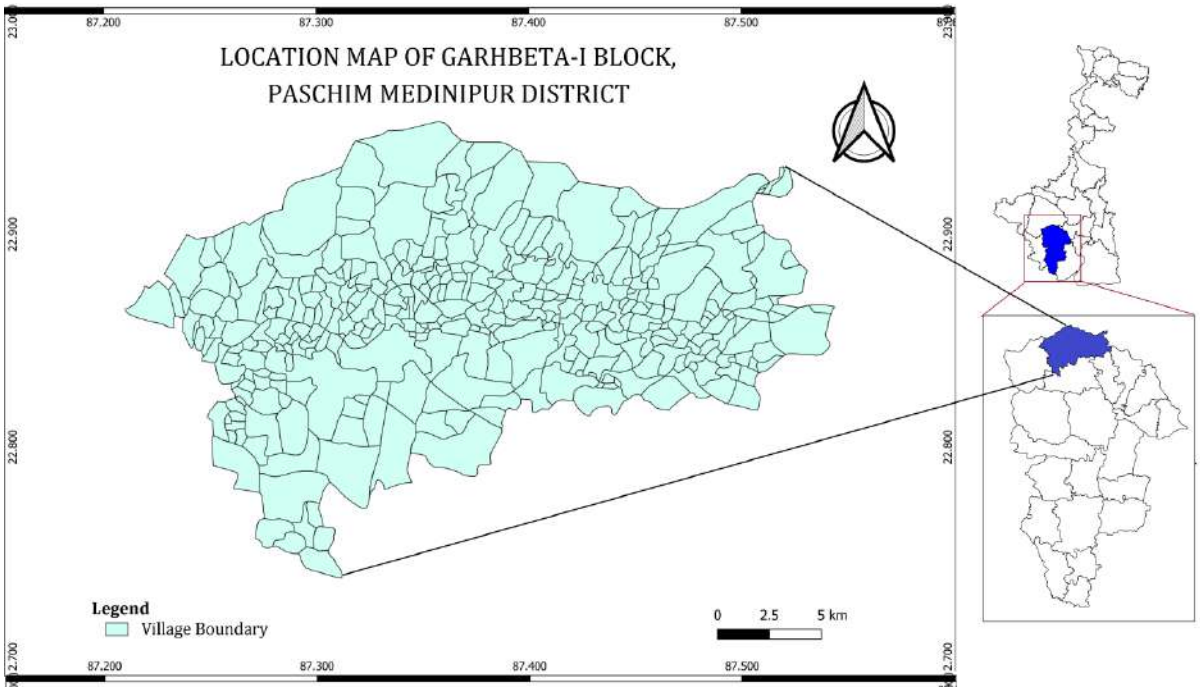


Figure11.6.1: Location Map of *Garhbeta-I* Block

Population (as on 2011):

Table 11.6.1: ***Details of population in Garhbeta-I block.***

Rural	Urban	Total	Population Density per Sq.km
218239	**10274**	228513	631

Rainfall: Total annual rainfall for the block is 1775 mm.

Table 11.6.2: *Rainfall Details*

Block	District Normal (mm)	District Actual (Annual) in mm				
		2018	2019	2020	2021	2022
Garhbeta-I	1626.8	2191.9	6457.6	5716.58	3519.08	5238.07

Agriculture& Irrigation (area in ha):

Table *11*.6.3: Salient Land use features of *Garhbeta-I* block

Block	Reporting Area	Forest Area	Area Under Non-Agricultural Waste	Gross cropped area	Net Sown Area	Area sown more than once	Area under undue uses
Garhbeta-I	36141	6707	1925	49700	23593	26107	3916

Table *11.6*.4: Crop water requirement of *Garhbeta-I* block

Block	Crops	Areasown (ha)	Irrigated area (ha)	Crop water demand (BCM)	Area to be irrigated (ha)	Water potential required (BCM)	Existing Water potential (BCM)	Water potential to be created (BCM)
Garhbeta-I	Cereals	20150	6250	0.10000	500	0.10800	0.10000	0.00800
	Coarse Cereals	130	100	0.00050	500	0.00300	0.00050	0.00250
	Pulses	170	160	0.00040	1000	0.00290	0.00040	0.00250
	Oil Seeds	7485	7485	0.01871	1000	0.02121	0.01871	0.00250
	Fibre	20	0	0.00000	200	0.00080	0.00000	0.00080
	Other crops	21745	20345	0.12207	1353	0.13019	0.12207	0.00812

Table *11.6.5* Command area (ha) of *Garhbeta-I* block

Block Name	Dug well		Shallow Tube well		Medium Tube well		Deep Tube well		Surface Flow		Surface Lift		CCA (ha.)		Total CCA (ha.)
	No.	CCA (ha.)	No.	CCA (ha.)	No.	CCA (ha.)	No.	CCA (ha.)	No.	CCA (ha.)	No.	CCA (ha.)	Ground Water	Surface Water	
Garhbeta-I	4	17.34	301	1402.26	1201	9394.83	140	1806.38	2	3.04	14	283.74	12620.81	286.78	12907.59

Disposition of Aquifers:

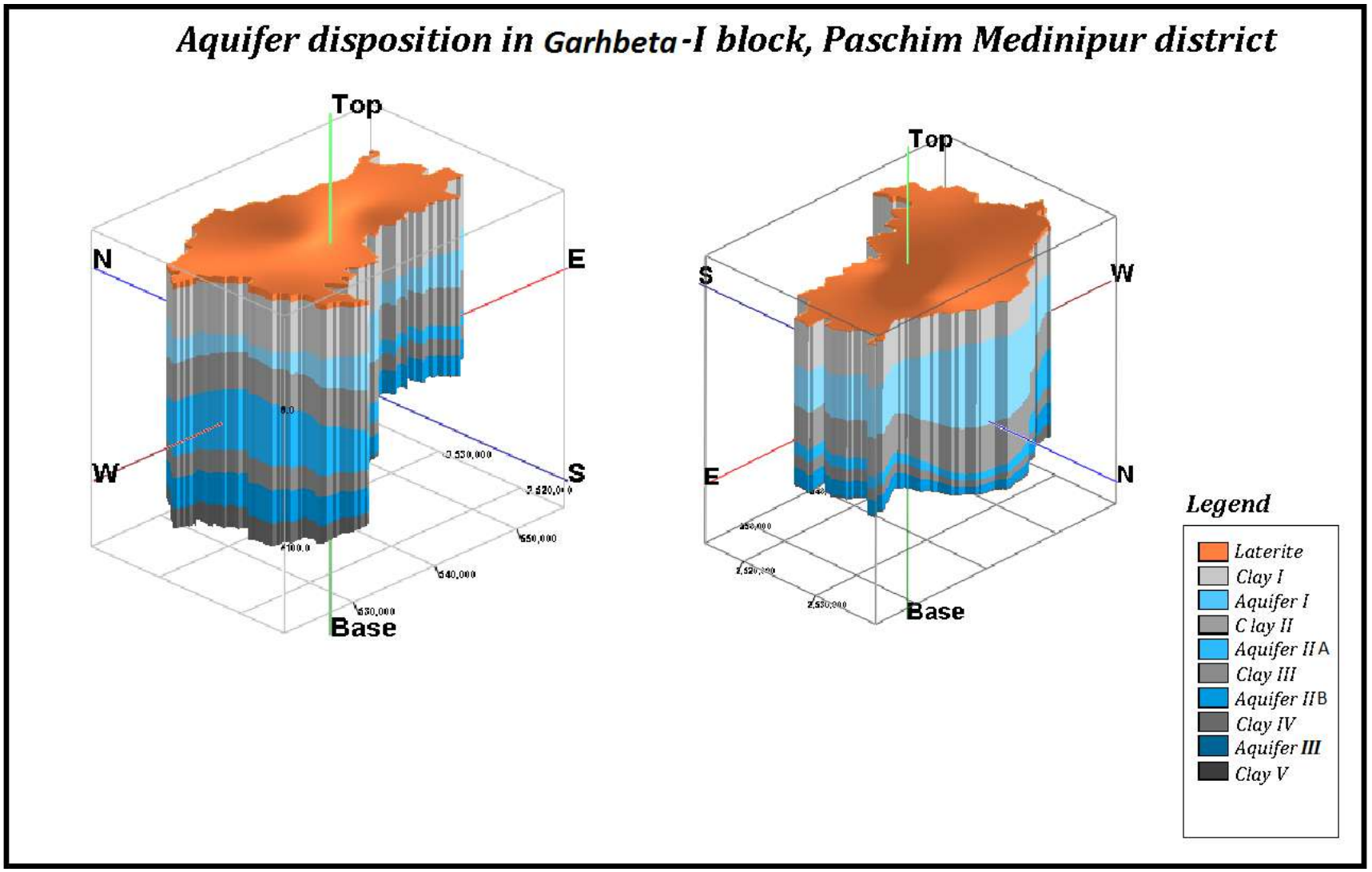
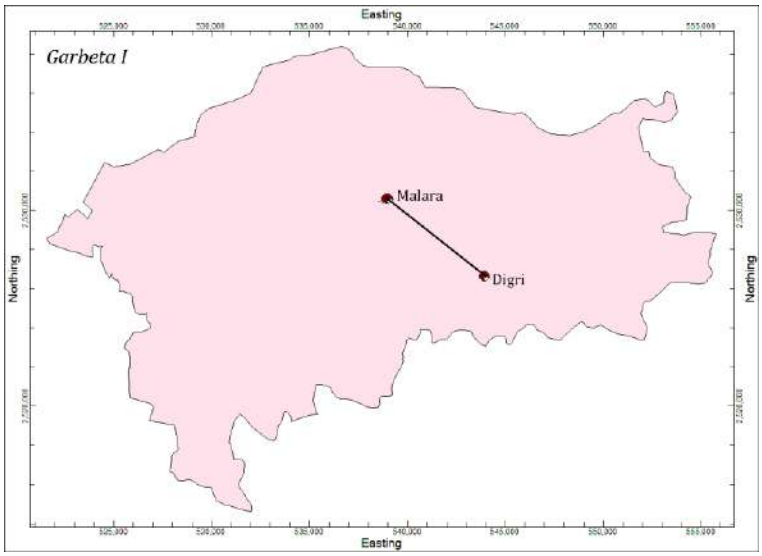


Figure. 11.6.2.3D Model of Aquifer Disposition of Garhbeta-I Block



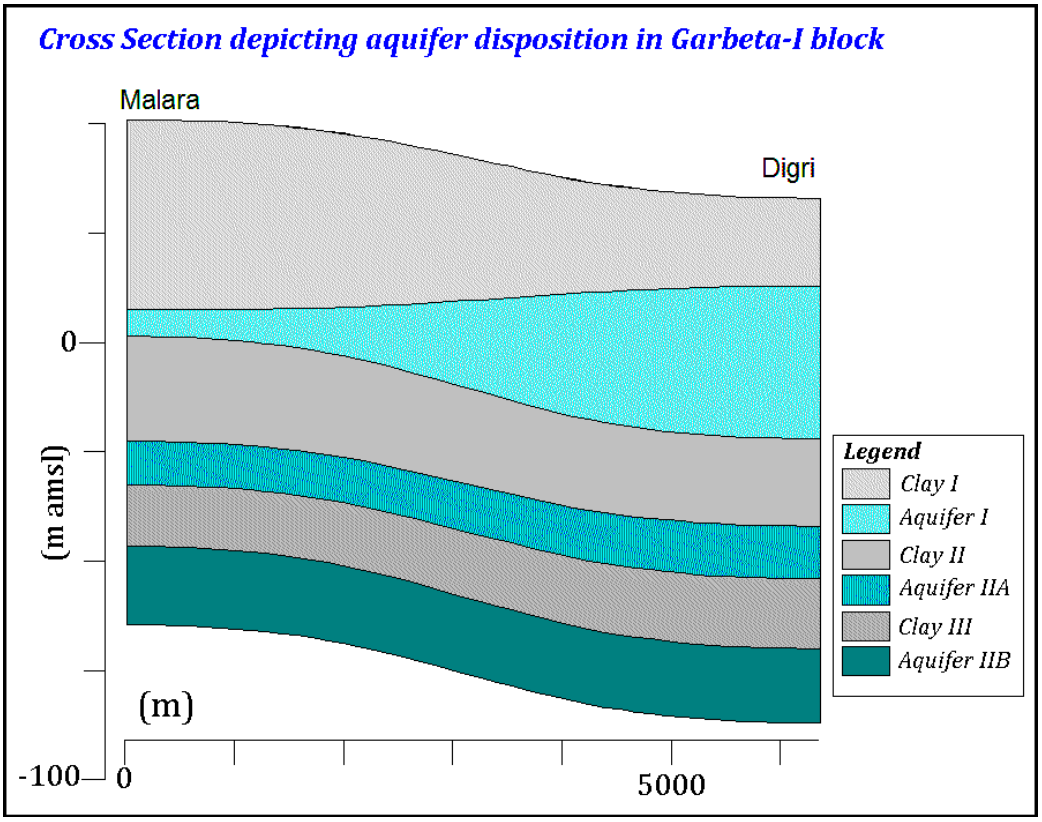


Figure. 11.6.3.2D Cross section of Aquifer Disposition

The principal aquifer systems encountered in this block is alluvium with laterite cappings in some areas.

The **shallow aquifers (Aquifer-I)** range from 43 mbgl to 49.5 m bgl. The water bearing zone varies between 43.5-49.5 m bgl.

The range of **medium aquifers (Aquifer-IIA and Aquifer-IIB)**is from 73.5 to 115.5 mbgl. The water bearing zone varies between 73.5-83.5 mbgl, 97.5-103.5 mbgl and 106.5-115.5 mbgl.

Table *11.6.6*: Details of aquifer disposition inGarhbeta-IBlock

Blocks (dominant in soft rock)	No. of Aquifers	Water bearing zone	Aquifer Thickness (m)			Discharge (lpm)	T (m^2/day)	SWL (mbgl)	Draw down (mbgl)	S
			Aquifer-I	Aquifer-II A	Aquifer-II B					
Garhbeta-I	2	43.5-49.5, 73.5-83.5, 97.5-103.5, 106.5-115.5	43.5-49.5	73.5-83.5	97.5-103.5, 106.5-115.5	647.40	--	14.79	--	--

Table 11.6.7: Details of Aquifer Wise Water Level Ranges & seasonal long term water level trends

Block	Pre-monsoon Trend			Post-monsoon Trend		
	WL Range (mbgl)	Rise (m/year)	Fall (m/year)	WL Range (mbgl)	Rise (m/year)	Fall (m/year)
Garhbeta-I	4.81-18.94	0.232	0.571	2.7-13.24	0.051	0.195

Ground water quality and issues:

The range of chemical parameter for the block is given below.

Table 11.6.8: Range of chemical parameters in Garhbeta-I Block

Block		pH	EC (µS/cm)	Na (mg/l)	Cl (mg/l)	F (mg/l)	NO_3 (mg/l)	Fe (mg/l)	Measured Hardness (mg/l)
Garhbeta-I	Aquifer-I	6.95-7.64	84-1168	0.7-159.9	4-262	0.04-0.43	0-58.9	0.04-0.22	40-210
	Aquifer-II	7.35-8	52-264	0.9-2	4-25	0.16-0.42	0-6	0.01-0.51	20-120

Ground Water Resource:

Table *11*.6.9: Details of Ground Water Resource Availability and Utilization in *Garhbeta-I* Block.

Name of the Block	**GARHBETA-I**
Total Annual Ground Water Recharge (Ham)	8152.16
Total Natural Discharges (Ham)	815.22
Annual Extractable Ground Water Recharge (Ham)	7336.94
Total Extraction	7016.02
Annual GW Allocation for Domestic Use as on 2025	595.04
Net Ground Water Availability for future use	278.96
Stage of Ground Water Extraction (%)	95.62
Categorization (OE/CRITICAL/ SEMI-CRITICAL/ SAFE)	Critical

Aquifer Management Plan:

Ground Water Management Plan for drinking purpose:

The block has sevencommissioned public water supply schemes by PHED in Garhbeta-I block. The block falls in Critical Category with 95.62% Stage of Development. There should be a general practice of conservation through rainwater harvesting, considering an adequate normal monsoon rainfall of 1160 mm which the block receives. The conserved rainwater can be utilized for drinking purpose by filtering through Horizontal Roughing Filters. The water from the lands can be channeled to ponds for recharge in the water bodies and this water can be tapped through shallow tube wells and dug wells for domestic and drinking purpose. In urban areas roof top rain water harvesting structure can be constructed for proper utilization of rainfall runoff.

Ground Water Management Plan for irrigation purposes:

- The block falls in critical category with stage of ground water development at 95.62%, exploitation of groundwater should be regulated to harness the additional available resource for site specific sustainable development.
- Micro-irrigation techniques like drip and sprinkler methods need to be adopted. Owing to its distinct hydrogeology, it is evident that cultivable command area is created by both surface as well as groundwater.
- Crops with low water requirement should be preferred.

- Construction of Farm ponds.
- In view of adequate rainfall in the area, excavation of tanks with large catchment areas, construction of check dams on second and third order streams, nallah bunds, gabion structures on first order streams, sub-surface dykes along the stream channels at suitable locations can be implemented to raise ground water level as well as to augment irrigation facilities. Irrigation by surface water may be increased. In addition to surface lift from canal & surface flows, rain water harvesting may also be considered.

Management Intervention through Harvesting of Surface Runoff and Artificial Recharge:

It has been estimated that the utilizable surface runoff produced in the block is **3.538**MCM. This surface runoff is proposed to be utilized for Artificial Recharge in the block. The number of AR structures to be constructed in the block are recommended in the table below:-

Table *11*.6.10: Details of structures recommended in feasible area of artificial recharge for Garhbeta-IBlock.

		Allocation of Utilizable Recourse (MCM)							Structures Feasible							Cost of Structures (in lakhs)							
	Utilizable Surface Run Off	Percolation Tank	REET with RS	Injection Well	Check Dam	Gabion/ Contour Bund	Sub-Surface Dyke	Dug Well Recharge	Percolation Tank	REET with RS	Injection Well	Check Dam	Gabion/ Contour Bund	Sub-Surface Dyke	Dug Well Recharge	Percolation Tank	REET with RS	Injection Well	Check Dam	Gabion/ Contour Bund	Sub-Surface Dyke	Dug Well Recharge	TOTAL
Garhbeta-I	3.538	1.769	0.708	1.061	0	0	0	0	4	7	4	0	0	0	0	32.00	28.00	12.00	0.00	0.00	0.00	0.00	72.00

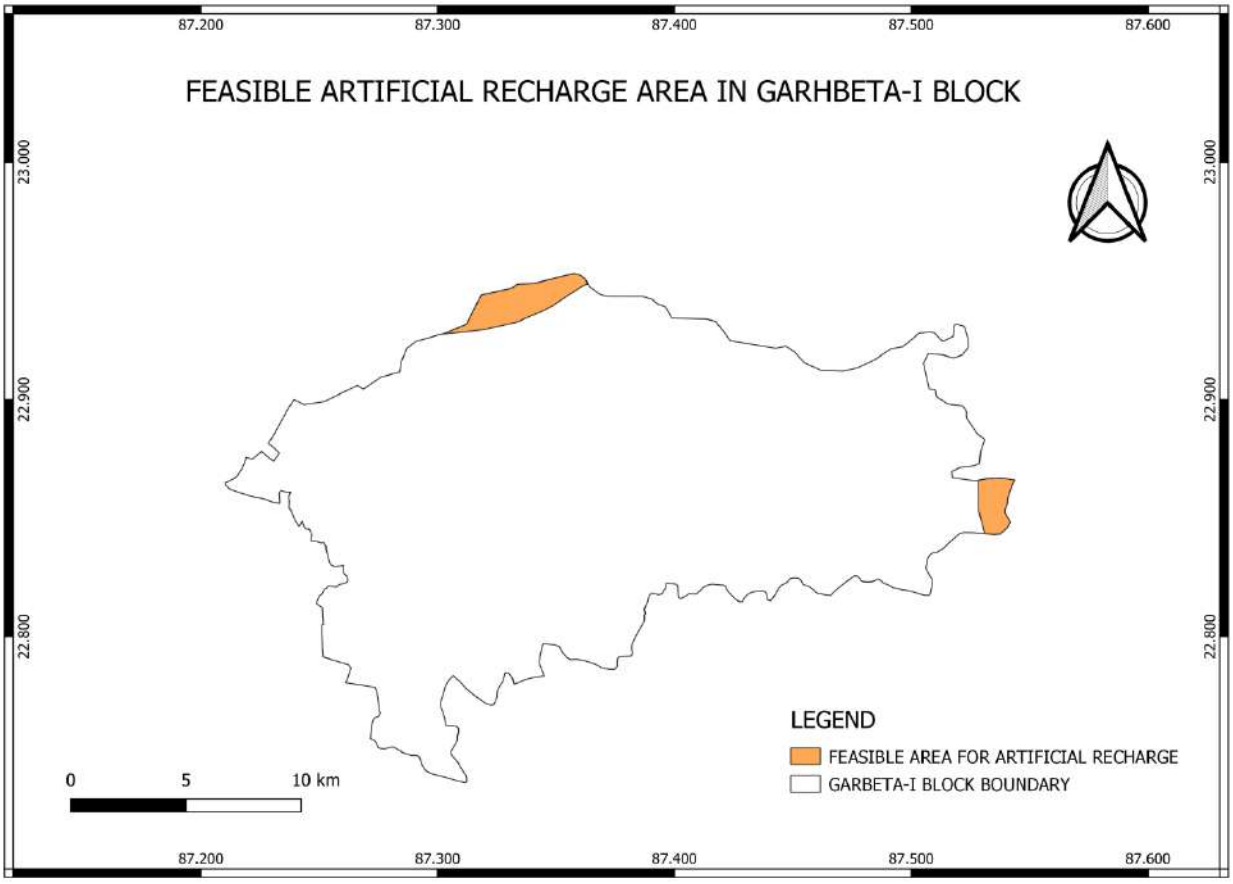


Figure11.6.4: Area Feasible for Artificial Recharge of groundwater for Garhbeta-IBlock

11.7 SALIENT INFORMATION

Block Name: *Garhbeta-II*

Geographical area (sq. km): 361.9

Mappable area (sq. km): 191

District: Paschim Medinipur

State: West Bengal

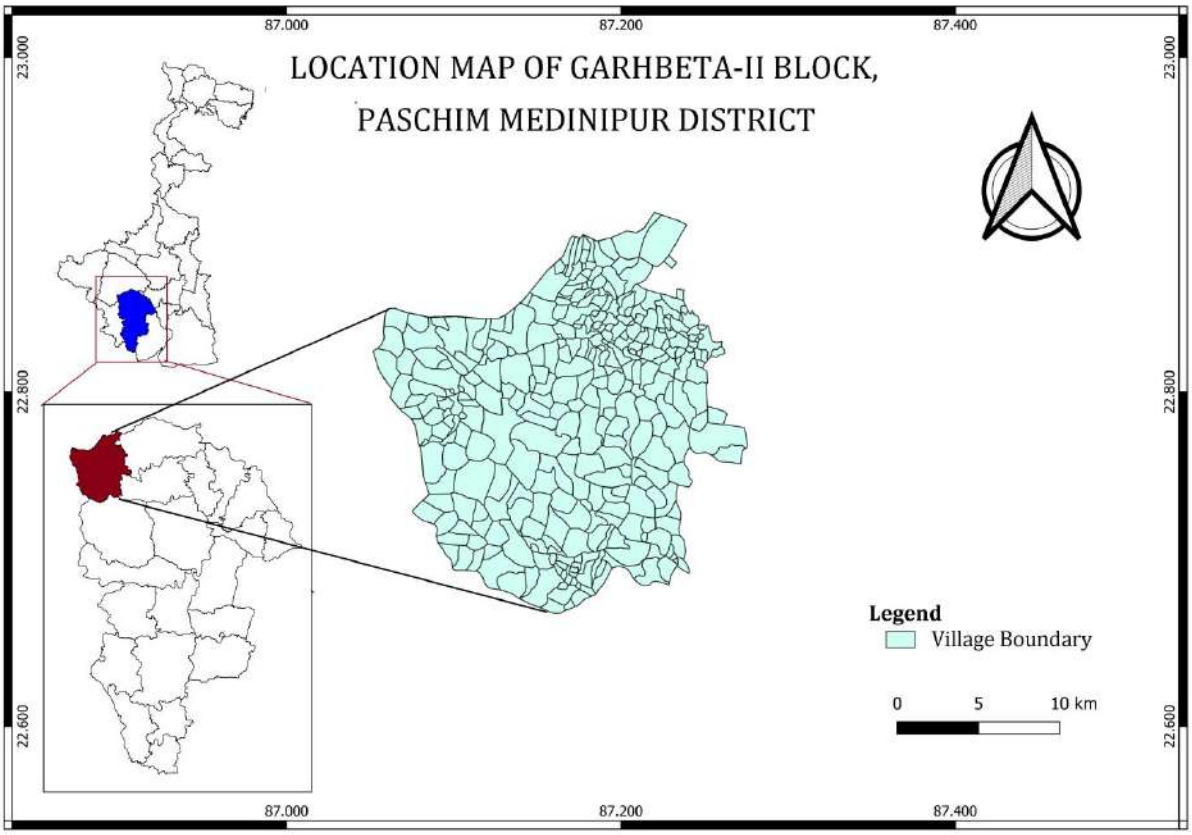


Figure11.7.1: Location Map of *Garhbeta-II* Block

Population (as on 2011):

Table 11.7.1: Details of population in Garhbeta-II block.

Rural	Urban	Total	Population Density per Sq.km
218239	**10274**	228513	631

Rainfall: Total annual rainfall for the block is 1775 mm.

Table 11.7.2: Rainfall Data

Block	District Normal (mm)	District Actual (Annual) in mm				
		2018	2019	2020	2021	2022
Garhbeta-II	1626.8	2191.9	6457.6	5716.58	3519.08	5238.07

Agriculture& Irrigation (area in ha):

Table 11.7.3: Salient Land use features of Garhbeta-II block

Block	Reporting Area	Forest Area	Area Under Non-Agricultural Waste	Gross cropped area	Net Sown Area	Area sown more than once	Area under undue uses
Garhbeta-II	36141	6707	1925	49700	23593	26107	3916

Table *11.7.*4: Crop water requirement of *Garhbeta-II* block

Block	Crops	Areasown (ha)	Irrigated area (ha)	Crop water demand (BCM)	Area to be irrigated (ha)	Water potential required (BCM)	Existing Water potential (BCM)	Water potential to be created (BCM)
Garhbeta-II	Cereals	20150	6250	0.10000	500	0.10800	0.10000	0.00800
	Coarse Cereals	130	100	0.00050	500	0.00300	0.00050	0.00250
	Pulses	170	160	0.00040	1000	0.00290	0.00040	0.00250
	Oil Seeds	7485	7485	0.01871	1000	0.02121	0.01871	0.00250
	Fibre	20	0	0.00000	200	0.00080	0.00000	0.00080
	Other crops	21745	20345	0.12207	1353	0.13019	0.12207	0.00812

Table *11.7.5* Command area (ha) of *Garhbeta-II* block

Block Name	Dug well		Shallow Tube well		Medium Tube well		Deep Tube well		Surface Flow		Surface Lift		CCA (ha.)		Total CCA (ha.)
	No.	CCA (ha.)	No.	CCA (ha.)	No.	CCA (ha.)	No.	CCA (ha.)	No.	CCA (ha.)	No.	CCA (ha.)	Ground Water	Surface Water	
Garhbeta-II	4	17.34	301	1402.26	1201	9394.83	140	1806.38	2	3.04	14	283.74	12620.81	286.78	12907.59

Disposition of Aquifers:

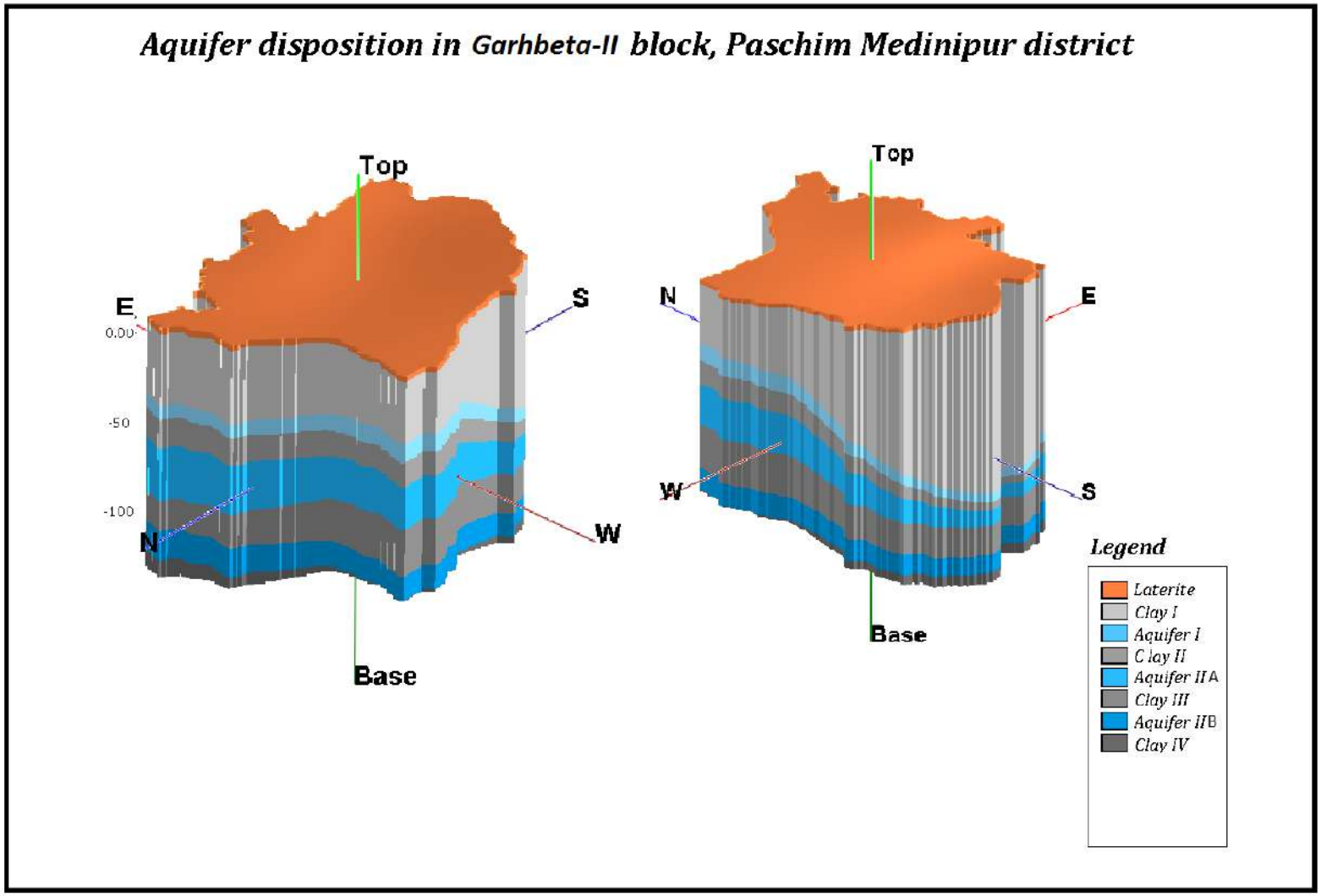
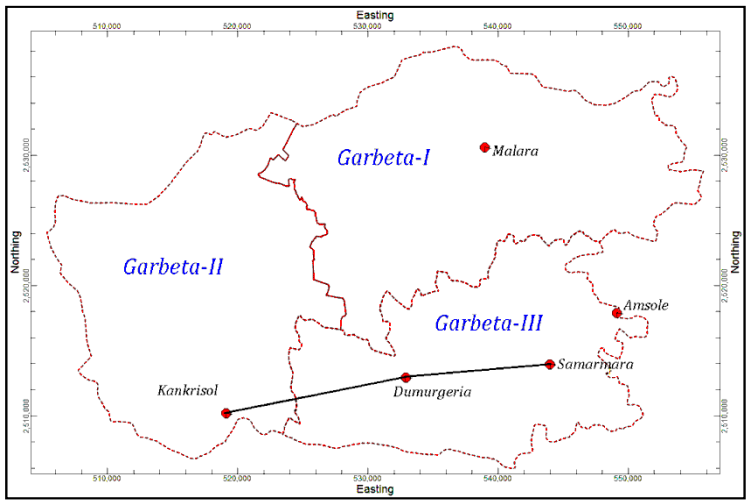


Fig. 11.7.2.3D Model of Aquifer Disposition of Garhbeta-II Block



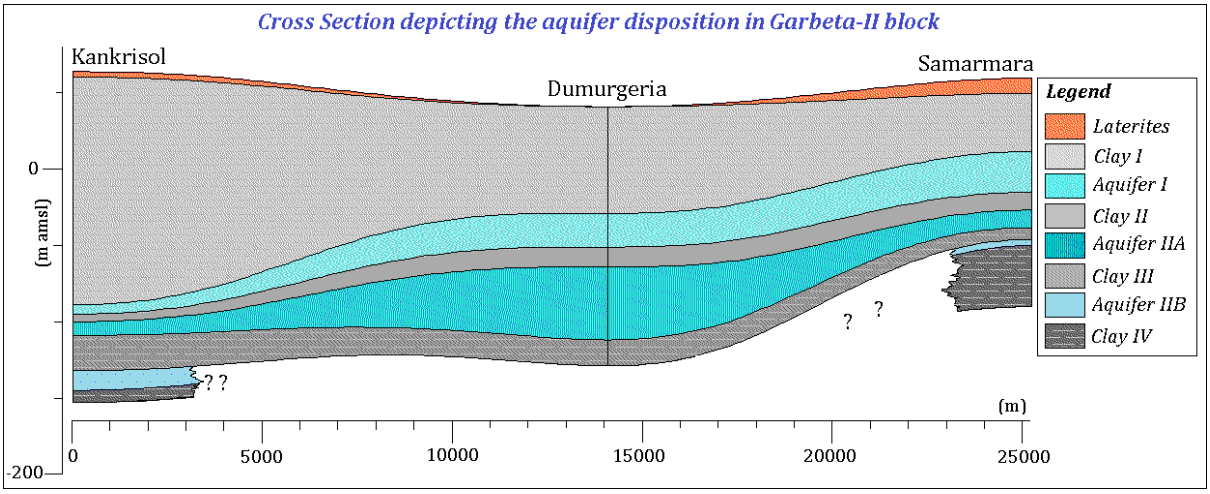


Fig. 11.7.3.2D Cross section of Aquifer Disposition

The principal aquifer systems encountered in this block is alluvium with laterite cappings in some areas.

The **shallow aquifers (Aquifer-I)** range from 45 m bgl to 48.5 m bgl. The water bearing zone varies between 45-48.5 mbgl and 75.5-78.4 mbgl.

The range of **medium aquifers(Aquifer-IIA and Aquifer-IIB)** is from 75 m bgl to 173 mbgl with clay intercalations. The water bearing zone varies between 153-159 mbgl, 164-173 mbgl.

Table *11.7.6*: Details of aquifer disposition in Garhbeta-IIIBlock

Blocks (dominant in soft rock)	No. of Aquifers	Water bearing zone	Aquifer Thickness (m)			Discharge (lpm)	T (m^2/day)	SWL (mbgl)	Draw down (mbgl)	S
			Aquifer-I	Aquifer-II A	Aquifer-II B					

Garhbeta-III	2	45-48.5, 75.5-78.4	44.62-47.90	75.5-78.74	153-159, 164-173	--	--	--	--	--

Table 11.7.7: Details of Aquifer Wise Water Level Ranges & seasonal long term water level trends

Block	Pre-monsoon Trend			Post-monsoon Trend		
	WL Range (mbgl)	Rise (m/year)	Fall (m/year)	WL Range (mbgl)	Rise (m/year)	Fall (m/year)
Garhbeta-II	0.8-12.8	0.202-0.814		0.86-8.39		--

Ground water quality and issues:

The range of chemical parameter for the block is given below.

Table 11.7.8: Range of chemical parameters in Garhbeta-II Block

Block		pH	EC (µS/cm)	Na (mg/l)	Cl (mg/l)	F (mg/l)	NO_3 (mg/l)	Fe (mg/l)	Measured Hardness (mg/l)
Garhbeta-II	Aquifer-I	7.58-8.20	251-1453	22.9-188	43-199	0.03-0.41	2.3-53.7	0.04-0.48	45-255
	Aquifer-II	7.98-8.16	73-655	0.7-41.4	7-78	0.03-0.34	1-14.7	0.12-2.37	35-215

Ground Water Resource:

Table *11.*7.9: Details of Ground Water Resource Availability and Utilization in *Garhbeta-II* Block.

Name of the Block	GARHBETA-II
Total Annual Ground Water Recharge (Ham)	7639.93
Total Natural Discharges (Ham)	381.99
Annual Extractable Ground Water Recharge (Ham)	7257.94

Total Extraction	4003.89
Annual GW Allocation for Domestic Use as on 2025	392.30
Net Ground Water Availability for future use	3233.96
Stage of Ground Water Extraction (%)	55.16
Categorization (OE/CRITICAL/ SEMI-CRITICAL/ SAFE)	Safe

Aquifer Management Plan:

Ground Water Management Plan for drinking purpose:

The block has sevencommissioned public water supply schemes by PHED in Garhbeta-II block. The block falls in Safe Category with 55.16% Stage of Development. There should be a general practice of conservation through rainwater harvesting, considering an adequate normal monsoon rainfall of 1792.6 mm which the block receives. The conserved rainwater can be utilized for drinking purpose by filtering through Horizontal Roughing Filters. The water from the lands can be channeled to ponds for recharge in the water bodies and this water can be tapped through shallow tube wells and dug wells for domestic and drinking purpose. In urban areas roof top rain water harvesting structure can be constructed for proper utilization of rainfall runoff.

Ground Water Management Plan for irrigation purposes:

- The block falls in safe category with stage of ground water development at 55.16%, exploitation of groundwater should be regulated to harness the additional available resource for site specific sustainable development.
- Micro-irrigation techniques like drip and sprinkler methods need to be adopted. Owing to its distinct hydrogeology, it is evident that cultivable command area is created by both surface as well as groundwater.
- Crops with low water requirement should be preferred.
- Construction of Farm ponds.
- In view of adequate rainfall in the area, excavation of tanks with large catchment areas, construction of check dams on second and third order streams, nallah bunds, gabion structures on first order streams, sub-surface dykes along the stream channels at suitable locations can be implemented to raise ground water level as well as to augment irrigation facilities. Irrigation by surface water may be increased. In addition to surface lift from canal & surface flows, rain water harvesting may also be considered.

11.8 SALIENT INFORMATION

Block Name: *Garhbeta-III*

Geographical area (sq. km): 312.12

Mappable area (sq. km): 159

District: Paschim Medinipur

State: West Bengal

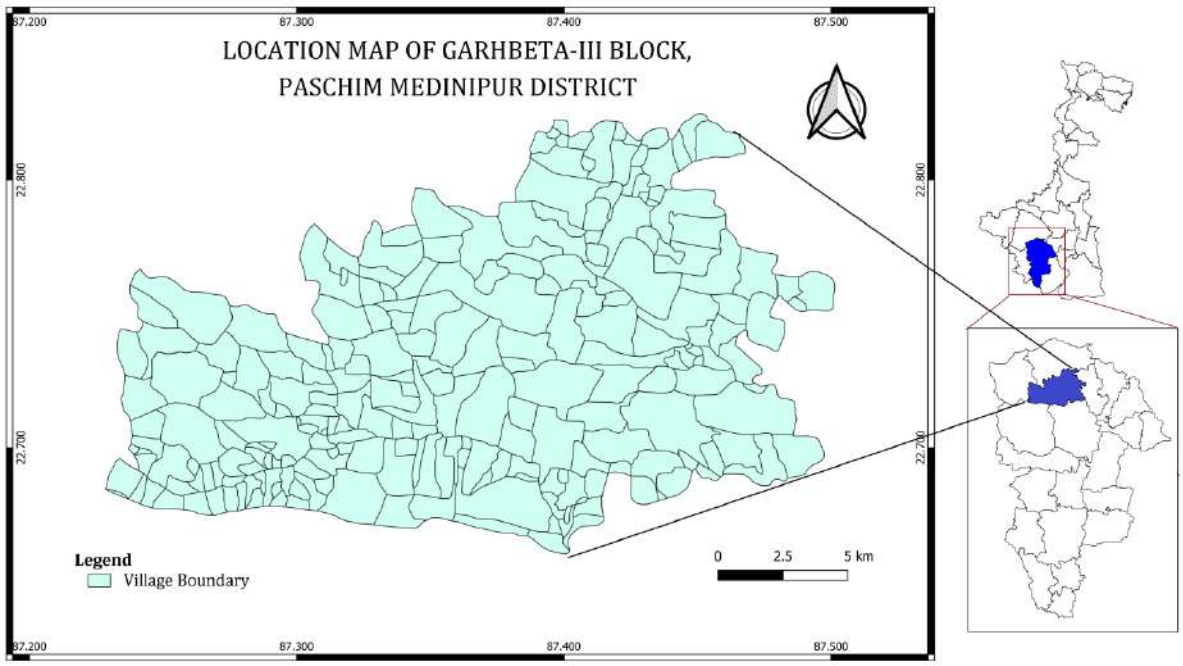


Figure11.8.1: Location Map of *Garhbeta-III* Block

Population (as on 2011):

Table 11.8.1: *Details of population in Garhbeta-III block.*

Rural	Urban	Total	Population Density per Sq.km
148809	20719	169528	543

Rainfall: Total annual rainfall for the block is 2411.6 (in mm)

Table *11*.8.2: Rainfall Data

Block	District Normal (mm)	District Actual (Annual) in mm				
		2018	2019	2020	2021	2022
Garhbeta-III	1626.8	2191.9	6457.6	5716.58	3519.08	5238.07

Agriculture& Irrigation (area in ha):

Table *11.8*.3: Salient Land use features of *Garhbeta-III* block

Block	Reporting Area	Forest Area	Area Under Non-Agricultural Waste	Gross cropped area	Net Sown Area	Area sown more than once	Area under undue uses
Garhbeta-III	31212	10279	1363	31320	16379	14941	3191

Table *11.8*.4: Crop water requirement of *Garhbeta-III* block

Block	Crops	Areasown (ha)	Irrigated area (ha)	Crop water demand (BCM)	Area to be irrigated (ha)	Water potential required (BCM)	Existing Water potential (BCM)	Water potential to be created (BCM)
Garhbeta-III	Cereals	14625	3625	0.05800	1000	0.07400	0.05800	0.01600
	Coarse Cereals	70	70	0.00035	500	0.00285	0.00035	0.00250
	Pulses	85	85	0.00021	1000	0.00271	0.00021	0.00250
	Oil Seeds	3660	3660	0.00915	1000	0.01165	0.00915	0.00250
	Fibre	5		0.00000	200	0.00080	0.00000	0.00080
	Other crops	12875	8885	0.05331	1769	0.06392	0.05331	0.01061

Table *11.8.5* Command area (ha) of *Garhbeta-III*block

Block Name	Dug well		Shallow Tube well		Medium Tube well		Deep Tube well		Surface Flow		Surface Lift		CCA (ha.)		Total CCA (ha.)
	No.	CCA (ha.)	No.	CCA (ha.)	No.	CCA (ha.)	No.	CCA (ha.)	No.	CCA (ha.)	No.	CCA (ha.)	Ground Water	Surface Water	
Garhbeta-III	112	158.29	44	81.25	714	3341.30	104	2446.25	14	145.45	130	613.06	6027.09	758.51	6786

Disposition of Aquifers:

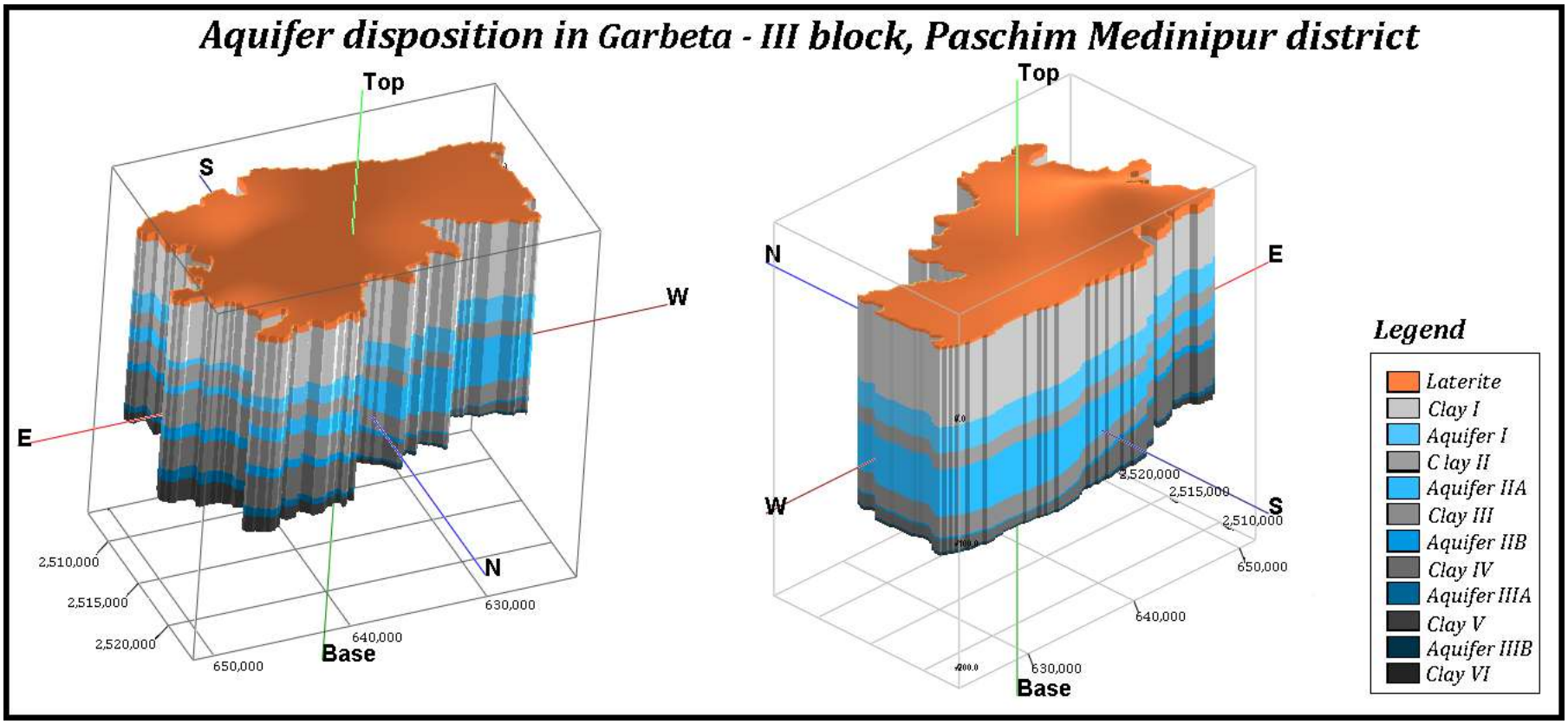
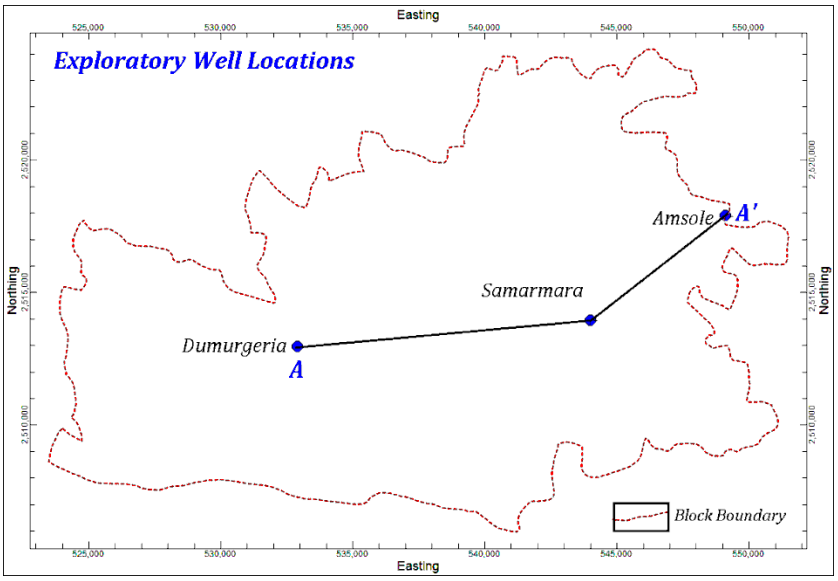


Fig. 11.8.2.3D Model of Aquifer Disposition of Garhbeta-III Block



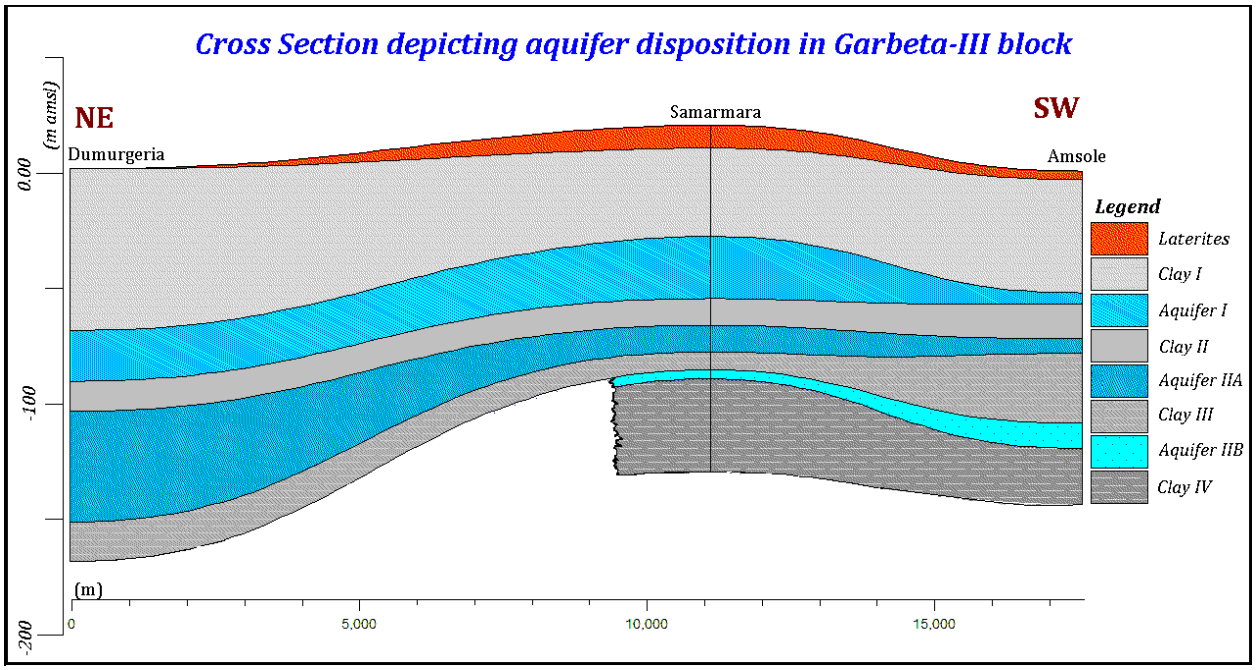


Fig. 11.8.2.2D Cross-section of Aquifer Disposition of Garhbeta-III Block

The principal aquifer systems encountered in this block is Alluvium with Laterite cappings in some areas.

The **shallow aquifer (Aquifer-I)** ranges from 44.62 m bgl to 47.90 m bgl. The water bearing zone varies between 44.62-47.90 mbgl and 75.46-78.74 mbgl.

The range of **medium aquifers (Aquifer-IIA and Aquifer-IIB)**is from 75.46 m bgl to 78.74 mbgl.

The range of **deeper aquifers (Aquifer-IIIA and Aquifer-IIIB)**is from 157.48 m bgl to 292.65 mbgl. The water bearing zone varies between 157.48-177.82 mbgl, 183.73-187 mbgl, 206.69-216.53 mbgl, 246.72-253.28 mbgl and 282.80-292.65 mbgl.

Table *11.8.6.*: Details of aquifer disposition inGarhbeta-IIIBlock

Blocks (dominant in soft rock)	No. of Aquifers	Water bearing zone (mbgl)	Aquifer Thickness (m)					Discharge (lpm)	T (m^2/day)	SWL (mbgl)	Drawdown (mbgl)	S
			Aquifer-I	Aquifer-II		Aquifer-III						
Garhbeta-III	3	44.62-47.90,75.46-78.74,157.48-177.82,183.73-187.00,206.69-216.53,246.72-253.28,282.80-292.65	44.62--78.74	Aquifer IIA	Aquifer IIB	Aquifer IIIA	Aquifer IIIB	1206	43.65	6.34	8.4	--
				75.46-78.74	157.48 - 177.82	183.73-187.00,206.69-216.53	246.72-253.28,282.80-292.65					

Table 11.8.7: Details of Aquifer Wise Water Level Ranges & seasonal long term water level trends

Block	Pre-monsoon Trend			Post-monsoon Trend		
	WL Range (mbgl)	Rise (m/year)	Fall (m/year)	WL Range (mbgl)	Rise (m/year)	Fall (m/year)
Garhebta-III	1.75-4.07	0.065		0.78-3.18	0.006	

Ground water quality and issues:

The range of chemical parameter for the block is given below.

Table 11.8.8: Range of chemical parameters in Garhbeta-III Block

Block	Aquifer Type	pH	EC (µS/cm)	Na (mg/l)	Cl (mg/l)	F (mg/l)	NO_3 (mg/l)	Fe (mg/l)	Measured Hardness (mg/l)
Chandrakona-I	Aquifer-I	8.05	482	43.6	39	0.13	2.3	0.48	140
	Aquifer-II	7.66-8.24	185-406	10.3-13.8	14-25	0.07-0.32	0.1-3.7	0.04-0.11	75-165

Ground Water Resource:

Table *11*.8.9 : Details of Ground Water Resource Availability and Utilization in *Garhbeta-III* Block.

Name of the Block	GARHBETA-III
Total Annual Ground Water Recharge (Ham)	6480.57
Total Natural Discharges (Ham)	648.05
Annual Extractable Ground Water Recharge (Ham)	5832.52
Total Extraction	3863.27
Annual GW Allocation for Domestic Use as on 2025	462.32
Net Ground Water Availability for future use	2044.04
Stage of Ground Water Extraction (%)	66.23
Categorization (OE/CRITICAL/ SEMI-CRITICAL/ SAFE)	Safe

Aquifer Management Plan:

Ground Water Management Plan for drinking purpose:

The block has commissioned public water supply schemes by PHED inChandrakonaRoa. Rly station, Raskundu and its adjoining mouzas, GuaphelaPatharkundaWater SupplyScheme and NarayanpurNerakupa Water Supply Scheme. However, there should be a general practice of conservation through rainwater harvesting, considering an adequate normal monsoon rainfall of 1751.7 mm which the block receives. The conserved rainwater can be utilized for drinking purpose by filtering through Horizontal Roughing Filters. The water from the lands can be channeled to ponds for recharge in the water bodies and this water can be tapped through shallow tube wells and dug wells for domestic and drinking purpose.

Ground Water Management Plan for irrigation purposes:

- The block falls in safe category with stage of ground water development at 66.23%, further development should be done in planned manner to harness the additional available resource for site specific sustainable development.
- Micro-irrigation techniques like drip and sprinkler methods need to be adopted. Owing to its distinct hydrogeology, it is evident that cultivable command area is created by both surface as well as groundwater.
- Crops with low water requirement should be preferred.
- In view of adequate rainfall in the area, excavation of tanks with large catchment areas, construction of check dams on second and third order streams, nallah bunds, gabion structures on first order streams, sub-surface dykes along the stream channels at suitable locations can be implemented to raise ground water level as well as to augment irrigation facilities. Irrigation by surface water may be increased. In addition to surface lift from canal & surface flows, rain water harvesting may also be considered.

11.9 SALIENT INFORMATION

Block Name: ***Salboni***

Geographical area (sq. km): 553.4

Mappable area (sq. km): 173

District: Paschim Medinipur

State: West Bengal

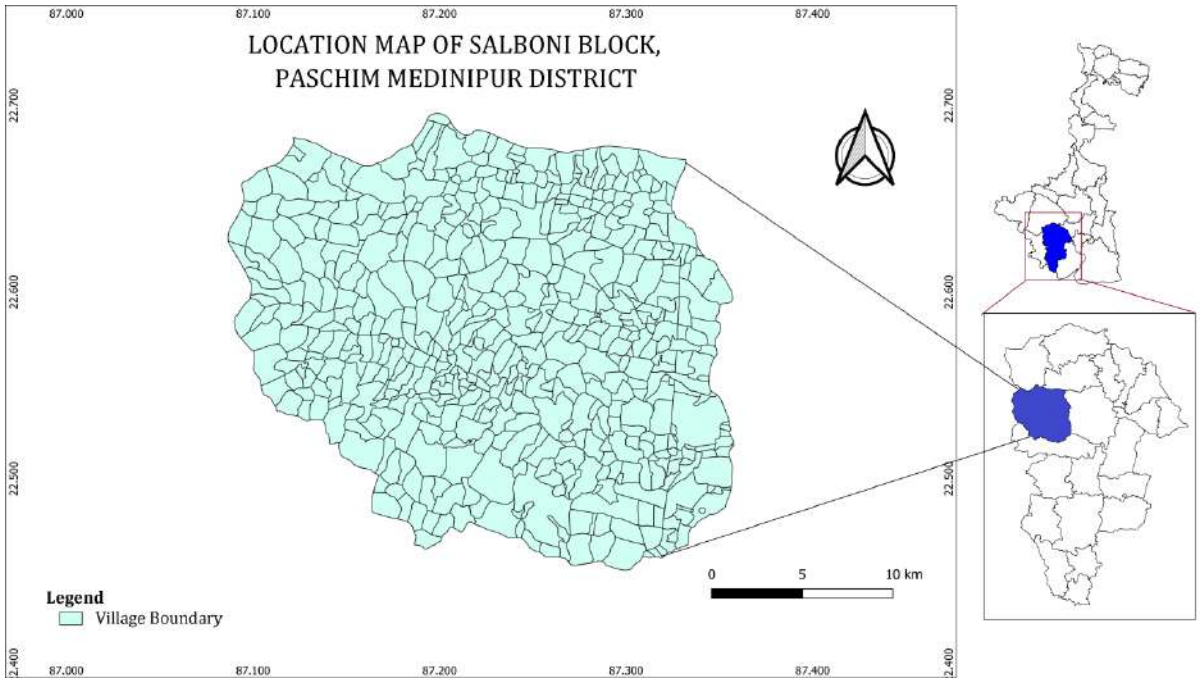


Figure11.9.1:Location Map of *Salboni* Block

Population (as on 2011):

Table 11.9.1: *Details of population in Salboni block.*

Rural	Urban	Total	Population Density per Sq.km
188653	0	188653	341

Rainfall: Total annual rainfall for the block is 2411.62 mm.

Table *11*.9.2: Rainfall Data

Block	District Normal (mm)	District Actual (Annual) in mm				
		2018	2019	2020	2021	2022
Salboni	1626.8	2191.9	6457.6	5716.58	3519.08	5238.07

Agriculture& Irrigation (area in ha):

Table *11.9*.3: Salient Land use features of *Salboni*block

Block	Reporting Area	Forest Area	Area Under Non-Agricultural Waste	Gross cropped area	Net Sown Area	Area sown more than once	Area under undue uses
Salboni	55340	20671	3674	38780	24856	13924	6794

Table *11.9*.4: Crop water requirement of *Salboni*block

Block	Crops	Areasown (ha)	Irrigated area (ha)	Crop water demand (BCM)	Area to be irrigated (ha)	Water potential required (BCM)	Existing Water potential (BCM)	Water potential to be created (BCM)
Salboni	Cereals	22720	4120	0.06592	1000	0.08192	0.06592	0.01600
	Coarse Cereals	160	100	0.00050	500	0.00300	0.00050	0.00250
	Pulses	145	130	0.00033	4000	0.01033	0.00033	0.01000
	Oil Seeds	5060	5060	0.01265	4000	0.02265	0.01265	0.01000
	Fibre	0		0.00000	200	0.00080	0.00000	0.00080
	Other crops	10695	8615	0.05169	2971	0.06952	0.05169	0.01783

Table *11.9.5* Command area (ha) of *Salboni* block

Block Name	Dug well		Shallow Tube well		Medium Tube well		Deep Tube well		Surface Flow		Surface Lift		CCA (ha.)		Total CCA (ha.)
	No.	CCA (ha.)	No.	CCA (ha.)	No.	CCA (ha.)	No.	CCA (ha.)	No.	CCA (ha.)	No.	CCA (ha.)	Ground Water	Surface Water	
Salboni	135	231.99	628	1774.20	458	2408.64	30	696.41	76	335.92	58	778.20	5111.24	1114.12	6225

Disposition of Aquifers:

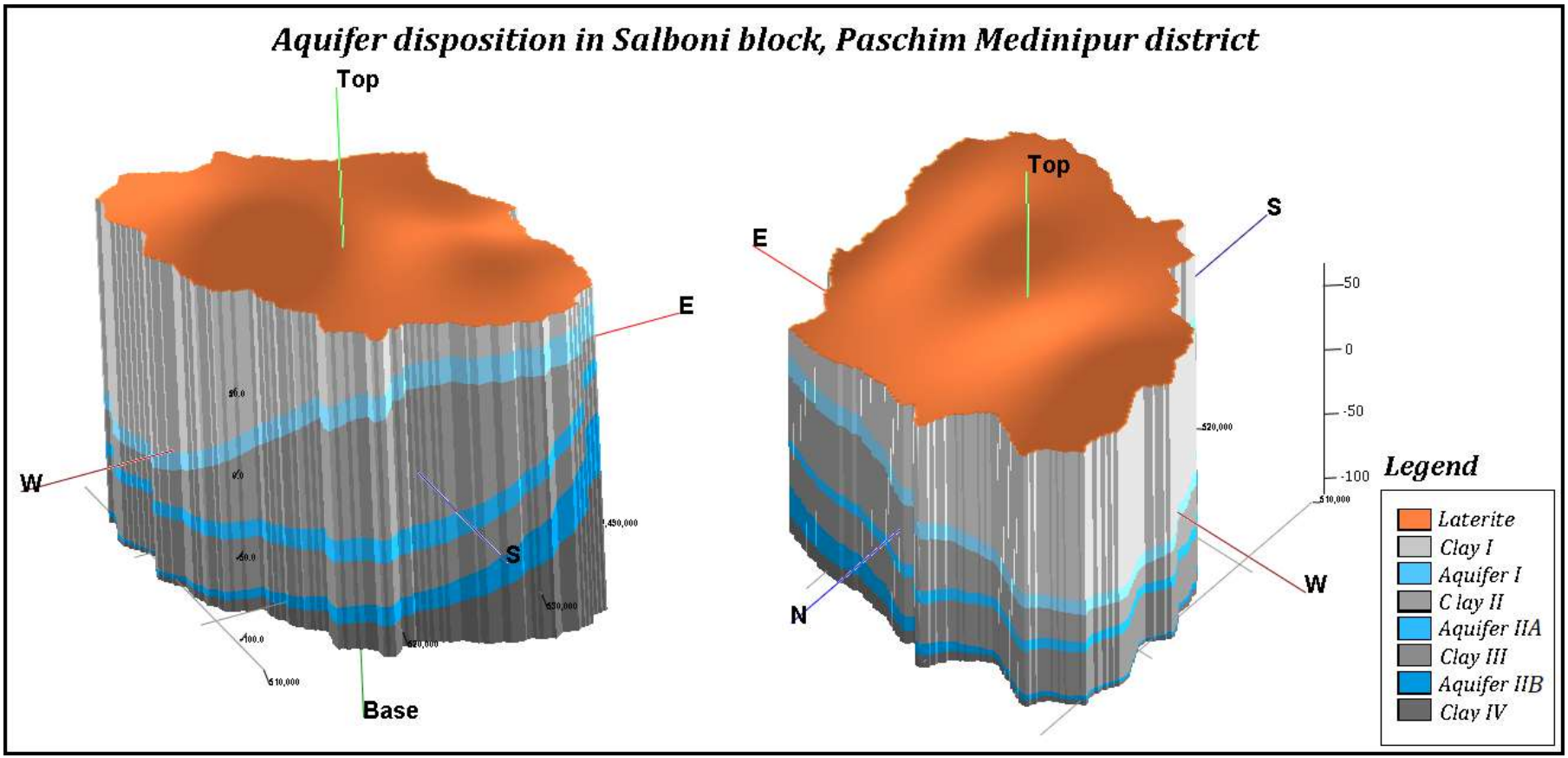
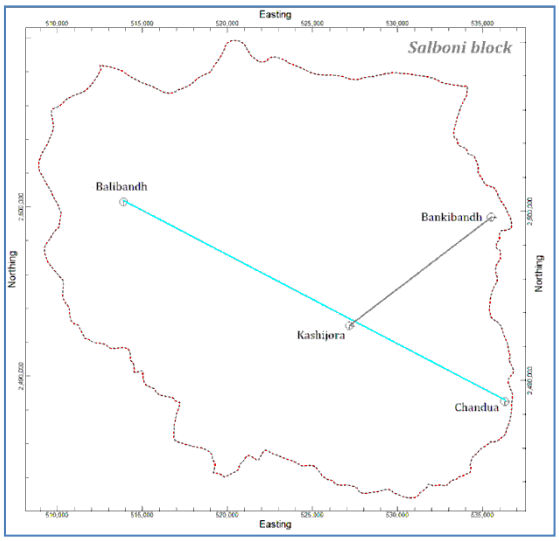


Fig. 11.9.2.3D Model of Aquifer Disposition of Salboni Block



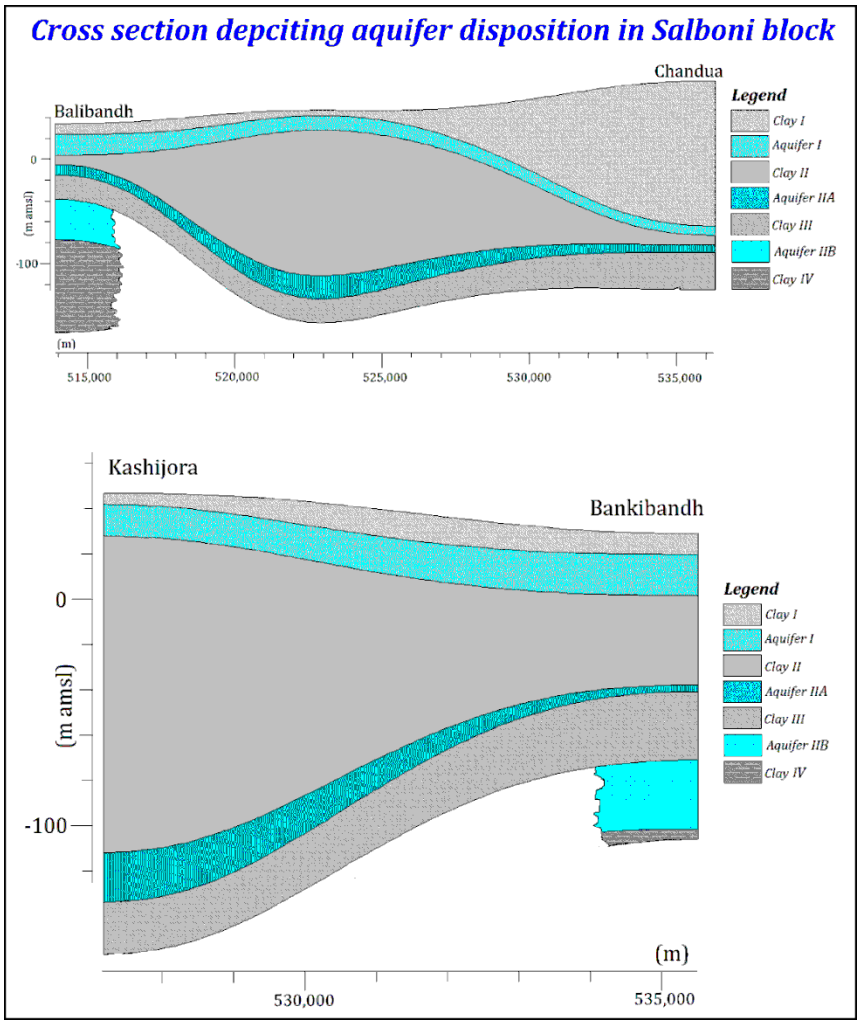


Figure. 11.9.3.2D Cross section of Aquifer Disposition along NW-SE and NE-SW

The principal aquifer systems encountered in this block is alluvium with laterite cappings.

The **shallow aquifers (Aquifer-I)** range from 46-71.01 m bgl. The water bearing zone varies between 45.68-52.49 m bgl and 65.45-71.01 m bgl.

The range of **medium aquifers (Aquifer IIA and Aquifer IIB)**is from 65 m bgl to 125 mbgl. The water bearing zone varies between 69-89.33 mbgl, 112.21-115.40 mbgl, 118.56-124.67, mbgl.

The range of **deeper aquifers (Aquifer III)**is from 170 m bgl to 175 mbgl. The water bearing zone varies between 170-175mbgl.

Table *11.9.6*: Details of aquifer disposition inSalboniBlock

Blocks (dominant in soft rock)	No. of Aquifers	Water bearing zone (mbgl)	Aquifer Thickness (m)				Discharge (lpm)	T (m^2/day)	SWL (mbgl)	Draw down (mbgl)	S
			Aquifer-I	Aquifer-II		Aquifer-III					
Salboni	3	45.68-52.49, 65.45-71.01, 69-89.33, 112.21-115.40, 118.56-124.67, 170-175	45.68-52.49, 65.45-71.01	Aq IIA	Aq IIB	170-175	745.8	43.151	15.34	6.9	--
				69-89.33	112.21-115.40, 118.56-124.67						

Table 11.9.7: Details of Aquifer Wise Water Level Ranges & seasonal long term water level trends

Block	Pre-monsoon Trend			Post-monsoon Trend		
	WL Range (mbgl)	Rise (m/year)	Fall (m/year)	WL Range (mbgl)	Rise (m/year)	Fall (m/year)
Salboni	1.7-9.95			1.15-10.24		--

Ground water quality and issues:

The range of chemical parameter for the block is given below.

Table 11.9.8 : Range of chemical parameters in Salboni Block

Block	Aquifer Type	pH	EC (µS/cm)	Na (mg/l)	Cl (mg/l)	F (mg/l)	NO_3 (mg/l)	Fe (mg/l)	Measured Hardness (mg/l)
Salboni	Aquifer-I	7.09-8.34	38-552	0.3-63.5	4-71	0.01-0.44	0.5-52.7	0.01-0.32	20-115
	Aquifer-II	7.17-8.07	60-366	0.2-15.7	7-25	0.03-0.49	0-6.9	0.18-13.5	45-145

Ground Water Resource:

Table *11*.9.9 : Details of Ground Water Resource Availability and Utilization in *Salboni* Block.

Name of the Block	SALBONI
Total Annual Ground Water Recharge (Ham)	15847.6
Total Natural Discharges (Ham)	1065.89
Annual Extractable Ground Water Recharge (Ham)	14781.71
Total Extraction	4965.59
Annual GW Allocation for Domestic Use as on 2025	505.61
Net Ground Water Availability for future use	9788.19
Stage of Ground Water Extraction (%)	33.59
Categorization (OE/CRITICAL/ SEMI-CRITICAL/ SAFE)	Safe

Aquifer Management Plan:

Ground Water Management Plan for drinking purpose:

The block has fifteen commissioned public water supply schemes by PHED in Salboni block. However, there should be a general practice of conservation through rainwater harvesting, considering an adequate normal monsoon rainfall of 1751.70 mm which the block receives. The conserved rainwater can be utilized for drinking purpose by filtering through Horizontal Roughing Filters. The water from the lands can be channeled to ponds for recharge in the water bodies and this water can be tapped through shallow tube wells and dug wells for domestic and drinking purpose.

Ground Water Management Plan for irrigation purposes:

- Although the block falls in safe category with stage of ground water development at 33.59%, further development should be done in planned manner to harness the additional available resource for site specific sustainable development.
- Micro-irrigation techniques like drip and sprinkler methods need to be adopted. Owing to its distinct hydrogeology, it is evident that cultivable command area is created by both surface as well as groundwater.
- Crops with low water requirement should be preferred.
- Construction of Farm ponds.
- In view of adequate rainfall in the area, excavation of tanks with large catchment areas, construction of check dams on second and third order streams, nallah bunds, gabion structures on first order streams, sub-surface dykes along the stream channels at suitable locations can be implemented to raise ground water level as well as to augment irrigation facilities. Irrigation by surface water may be increased. In addition to surface lift from canal & surface flows, rain water harvesting may also be considered.

Management Intervention through Harvesting of Surface Runoff and Artificial Recharge:

It has been estimated that the utilizable surface runoff produced in the block is **0.327** MCM. This surface runoff is proposed to be utilized for Artificial Recharge in the block. The number of AR structures to be constructed in the block are recommended in the table below:-

Table *11*.9.10: Details of structures recommended in feasible area of artificial recharge for Salboni Block.

		Allocation of Utilizable Recourse (MCM)							Structures Feasible							Cost of Structures (in lakhs)							
	Utilizable Surface Run Off	Percolation Tank	REET with RS	Injection Well	Check Dam	Gabion/ Contour Bund	Sub-Surface Dyke	Dug Well Recharge	Percolation Tank	REET with RS	Injection Well	Check Dam	Gabion/ Contour Bund	Sub-Surface Dyke	Dug Well Recharge	Percolation Tank	REET with RS	Injection Well	Check Dam	Gabion/ Contour Bund	Sub-Surface Dyke	Dug Well Recharge	TOTAL
Salboni	0.327	0.164	0.065	0.098	0	0	0	0	0	1	0	0	0	0	0	0.00	4.00	0.00	0.00	0.00	0.00	0.00	4.00

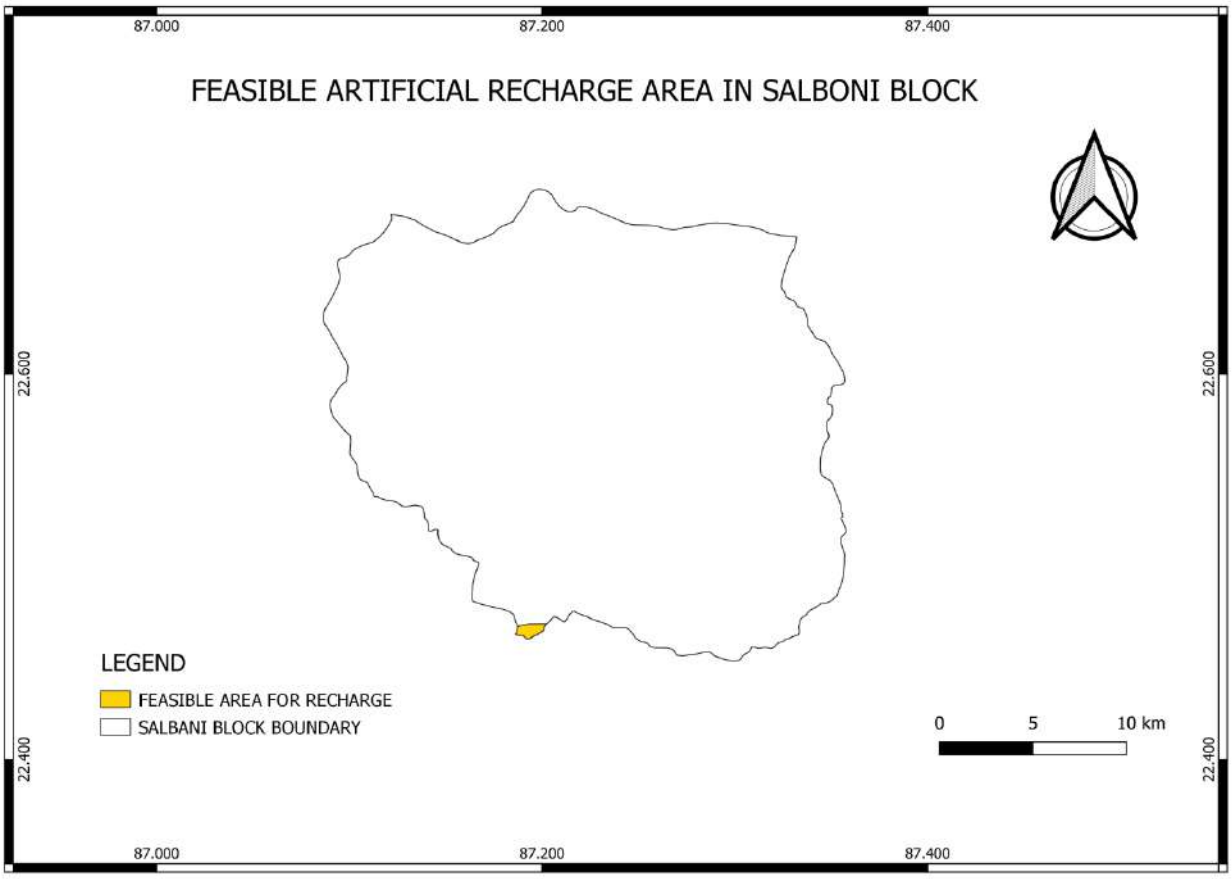


Figure11.9.4: Area Feasible for Artificial Recharge of groundwater for *Salboni*Block

11.10 SALIENT INFORMATION

Block Name: ***Keshpur***

Geographical area (sq. km): 483

Mappable area (sq. km): 263

District: Paschim Medinipur

State: West Bengal

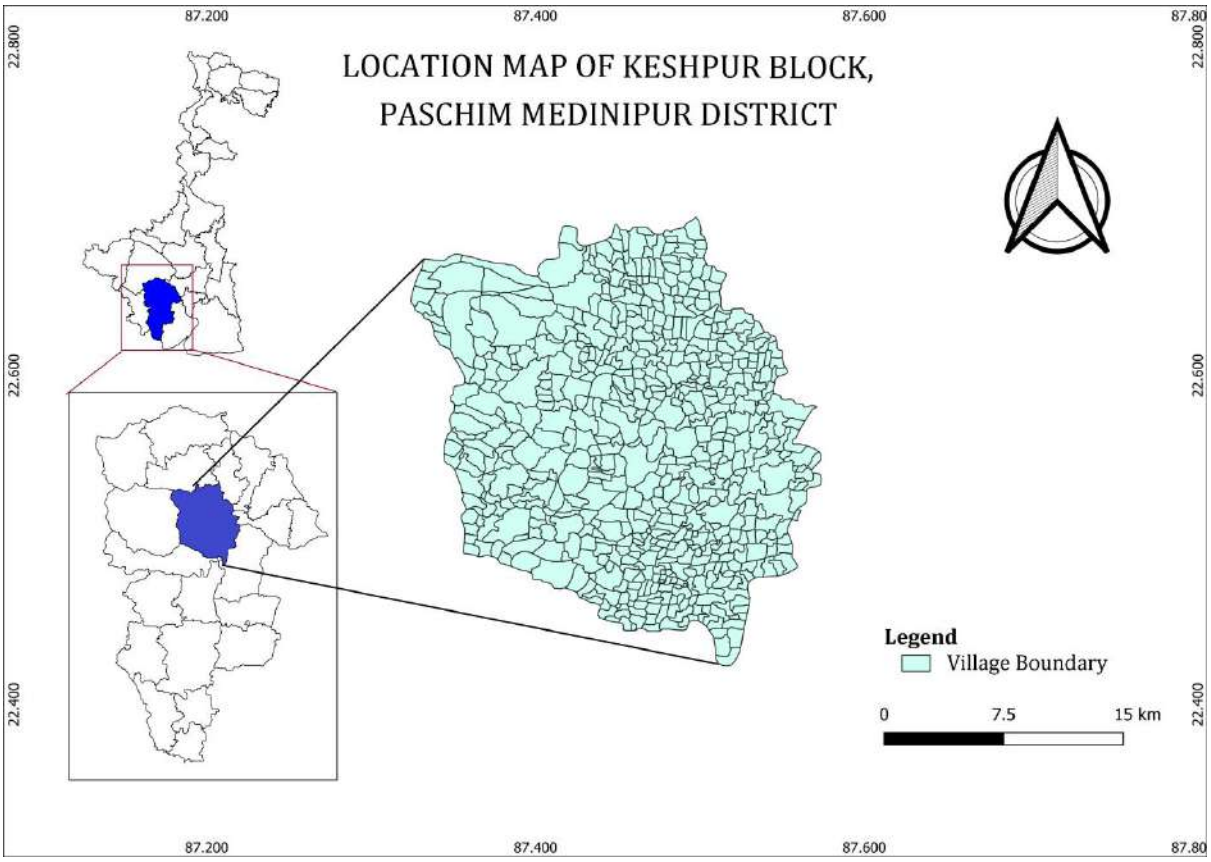


Figure11.10.1: Location Map of *Keshpur* Block

Population (as on 2011):

Table 11.10.1: *Details of population in Keshpur block.*

Rural	Urban	Total	Population Density per Sq.km
173504	165744	339248	702

Rainfall: Total annual rainfall for the block is 2571.4 mm.

Table 11.10.2.: ***Rainfall Details***

Block	District Normal (mm)	District Actual (Annual) in mm				
		2018	2019	2020	2021	2022
Keshpur	1626.8	2191.9	6457.6	5716.58	3519.08	5238.07

Agriculture& Irrigation (area in ha):

Table *11.*10.3: Salient Land use features of *Keshpur* block

Block	Reporting Area	Forest Area	Area Under Non-Agricultural Waste	Gross cropped area	Net Sown Area	Area sown more than once	Area under undue uses
Salboni	48283	3727	2064	72050	36450	35600	6042

Table *11.10.*4: Crop water requirement of *Keshpur*block

Block	Crops	Areasown (ha)	Irrigated area (ha)	Crop water demand (BCM)	Area to be irrigated (ha)	Water potential required (BCM)	Existing Water potential (BCM)	Water potential to be created (BCM)
Keshpur	Cereals	40725	10025	0.16040	500	0.16840	0.16040	0.00800
	Coarse Cereals	235	200	0.00100	300	0.00250	0.00100	0.00150
	Pulses	705	680	0.00170	1000	0.00420	0.00170	0.00250
	Oil Seeds	16705	16705	0.04176	1000	0.04426	0.04176	0.00250
	Fibre	550	300	0.00120	500	0.00320	0.00120	0.00200
	Other crops	13130	12560	0.07536	2062	0.08773	0.07536	0.01237

Table *11.10.5* Command area (ha) of *Keshpur*block

Block Name	Dug well		Shallow Tube well		Medium Tube well		Deep Tube well		Surface Flow		Surface Lift		CCA (ha.)		Total CCA (ha.)
	No.	CCA (ha.)	No.	CCA (ha.)	No.	CCA (ha.)	No.	CCA (ha.)	No.	CCA (ha.)	No.	CCA (ha.)	Ground Water	Surface Water	
Keshpur	20	39.12	226	704.04	2603	18010.20	51	1176.04	5	16.81	46	469.17	19929.20	485.98	20415

Disposition of Aquifers:

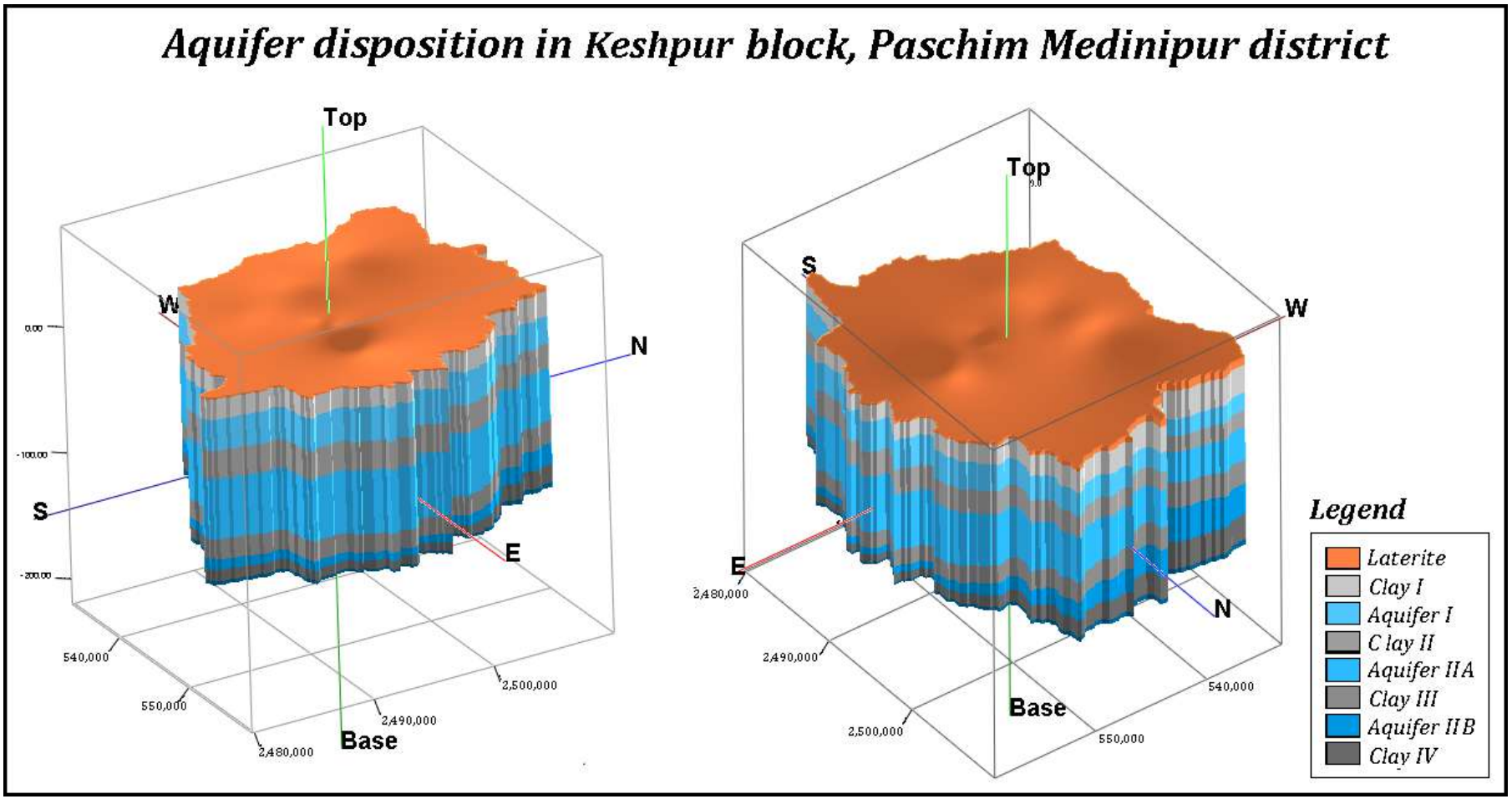
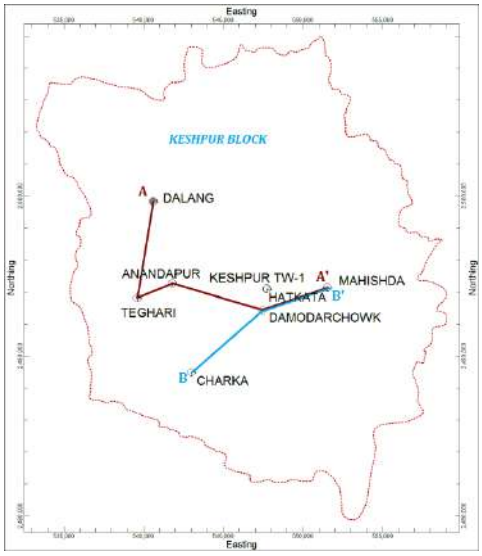


Fig. 11.10.2.3D Model of Aquifer Disposition of Keshpur Block



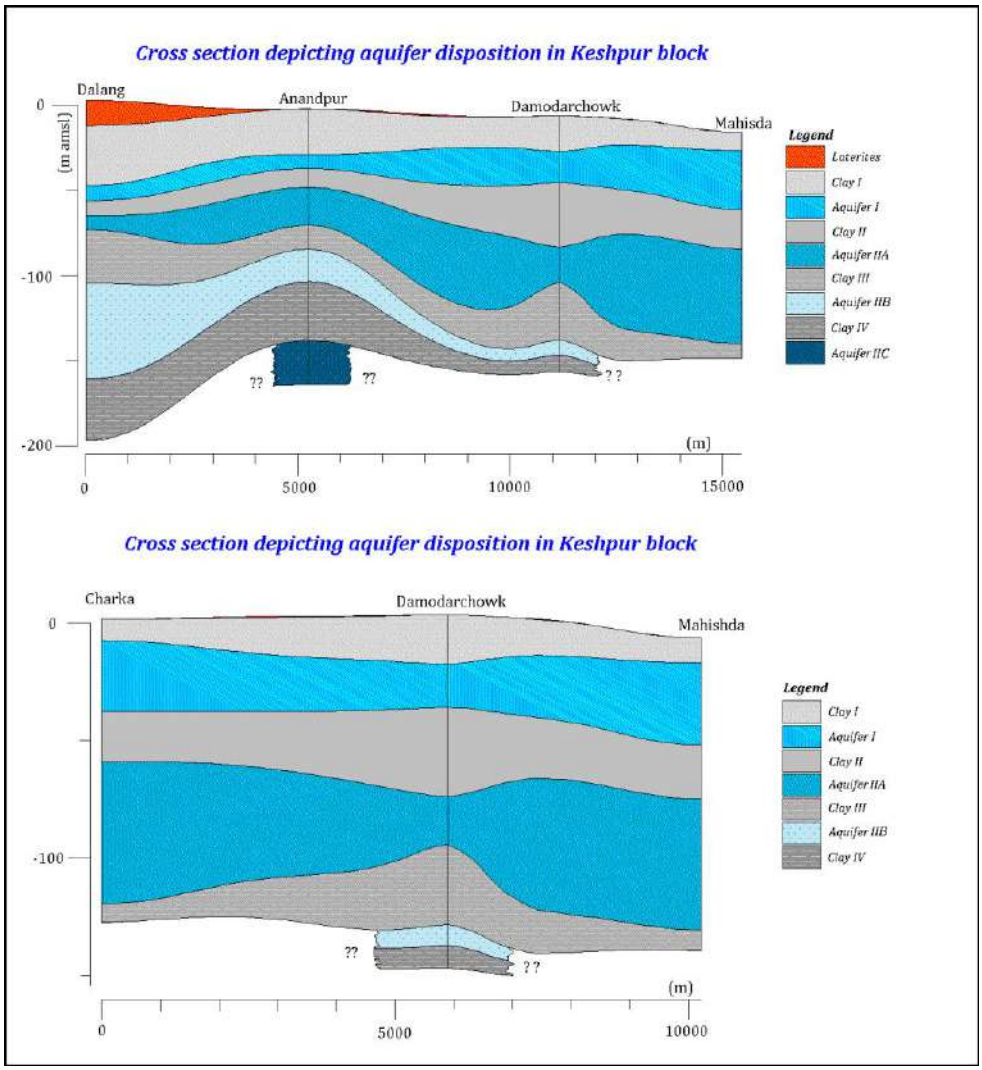


Fig. 11.10.3.2D Cross section of Aquifer Disposition along NW-SE and NE-SW

The principal aquifer systems encountered in this block is alluvium with laterite cappings in some areas.

The **shallow aquifers (Aquifer-I)** range from 33 m to 63 m. The water bearing zone varies between 33-45 mbgl and 48-63 mbgl.

The range of **deeper aquifers(Aquifer-IIA and Aquifer-IIB)** is from 81 m bgl to 111 mbgl and 100 mbgl to 119 mbgl. The water bearing zone varies between 81-87 mbgl, 105-111 mbgl, 103-118.5 mbgl and 150-155 mbgl.

Table *11.10*.6: Details of aquifer disposition in*Keshpur*Block

Blocks (dominant in soft rock)	No. of Aquifers	Water bearing zone (mbgl)	Aquifer Thickness (m)			Discharge (lpm)	T (m^2/day)	SWL (mbgl)	Draw down (mbgl)	S
			Aquifer-I	Aquifer-II A	Aquifer-II B					
Keshpur	2	33-45, 48-63, 81-87, 100.5-103.5, 105-111,109.5-118.5, 150- 155	33-63	81-118.5	150- 155	568.2-577.8	--	2.78-3.59	--	--

Table 11.10.7: Details of Aquifer Wise Water Level Ranges & seasonal long term water level trends

Block	Pre-monsoon Trend			Post-monsoon Trend		
	WL Range (mbgl)	Rise (m/year)	Fall (m/year)	WL Range (mbgl)	Rise (m/year)	Fall (m/year)
Keshpur	1.38-20.98	0.636	0.757	0.48-17.59		--

Ground water quality and issues:

The range of chemical parameter for the block is given below.

Table 11.10.8: Range of chemical parameters in KeshpurBlock

Block	Aquifer Type	pH	EC (µS/cm)	Na (mg/l)	Cl (mg/l)	F (mg/l)	NO_3 (mg/l)	Fe (mg/l)	Measured Hardness (mg/l)
Keshpur	Aquifer-I	7.87	58	0.7	11	0.26	0	0.26	25
	Aquifer-II	7.62-8.07	301-510	5.1-36.8	25-74	0.03-0.38	0-18.7	0.04-15.22	125-180

Ground Water Resource:

Table *11*.10.9: Details of Ground Water Resource Availability and Utilization in *Keshpur* Block.

Name of the Block	KESHPUR
Total Annual Ground Water Recharge (Ham)	20384.61
Total Natural Discharges (Ham)	2038.46
Annual Extractable Ground Water Recharge (Ham)	18346.15
Total Extraction	13408.60
Annual GW Allocation for Domestic Use as on 2025	952.84
Net Ground Water Availability for future use	4871.53
Stage of Ground Water Extraction (%)	73.08
Categorization (OE/CRITICAL/ SEMI-CRITICAL/ SAFE)	Semi-Critical

Aquifer Management Plan:

Ground Water Management Plan for drinking purpose:

The block has six commissioned public water supply schemes by PHED in Keshpurblock. However, there should be a general practice of conservation through rainwater harvesting, considering an adequate normal monsoon rainfall of 1812 mm which the block receives. The conserved rainwater can be utilized for drinking purpose by filtering through Horizontal Roughing Filters. The water from the lands can be channeled to ponds for recharge in the water bodies and this water can be tapped through shallow tube wells and dug wells for domestic and drinking purpose.In urban areas roof top rain water arvesting structure can be constructed for proper utilization of rainfall runoff.

Ground Water Management Plan for irrigation purposes:

- The block falls in semi-critical category with stage of ground water development at 73.08%, adequate recharge measures and regulated groundwater extraction should be carried out to harness the additional available resource for site specific sustainable development.
- Micro-irrigation techniques like drip and sprinkler methods need to be adopted. Owing to its distinct hydrogeology, it is evident that cultivable command area is created by both surface as well as groundwater.
- Crops with low water requirement should be preferred.
- Construction of Farm ponds.
- In view of adequate rainfall in the area, excavation of tanks with large catchment areas, construction of check dams on second and third order streams, nallah bunds, gabion structures on first order streams, sub-surface dykes along the stream channels at suitable locations can be implemented to raise ground water level as well as to augment irrigation facilities. Irrigation by surface water may be increased. In addition to surface lift from canal & surface flows, rain water harvesting may also be considered.

Management Intervention through Harvesting of Surface Runoff and Artificial Recharge:

It has been estimated that the utilizable surface runoff produced in the block is **25.585**MCM. This surface runoff is proposed to be utilized for Artificial Recharge in the block. The number of AR structures to be constructed in the block are recommended in the table below:-

Table *11.*10.10: Details of structures recommended in feasible area of artificial recharge for KeshpurBlock.

		Allocation of Utilizable Recourse (MCM)							Structures Feasible							Cost of Structures (in lakhs)							
	Utilizable Surface Run Off	Percolation Tank	REET with RS	Injection Well	Check Dam	Gabion/ Contour Bund	Sub-Surface Dyke	Dug Well Recharge	Percolation Tank	REET with RS	Injection Well	Check Dam	Gabion/ Contour Bund	Sub-Surface Dyke	Dug Well Recharge	Percolation Tank	REET with RS	Injection Well	Check Dam	Gabion/ Contour Bund	Sub-Surface Dyke	Dug Well Recharge	TOTAL
Keshpur	25.585	12.793	5.117	7.676	0	0	0	0	26	51	26	0	0	0	0	208.00	204.00	78.00	0.00	0.00	0.00	0.00	490.00

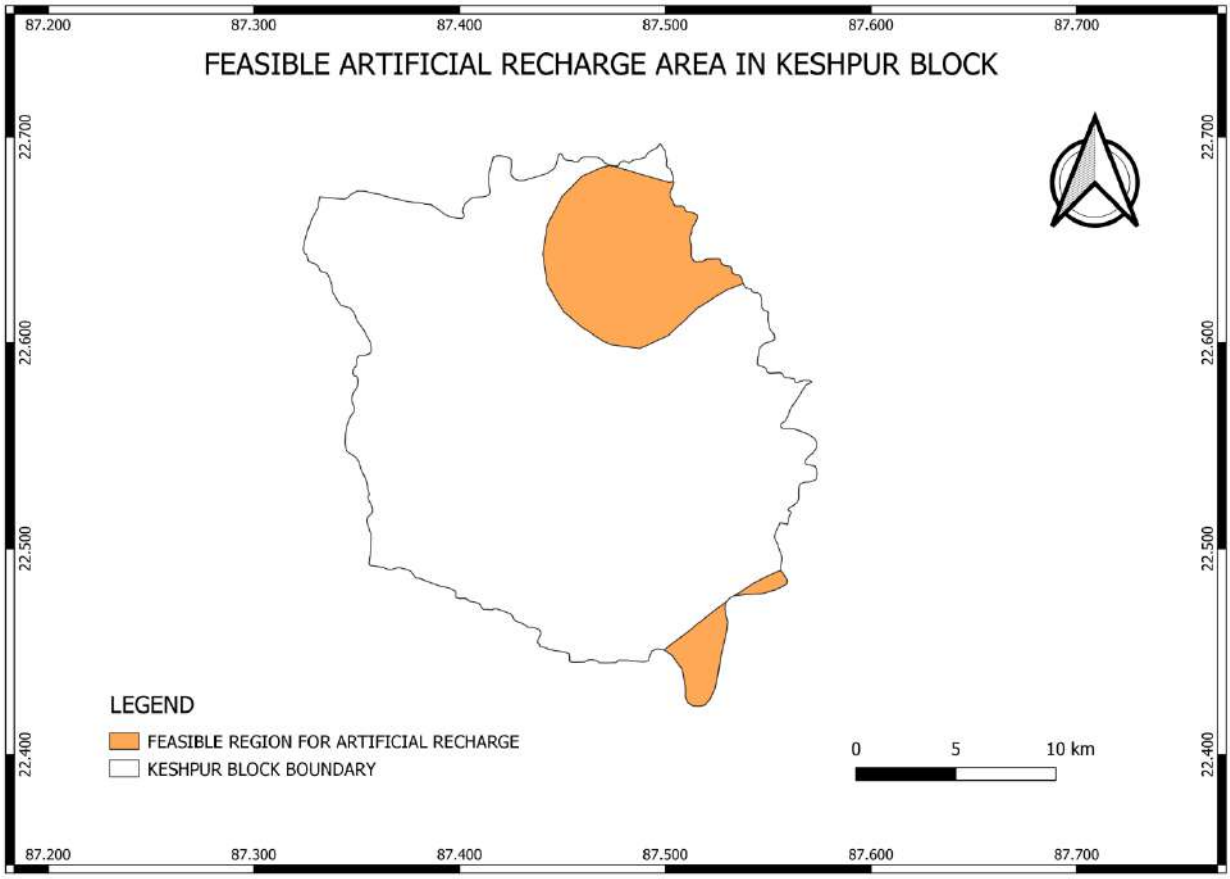


Figure11.10.4: Area Feasible for Artificial Recharge of groundwater for *Keshpur*Block

11.11 SALIENT INFORMATION

Block Name: *Keshiary*

Geographical area (sq. km): 292.09

Mappable area (sq. km): 178

District: PaschimMedinipur

State: West Bengal

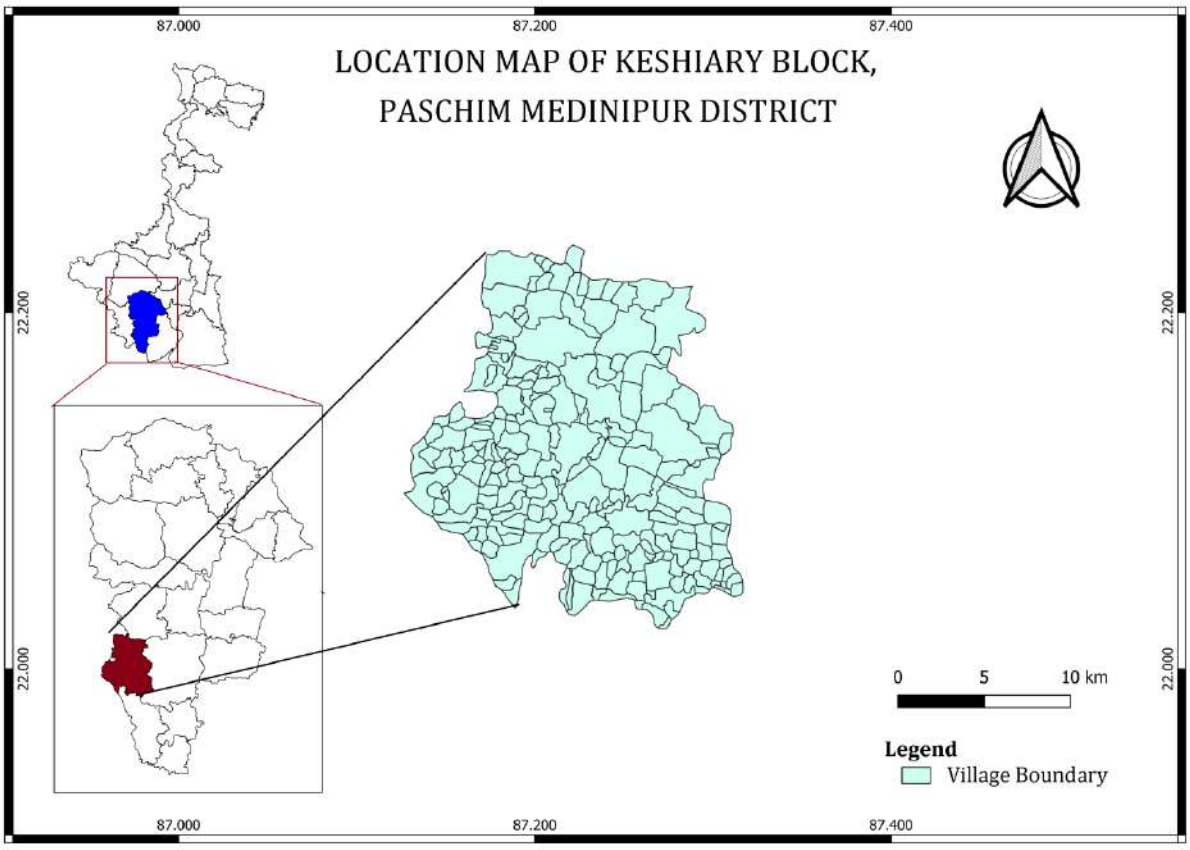


Figure11.11.1: Location Map of *Keshiary*Block

Population (as on 2011):

Table 11.11.1: *Details of population in Keshiary block.*

Rural	Urban	Total	Population Density per Sq.km
75601	**73659**	149260	511

Rainfall: Total annual rainfall for the block is 1689.2 mm.

***Table 11.11.2*:Rainfall Data**

Block	District Normal (mm)	District Actual (Annual) in mm				
		2018	2019	2020	2021	2022
Keshiary	1626.8	2191.9	6457.6	5716.58	3519.08	5238.07

Agriculture& Irrigation (area in ha):

Table *11.11.3*: Salient Land use features of *Keshiary* block

Block	Reporting Area	Forest Area	Area Under Non-Agricultural Waste	Gross cropped area	Net Sown Area	Area sown more than once	Area under undue uses
Keshiary	29209	2288	646	33755	21575	12180	4700

Table *11.11.*4: Crop water requirement of *Keshiary* block

Block	Crops	Areasown (ha)	Irrigated area (ha)	Crop water demand (BCM)	Area to be irrigated (ha)	Water potential required (BCM)	Existing Water potential (BCM)	Water potential to be created (BCM)
Keshiary	Cereals	29605	17100	0.27360	500	0.28160	0.27360	0.00800
	Coarse Cereals	20	20	0.00010	500	0.00260	0.00010	0.00250
	Pulses	690	690	0.00173	500	0.00298	0.00173	0.00125
	Oil Seeds	1235	1235	0.00309	500	0.00434	0.00309	0.00125
	Fibre	10	10	0.00004	200	0.00084	0.00004	0.00080
	Other crops	2195	2165	0.01299	1455	0.02172	0.01299	0.00873

Table *11.11.5* Command area (ha) of *Keshiary*block

Block Name	Dug well		Shallow Tube well		Medium Tube well		Deep Tube well		Surface Flow		Surface Lift		CCA (ha.)		Total CCA (ha.)
	No.	CCA (ha.)	No.	CCA (ha.)	No.	CCA (ha.)	No.	CCA (ha.)	No.	CCA (ha.)	No.	CCA (ha.)	Ground Water	Surface Water	
Keshiary	51	85.15	164	1208.19	378	4611.50	155	1854.04	8	109.61	18	397.72	7758.88	507.33	8266.21

Disposition of Aquifers:

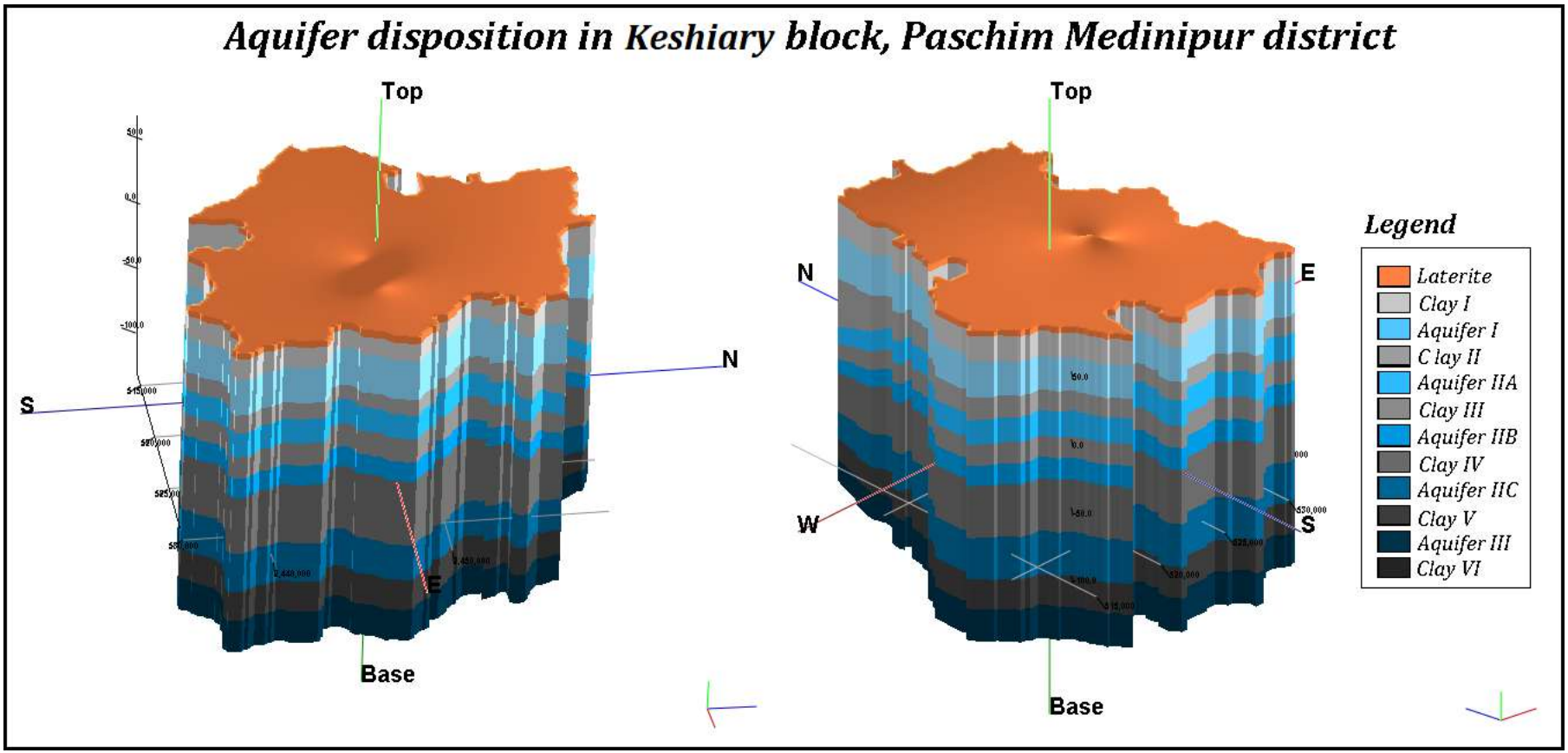
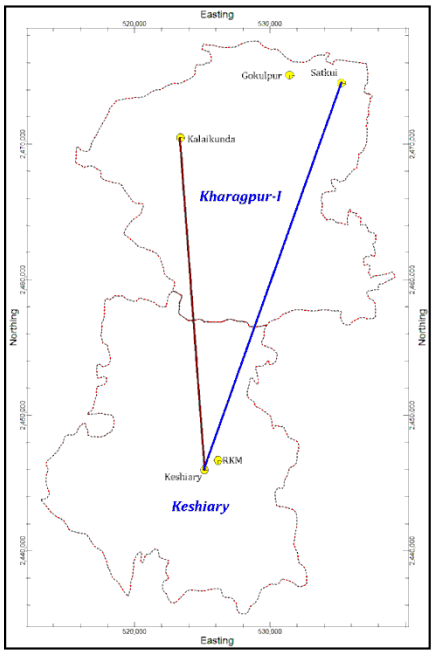


Fig. 11.11.2.3D Model of Aquifer Disposition of Keshiary Block



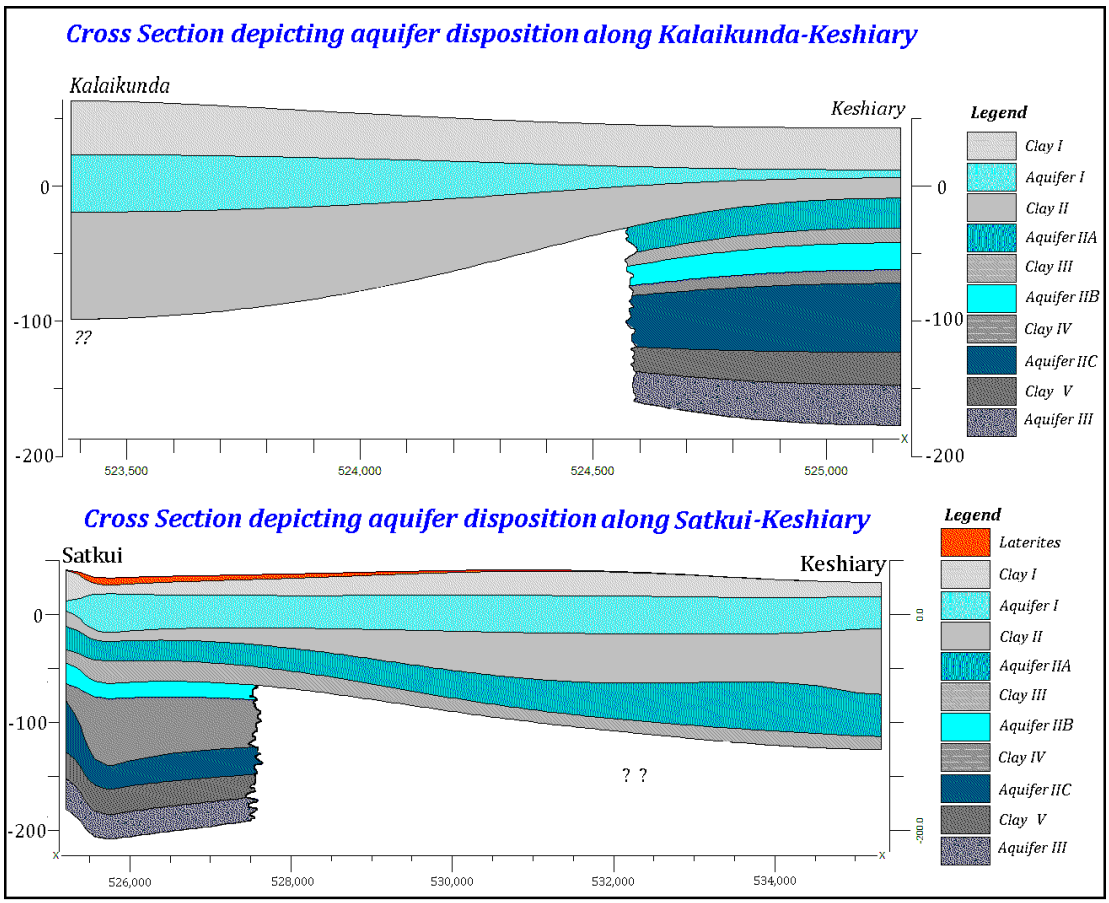


Fig. 11.11.3.2D Cross section of Aquifer Disposition

The principal aquifer systems encountered in this block is alluvium with laterite cappings in some areas.

The range of **shallow aquifers** is from 31-74 mbgl. The water bearing zones are 21-37 mbgl, 52-58 mbgl, 60-74 mbgl.

The range of **medium aquifers**is from 85 to 145 mbgl. The water bearing zones are 85-105 mbgl, 115-145 mbgl, 150-160 mbgl, 160-166 mbgl, 190-222 mbgl.

Table 11.11.6: Details of Aquifer Disposition in Keshiary Block

Blocks (dominant in soft rock)	No. of Aquifers	Water bearing zone	Aquifer Thickness (m)					Discharge (lpm)	T (m^2/day)	SWL (mbgl)	Draw down (mbgl)	S
			Aquifer -I	Aquifer -II A	Aquifer -IIB	Aquifer -IIC	Aquifer -III					
Keshiary	2	31-37, 52-58,60-74, 85-105, 115-145, 150-160, 160-166, 190-222	31-37, 52-58	60-74, 85-105	115-145	150-160	160-166, 190-222	729	192-222		4.18	

Table 11.11.7: Details of Aquifer Wise Water Level Ranges & seasonal long term water level trends

Block	Pre-monsoon Trend			Post-monsoon Trend		
	WL Range (mbgl)	Rise (m/year)	Fall (m/year)	WL Range (mbgl)	Rise (m/year)	Fall (m/year)
Keshiary	1.18-19.53	1.423		0.62-12.70		0.083

Ground water quality and issues:

The range of chemical parameter for the block is given below.

Table 11.11.8: Range of chemical parameters in KeshiaryBlock

Block	pH	EC (µS/cm)	Na (mg/l)	Cl (mg/l)	F (mg/l)	NO_3 (mg/l)	Fe (mg/l)	Measured Hardness (mg/l)
Keshiary	7.53-7.76	140-425	1-17.3	14-35	0.38-0.58	2.4-7.6	88-242	65-170

Ground Water Resource:

Table *11.*11.9: Details of Ground Water Resource Availability and Utilization in *Keshiary*Block.

Name of the Block	KESHIARY
Total Annual Ground Water Recharge (Ham)	11185.55
Total Natural Discharges (Ham)	1118.56
Annual Extractable Ground Water Recharge (Ham)	10066.99
Total Extraction	2788.89
Annual GW Allocation for Domestic Use as on 2025	498.20
Net Ground Water Availability for future use	7252.99
Stage of Ground Water Extraction (%)	27.70
Categorization (OE/CRITICAL/ SEMI-CRITICAL/ SAFE)	Safe

Aquifer Management Plan:

Ground Water Management Plan for drinking purpose:

The block hasonecommissioned public water supply scheme by PHED in Keshiary block. The block falls in Safe Category with 27.70% Stage of Development. There should be a general practice of conservation through rainwater harvesting, considering an adequate normal monsoon rainfall of 1689.2 mm which the block receives. The conserved rainwater can be utilized for drinking purpose by filtering through Horizontal Roughing Filters. The water from the lands can be channeled to ponds for recharge in the water bodies and this water can be tapped through shallow tube wells and dug wells for domestic and drinking purpose. In urban areas roof top rain water harvesting structure can be constructed for proper utilization of rainfall runoff.

Ground Water Management Plan for irrigation purposes:

- The block falls in safe category with stage of ground water development at 27.70%, exploitation of groundwater should be regulated to harness the additional available resource for site specific sustainable development.
- Micro-irrigation techniques like drip and sprinkler methods need to be adopted. Owing to its distinct hydrogeology, it is evident that cultivable command area is created by both surface as well as groundwater.
- Crops with low water requirement should be preferred.
- Construction of Farm ponds.
- In view of adequate rainfall in the area, excavation of tanks with large catchment areas, construction of check dams on second and third order streams, nallah bunds, gabion structures on first order streams, sub-surface dykes along the stream channels at suitable locations can be implemented to raise ground water level as well as to augment irrigation facilities. Irrigation by surface water may be increased. In addition to surface lift from canal & surface flows, rain water harvesting may also be considered.

PART-III

DATA GAP ANALYSIS

12. DATA GAP ANALYSIS FOR AQUIFER MAPPING PROGRAMME IN PASCHIM MEDINIPUR DISTRICT

(AAP 2022-2023)

The study area comprises 11 blocks out of 21 blocks in Paschim Medinipur District. The area can be located in Survey of India Degree Sheet nos.73 N. Major portion of this NAQUIM area is coveredby Toposheet **73 N/1**, **73 N/2, 73 N/5, 73 N/6 and 73 N/7.**Minor portion of the NAQUIM area is covered by five other Toposheets **73 N/3 & 73 N/4, 73N/8, 73N/9 and 73 N/10.**

The NAQUIM area of 2038 sq. kmincluding 11 blocks of Paschim Medinipur district of West Bengal (Fig. 1.4.1) is locatedbetween 22.75°N to 22.97°N latitudes and 87.035°E to 87.89°E longitudes. The entire district of Paschim Medinipur lies between 22.75°N to 22.97°N latitudes and 87.035°E to 87.89°E longitudes with a total geographical area of 6308 Sq. Kms.

Data Gap in terms of exploratory wells (EW), water level monitoring stations (key wells), geophysical studies viz. Vertical Electrical Sounding (VES), etc. to study the aquifers in the area has been tabulated quadrant wise in different Toposheet.

12.1. Data Gap for Exploratory Wells

Exploratory wells constructed by CGWB, ER, and Kolkata have been considered for the study. After plotting the existing exploratory wells and following the guidelines it is seen that a total of 34 Exploratory wells (EW), 12 Observation wells (OW) and 6 well fields are required in the study area.

Map showing existing location of Exploratory Wells is shown in **Figure 12.1.**

Table suggesting additional exploratory wells and their depths for the study area is given in **Table 12.1.**

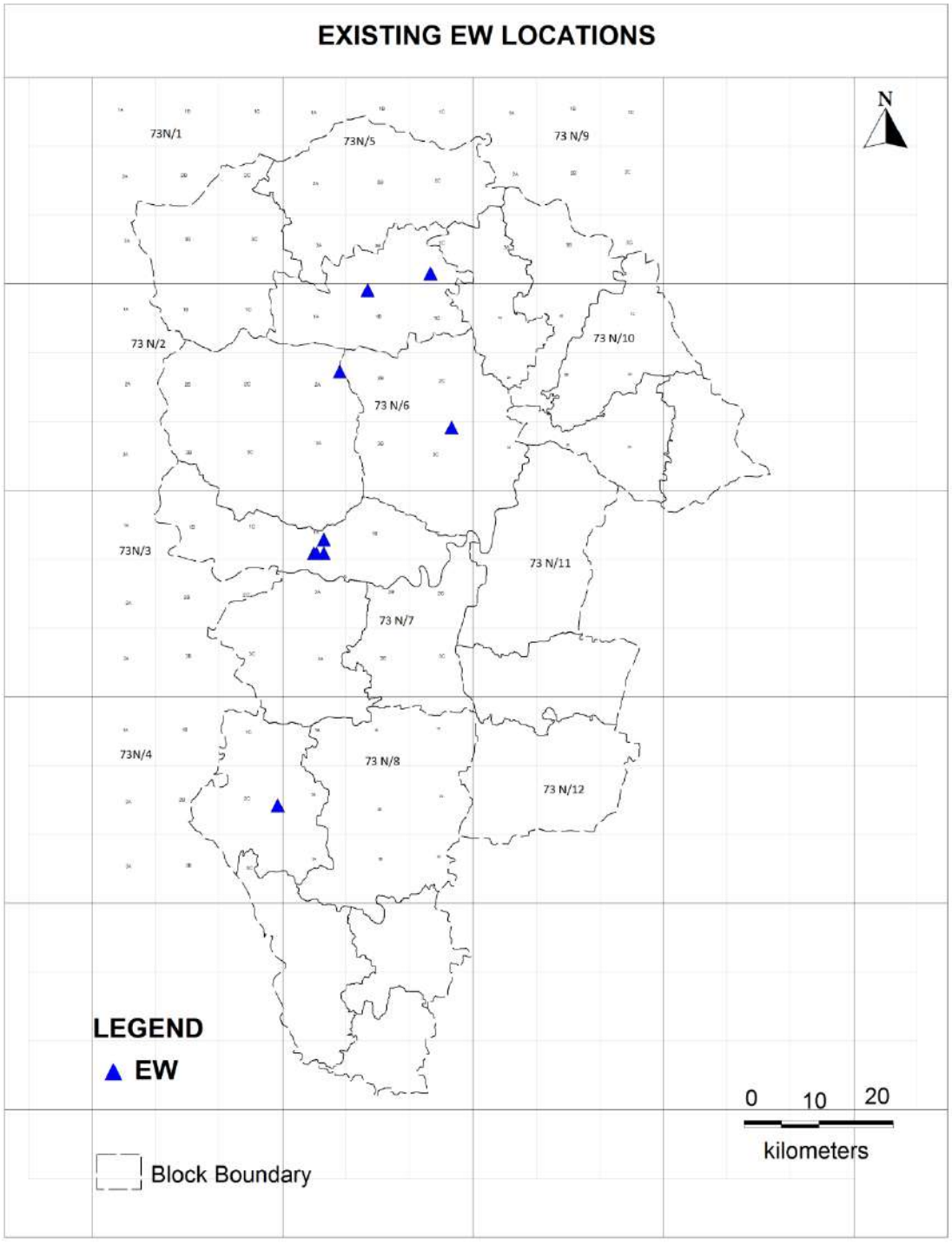


Fig 12.1. Map showing existing location of Exploratory Wells

Table 12.1. Table suggesting additionalExploratory wells and their depths for the study area

Toposheet No.	Quadrant	No. of Additional EW/OW required	Depth of Drilling (Meters)
73 N/1	3C	1 EW	300
73 N/2	1C	1 EW	300
	2B	2EW,	
		2OW	300
		1WELL FIELD	
	3C	1 EW	300
73 N/3	1C	1 EW	300
	3C	1 EW	300
73 N/4	1C	1 EW	300
	2B	2EW,	
		2OW	300
		1WELL FIELD	
	3C	1 EW	300
73 N/5	1C	1 EW	300
	2B	2EW,	
		2OW	300
		1WELL FIELD	
	3A	1 EW	300
	3C	1 EW	300
73 N/6	1A	1 EW	
	1C	1 EW	
	2B	2EW,	
		2OW	
		1WELL FIELD	300
	3A	1 EW	300
73 N/7	1C	1 EW	300
	2B	2EW,	
		2OW	300
		1WELL FIELD	
	3A	1 EW	300
	3C	1 EW	300
73 N/8	1A	1 EW	300
	3A	1 EW	300
73 N/9	3A	1 EW	300
	3C	1EW	300
73 N/10	1A	1 EW	300
	2B	2EW,	
		2OW	300
		1WELL FIELD	
	3A	1 EW	300

12.2. Data Gap for Groundwater Monitoring stations (Key wells)

Monitoring wells in terms of key wells were plotted for data gap analysis. The NHS monitoring wells of CGWB) has been for the study. It has been found that an extra of 86 wells tapping Aquifer-I, 29 wells tapping Aquifer-II are required for future monitoring.

Map showing existing location of NHNS Wells is given in **Figure 12.2.**

Number of Additional Key wells required Aquifer wise is given in **Table 12.2.**

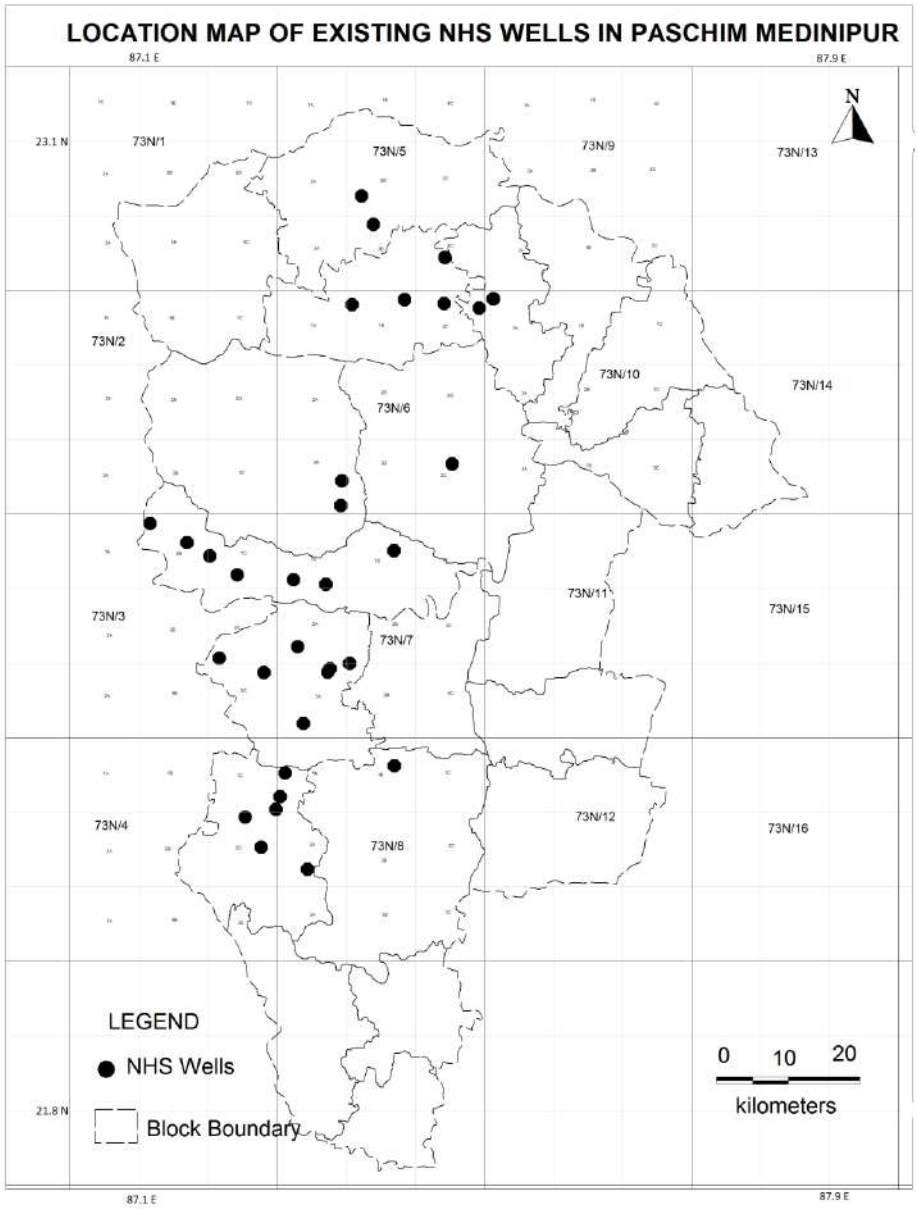


Fig 12.2. Map showing existing location of NHNS Wells

Table 12.2 Number of Additional Key wells required Aquifer wise

Toposheet No.	Quadrant	Number of Additional Key wells required Aquifer wise
73 N/1	2C	Aquifer I: 2, Aquifer II: 0, Aquifer III: 0
	3B	Aquifer I: 2, Aquifer II:0, Aquifer III: 0
	3C	Aquifer I: 2, Aquifer II: 1, Aquifer III: 0 0
73 N/2	1B	Aquifer I: 2, Aquifer II: 0, Aquifer III: 0
	1C	Aquifer I: 2, Aquifer II: 1, Aquifer III: 0
	2B	Aquifer I: 2, Aquifer II: 1, Aquifer III: 0
	2C	Aquifer I: 2, Aquifer II: 0, Aquifer III: 0
	3B	Aquifer I: 2, Aquifer II: 0, Aquifer III: 0
	3C	Aquifer I: 2, Aquifer II: 1, Aquifer III: 0
73 N/3	1B	Aquifer I: 1, Aquifer II: 0, Aquifer III: 0
	1C	Aquifer I: 1, Aquifer II: 1, Aquifer III: 0
	2C	Aquifer I: 1, Aquifer II: 1, Aquifer III: 0
	3C	Aquifer I: 1, Aquifer II: 1, Aquifer III: 0
73 N/4	1C	Aquifer I: 2, Aquifer II: 1, Aquifer III: 0
	2C	Aquifer I: 1, Aquifer II:0, Aquifer III: 0
	3C	Aquifer I: 2, Aquifer II:1, Aquifer III: 0
73 N/5	1B	Aquifer I: 1, Aquifer II:0, Aquifer III: 0
	2A	Aquifer I: 2, Aquifer II:0, Aquifer III: 0
	2B	Aquifer I: 1, Aquifer II: 1, Aquifer III: 0
	2C	Aquifer I: 2, Aquifer II:0, Aquifer III: 0
	3A	Aquifer I: 2, Aquifer II: 1, Aquifer III: 0
	3B	Aquifer I: 1, Aquifer II:0, Aquifer III: 0
	3C	Aquifer I: 1, Aquifer II: 1, Aquifer III: 0
73 N/6	1A	Aquifer I: 2, Aquifer II: 1, Aquifer III: 0
	1B	Aquifer I: 1, Aquifer II: 0, Aquifer III: 0
	1C	Aquifer I: 1, Aquifer II: 1, Aquifer III: 0
	2A	Aquifer I: 2, Aquifer II: 0, Aquifer III: 0
	2B	Aquifer I: 2, Aquifer II: 1, Aquifer III: 0
	2C	Aquifer I: 2, Aquifer II: 0, Aquifer III: 0
	3A	Aquifer I:1, Aquifer II: 1, Aquifer III: 0
	3B	Aquifer I: 2, Aquifer II: 0, Aquifer III: 0
	3C	Aquifer I: 1, Aquifer II: 1, Aquifer III: 0
73 N/7	1A	Aquifer I: 0, Aquifer II: 1, Aquifer III: 0
	1B	Aquifer I: 1, Aquifer II: 0, Aquifer III: 0
	1C	Aquifer I: 2, Aquifer II: 1, Aquifer III: 0
	2A	Aquifer I: 1, Aquifer II: 0, Aquifer III: 0
	2B	Aquifer I: 2, Aquifer II: 1, Aquifer III: 0
	2C	Aquifer I: 2, Aquifer II: 0, Aquifer III: 0

	3A	Aquifer I: 1, Aquifer II: 1, Aquifer III: 0
	3B	Aquifer I: 2, Aquifer II: 0, Aquifer III: 0
	3C	Aquifer I: 2, Aquifer II: 1, Aquifer III: 0
73 N/8	1A	Aquifer I: 2, Aquifer II: 1, Aquifer III: 0
	2A	Aquifer I: 2, Aquifer II: 0, Aquifer III: 0
	3A	Aquifer I: 2, Aquifer II: 1, Aquifer III: 0
73 N/9	2A	Aquifer I: 2, Aquifer II: 0, Aquifer III: 0
	3A	Aquifer I: 2, Aquifer II: 1, Aquifer III: 0
	3B	Aquifer I: 2, Aquifer II: 0, Aquifer III: 0
	3C	Aquifer I: 2, Aquifer II: 1, Aquifer III: 0
73 N/10	1A	Aquifer I: 1, Aquifer II: 1, Aquifer III: 0
	1B	Aquifer I: 2, Aquifer II: 0, Aquifer III: 0
	2A	Aquifer I: 2, Aquifer II: 0, Aquifer III: 0
	2B	Aquifer I: 2, Aquifer II: 1, Aquifer III: 0
	3A	Aquifer I: 2, Aquifer II: 1, Aquifer III: 0

12.3. Data Gap for Geophysical studies (VES)

A total of 159 VES are suggested to carry out in the study area.

Existing VES locations in the study area are given in **Figure 12.3.**

The detail of numbers of VES required is explained quadrant wise in the following **Table 12.3** below.

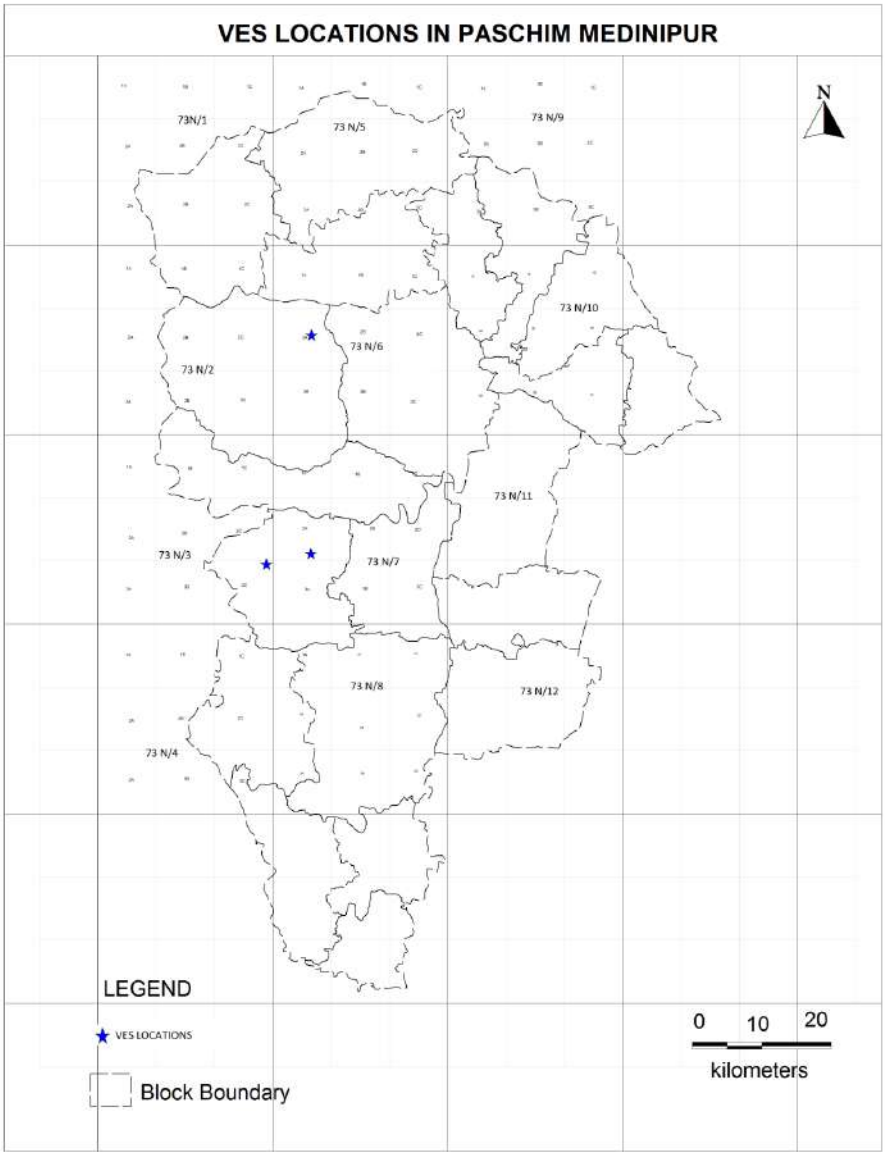


Figure 12.3 VES Locations in the study area

Table 12.3 Number of Additional VES required in the study area

Toposheet No.	Quadrant	No. of VES required within the quadrant
73 N/1	2C	3
	3B	3
	3C	3
73 N/2	1B	3
	1C	3
	2B	3
	2C	3
	3B	3
	3C	3
73 N/3	1B	3
	1C	3
	2C	3
	3C	2
73 N/4	1C	3
	2C	3
	3C	3
73 N/5	1B	3
	2A	3
	2B	3
	2C	3
	3A	3
	3B	3
	3C	3
73 N/6	1A	3
	1B	3
	1C	3
	2A	2
	2B	3
	2C	3
	3A	3
	3B	3
	3C	3
73 N/7	1A	3
	1B	3
	1C	3
	2A	2
	2B	3
	2C	3
	3A	3
	3B	3
	3C	3
73 N/8	1A	3
	2A	3

	3A	3
73 N/9	2A	3
	3A	3
	3B	3
	3C	3
73 N/10	1A	3
	1B	3
	2A	3
	2B	3
	3A	3
	3B	3

12.3. Data Gap for Groundwater Quality Data

Groundwater Chemical Quality data from a totalnumber of 48 Dugwells, 23 Tubewells are suggested to carry out in the study area.

The existing chemical quality data plots are given in **Figure 12.4.**

The detail of numbers of VES required is explained quadrant wise in the following **Table 12.4**below.

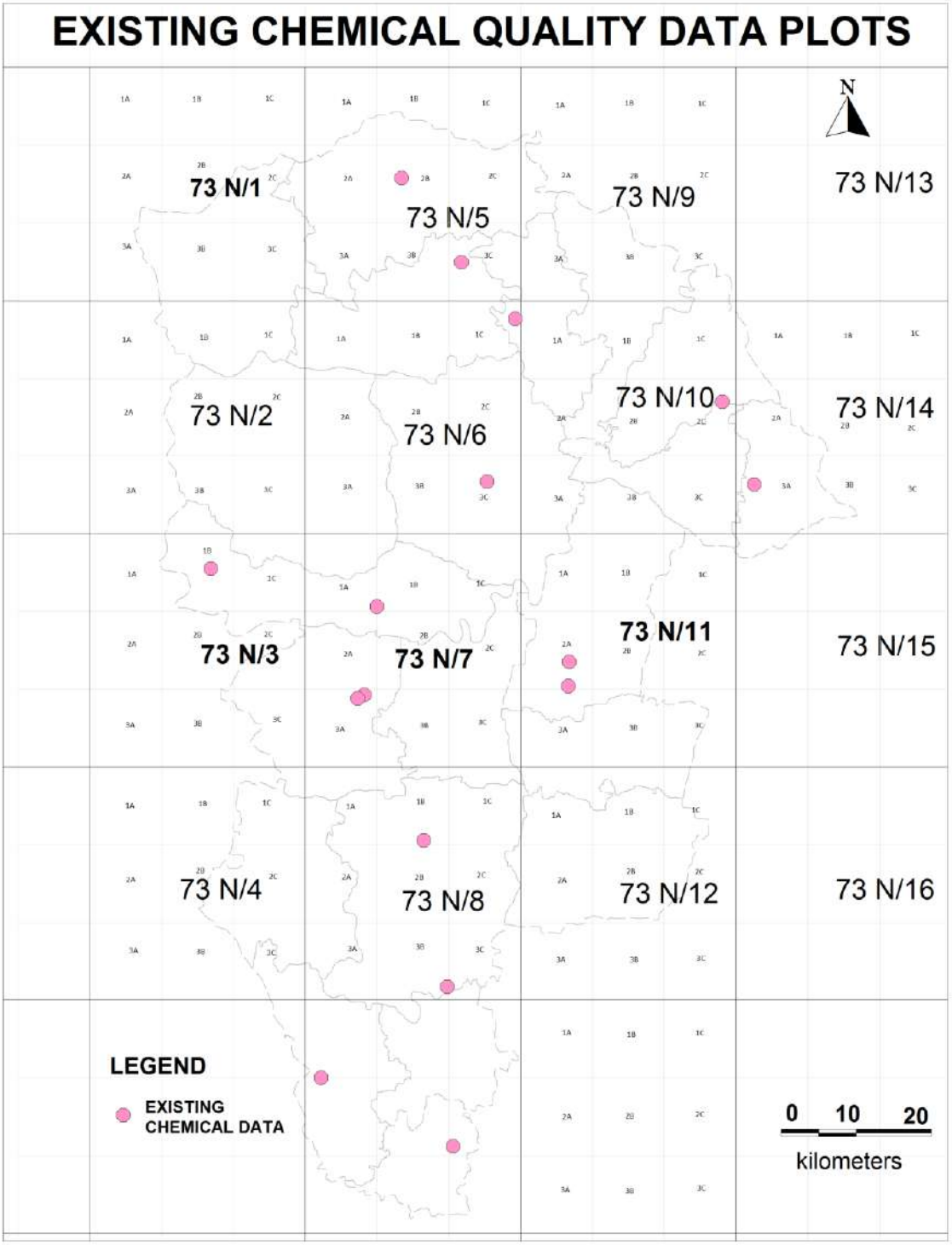


Figure. 12.4 Existing Chemical Data Diagram

Table 12.4 Number of Additional wells for Water Quality Data required in the study area

Toposheet No.	Quadrant	Number of Additional Quality Data required Aquifer wise
73 N/1	2C	Aquifer I: 1, Aquifer II: 0, Aquifer III: 0
	3B	Aquifer I: 1, Aquifer II:0, Aquifer III: 0
	3C	Aquifer I: 1, Aquifer II: 1, Aquifer III: 0 0
73 N/2	1B	Aquifer I: 1, Aquifer II: 0, Aquifer III: 0
	1C	Aquifer I: 1, Aquifer II: 1, Aquifer III: 0
	2B	Aquifer I: 1, Aquifer II: 1, Aquifer III: 0
	2C	Aquifer I: 1, Aquifer II: 0, Aquifer III: 0
	3B	Aquifer I: 1, Aquifer II: 0, Aquifer III: 0
	3C	Aquifer I: 1, Aquifer II: 1, Aquifer III: 0
73 N/3	1B	Aquifer I: 1, Aquifer II: 0, Aquifer III: 0
	1C	Aquifer I: 1, Aquifer II: 1, Aquifer III: 0
	3C	Aquifer I: 1, Aquifer II: 1, Aquifer III: 0
73 N/4	1C	Aquifer I: 1, Aquifer II: 1, Aquifer III: 0
	2C	Aquifer I: 1, Aquifer II:0, Aquifer III: 0
	3C	Aquifer I: 1, Aquifer II:1, Aquifer III: 0
73 N/5	1B	Aquifer I: 1, Aquifer II:0, Aquifer III: 0
	2A	Aquifer I: 1, Aquifer II:0, Aquifer III: 0
	2B	Aquifer I: 1, Aquifer II: 0, Aquifer III: 0
	2C	Aquifer I: 1, Aquifer II:0, Aquifer III: 0
	3A	Aquifer I: 1, Aquifer II: 1, Aquifer III: 0
	3B	Aquifer I: 1, Aquifer II:0, Aquifer III: 0
	3C	Aquifer I: 0, Aquifer II: 1, Aquifer III: 0
73 N/6	1A	Aquifer I: 1, Aquifer II: 1, Aquifer III: 0
	1B	Aquifer I: 1, Aquifer II: 0, Aquifer III: 0
	1C	Aquifer I: 0, Aquifer II: 1, Aquifer III: 0
	2A	Aquifer I: 1, Aquifer II: 0, Aquifer III: 0
	2B	Aquifer I: 1, Aquifer II: 1, Aquifer III: 0
	2C	Aquifer I: 1, Aquifer II: 0, Aquifer III: 0
	3A	Aquifer I:1, Aquifer II: 1, Aquifer III: 0
	3B	Aquifer I: 1, Aquifer II: 0, Aquifer III: 0
73 N/7	1A	Aquifer I: 1, Aquifer II: 1, Aquifer III: 0
	1B	Aquifer I: 1, Aquifer II: 0, Aquifer III: 0
	1C	Aquifer I: 1, Aquifer II: 1, Aquifer III: 0
	2A	Aquifer I: 1, Aquifer II: 0, Aquifer III: 0
	2B	Aquifer I: 1, Aquifer II: 1, Aquifer III: 0
	2C	Aquifer I: 1, Aquifer II: 0, Aquifer III: 0
	3A	Aquifer I: 0, Aquifer II: 1, Aquifer III: 0

	3B	Aquifer I: 1, Aquifer II: 0, Aquifer III: 0
	3C	Aquifer I: 1, Aquifer II: 1, Aquifer III: 0
73 N/8	1A	Aquifer I: 1, Aquifer II: 0, Aquifer III: 0
	2A	Aquifer I: 1, Aquifer II: 0, Aquifer III: 0
	3A	Aquifer I: 1, Aquifer II: 0, Aquifer III: 0
73 N/9	2A	Aquifer I: 1, Aquifer II: 0, Aquifer III: 0
	3A	Aquifer I: 1, Aquifer II: 1, Aquifer III: 0
	3B	Aquifer I: 1, Aquifer II: 0, Aquifer III: 0
	3C	Aquifer I: 1, Aquifer II: 1, Aquifer III: 0
73 N/10	1A	Aquifer I: 1, Aquifer II: 1, Aquifer III: 0
	1B	Aquifer I: 1, Aquifer II: 0, Aquifer III: 0
	2A	Aquifer I: 1, Aquifer II: 0, Aquifer III: 0
	2B	Aquifer I: 1, Aquifer II: 1, Aquifer III: 0
	3A	Aquifer I: 1, Aquifer II: 0, Aquifer III: 0

ANNEXURES

Annexure-I

Interpreted Results of VES curves at New Note Press Area, Salboni

APPENDIX - V

INTERPRETED RESULTS OF VES-CURVES AT NEW NOTE PRESS PROJECT AREA, SALBONI, MEDINIPUR DISTRICT, WEST BENGAL

VES No.	Resistivity of Individual Layer (ohm-m)					Thickness of Individual Layer (m)			
	ρ1	ρ2	ρ3	ρ4	ρ5	h1	h2	h3	h4
1	96	48	116	18	-	1.5	3.0	5.6	-
2	65	42	100	13	-	1.5	2.6	15.2	-
3	340	136	450	128	16	1.1	1.93	5.1	10.5
4	490	98	32	-	-	2.2	6.6	-	-
5	290	145	47	38	-	3.5	7.0	10	-
6	200	30	64	25	-	3.5	15.8	41.4	-
7	2400	360	53	21	-	1.1	4.62	56.1	-
8	380	57	78	47	-	3.1	15.8	21.0	-
9	230	46	19	53	14	2.45	10.3	72	27.5
10	11	37	19	44	12	2.4	12	74	52.8
11	1600	160	136	39	-	2.2	9.24	35.2	-
12	1048	73	30	-	-	4.5	18.5	-	-
13	460	92	28	-	-	2.2	6.6	-	-
14	28	14	119	22	-	1.3	2.21	6.65	-
15	101	40	106	36	-	1.0	2.6	9.0	-

Annexure-II

Interpreted Results of VES data of Income Tax Quarter premises, Medinipur, Medinipur District, West Bengal

APPENDIX VII

VES No.	Resistivity value of individual layer (ohm-m)					Thickness of Individual layer (m)				Ground water bearing potential
	e1	e2	e3	e4	e5	h1	h2	h3	h4	
1	Not Interpretable									
2	490	74.0	23.0	60.0	-	3.0	48.0	70.0	-	3-51 mbgl below 121 mbgl.
3	400	60.0	20.0	56.0	-	3.2	35.2	64.6	-	3.2-38.4 mbgl below 103 mbgl.
4	350	70.0	22.0	52.0	-	4.5	31.5	96.0	-	4.5-36 mbgl and below 132 mbgl.
5	Not Interpretable									
6	1250	125.0	56.0	19.0	45	2.1	16.8	40.7	58.3	2.1-59.6 mbgl and below 118 mbgl.

Annexure-III

Water Level data of Key-wells (Shallow Aquifers) established in Paschim Midnapore (Pre-monsoon, June 2022)

Location	Latitude	Longitude	Altitude (m)	DTWL (mbgl)	GWT(m)
Jagannathpur DW	22.58136	87.45567	20.7	2.79	17.91
Daumabari DW	22.7362	87.54098	31.1	2.44	28.66
Kashijora DW	22.28764	87.33514	36.7	1.76	34.94
Saibandh DW	22.21709	87.19545	51.3	3.6	47.7
Kiarchandra DW	22.17112	87.17459	43.3	1.5	41.8
Jharia DW	22.14122	87.21982	45.5	1.83	43.67
Dainbari DW	22.07249	87.18246	32.7	2.5	30.2
Harinakhuri DW	22.19096	87.28564	35	2.82	32.18
Bhadutala DW	22.48493	87.32658	46.1	3.61	42.49
Benucha DW	22.52468	87.30036	45.4	3.44	41.96
Tilakhula DW	22.64413	87.31774	43.5	5.64	37.86
Pathardaha DW	22.62831	87.26459	64	12.72	51.28
Borosijua DW	22.64945	87.18689	60.6	3.03	57.57
Pirakata DW	22.56051	87.18184	64.2	2.68	61.52
Mugardihi DW	22.51369	87.2491	54.6	4.83	49.77
Siyarboni DW	22.49469	87.10858	55.2	5.27	49.93
Goaltore DW	22.70566	87.16933	69.4	5.85	63.55
Maharajpur DW	22.68949	87.24326	61.5	5.61	55.89
Sundara sayedpur DW	22.58399	87.33179	39.1	1.87	37.23
Darkhola DW	22.69038	87.30033	49.9	5	44.9
Gohaldanga DW	22.75566	87.23541	76.2	3.68	72.52
Gotsol DW	22.80164	87.19011	77.1	5.6	71.5
Aulia DW	22.85955	87.1613	71.5	2.9	68.6
Kunarpur DW	22.81134	87.11851	75.5	2.51	72.99
Jara DW	22.52663	87.25044	54.1	5.78	48.32
Bagpichla DW	22.6081	87.23414	72.6	6.93	65.67
Kusumdahari DW	22.77236	87.29647	62.4	4.5	57.9
Keshia DW	22.80358	87.33696	63.8	5.26	58.54
Fatesinghpur DW	22.84642	87.30339	54	10.15	43.85
Balarampur DW	22.40954	87.41438	29.5	2.87	26.63
Deulbar DW	22.55001	87.37095	36	4.1	31.9
Moulapota DW	22.8638	87.42223	41.5	5.37	36.13
Chaukighata DW	22.50573	87.37145	37.4	3.68	33.72
Chattraganj DW	22.77769	87.51961	32.1	2.49	29.61
Gargarighati DW	22.80942	87.48828	35.1	1.94	33.16

Location	Latitude	Longitude	Altitude (m)	DTWL (mbgl)	GWT(m)
Jorakushmi DW	22.50686	87.27638	50.7	4.61	46.09
Bhangabandh DW	22.52037	87.19755	71.6	4.47	67.13
Golakchak DW	22.49183	87.18114	76.1	7.8	68.3
Srikrishnapur DW	22.53672	87.15816	91.4	10.18	81.22
Murakata DW	22.53328	87.16704	85.2	3.02	82.18
Kadmasole DW	22.55528	87.1407	81.6	4.44	77.16
Mushina DW	22.60333	87.14501	69	2.85	66.15
Birbhanpur DW	22.65058	87.11256	87.7	9.17	78.53
Sandhipur DW	22.85087	87.50739	38.9	2.17	36.73
Nischintapur DW	22.89544	87.50914	55.5	2.64	52.86
Pachadahara DW	22.92182	87.38984	53.7	5.54	48.16
Ramjibanpur DW	22.82914	87.60198	32.9	2.5	30.4
Rangamatia DW	22.26683	87.31918	37.2	5.75	31.45
Ambasole DW	22.32256	87.26929	56.8	5.1	51.7

Annexure-IV

Water Level data of Key-wells (Deeper Aquifers) established in Paschim Midnapore (Pre-monsoon, June 2022)

Location	Latitude	Longitude	Altitude (m)	DTWL (mbgl)	GWT(m)
Mohbani TW	22.643448	87.47709	25.1	17	8.15
Uttar Baharat TW	22.680407	87.452486	32.5	16	16.71
Tathua Patna TW	22.679333	87.49229	25.5	13	12.12
Bhogoban Chak TW	22.624931	87.54145	16.1	13	3.35
Damodarpur TW	22.649762	87.564517	16.7	16	1.03
Kenchkapur TW	22.688153	87.575869	20.6	16	4.55
Bhabanipur TW	22.7264	87.584647	17.7	16	2
Jakpur TW	22.373191	87.393091	27.7	9	18.7
Paikara TW	22.402566	87.382665	29.4	10	19.05
Magaria TW	22.356246	87.434839	26.9	13	14.15
Goalara TW	22.338464	87.408697	28.1	10	18.1
Gangarampur TW	22.333382	87.368497	31.6	12	20.07
Sikharpari TW	22.257822	87.370924	38.7	21	17.45
Sakoalok TW	22.283573	87.41871	25.7	12	14.13
ChheruaTW	22.409123	87.379819	27.7	11	17.2
Malida TW	22.437872	87.426426	26.8	14	13
Chakla Mark ll	22.130237	87.195945	34.9	12	23.4
Kharipura TW	22.127507	87.162397	35.6	8	27.36
Gholardanga TW	22.137764	87.295091	32.9	10	22.5
Belar TW	22.076307	87.303405	31.3	16	14.93
Naraharimunda TW	22.065599	87.272731	28.2	14	13.97
Kharat TW	22.034805	87.278479	29.8	10	19.35
Dakshinadiha TW	22.043858	87.230525	27.8	9	18.34
Dangarpara TW	22.502216	87.349678	37.4	10	27.83
Karnagar Mark II	22.508446	87.355966	37.9	9	28.45
Birbhanpur TW	22.628161	87.321347	41.5	10	32
Mugardihi TW	22.513634	87.249529	54.7	7	48.16
Manidaha Mark II	22.407797	87.184755	42.9	9	33.79
Bakshibandh TW	22.5253	87.109781	81.3	22	59.5
Gotshingla TW	22.724227	87.217039	66.7	20	46.25
Nalbona TW	22.744467	87.27606	64.5	25	39.15
Kantore TW	22.8858	87.186808	52.9	6	47.25
Patharberia TW	22.836512	87.245534	46.4	11	35.47
Saltora TW	22.807698	87.169608	82.4	6	76.3
Gachh Gerya TW	22.4678	87.4864	18.9	12	6.7
Gopalchowk Mark II	22.502134	87.466223	18.7	12	6.35

Location	Latitude	Longitude	Altitude (m)	DTWL (mbgl)	GWT(m)
Dhamshai TW	22.506591	87.515443	18.8	11	7.7
Kanakhali Mark II	22.585507	87.545206	13.4	9	4.1
Kanchantala TW	22.532799	87.567324	17.9	14	4.02
Bagargerya Asti TW	22.454406	87.459173	21.3	12	9.5
Mirga TW	22.642959	87.28508	56.6	15	41.35
Kusumdahari TW	22.772023	87.296995	62.6	8	54.25
Sholdiha TW	22.632638	87.406475	35.6	19	16.5
Tatarpur TW	22.607024	87.438666	27.1	15	11.8
Dingal TW	22.649434	87.597225	18.7	13	5.22
Bashberia nonadanga TW	22.74022	87.662319	17.4	20	2.8
Narayanpur TW	22.785774	87.578322	28	14	14
Fatehganj Bankati TW	22.691299	87.48285	33.5	17	16.73
Chattraganj Basanchera TW	22.77827	87.52128	32.9	6	27.2
Keshedal TW	22.810145	87.519852	29.2	8	21.6
Chandabila TW	22.84349	87.452765	46.6	22	24.8
Godamouli TW	22.475345	87.272555	56.5	13	43.88
Dakshinsol TW	22.54152	87.212976	63.9	8	56.15
Golakchak TW	22.49246	87.180668	72.2	8	64.7
Mushina TW	22.604753	87.141091	73.5	6	68
Raikhan TW	22.85687	87.529708	46.8	22	24.55
Sandhipur TW	22.850615	87.509079	38.1	17	21.48
Mohanpur TW	22.894808	87.471153	46.1	11	35.08
Namjaba TW	22.898782	87.431807	42.9	14	29.3
Gilabani TW	22.916274	87.310239	62.9	8	54.75
Maita TW	22.870674	87.276428	50.8	14	36.9
Bagchari TW	22.83977	87.562912	35.7	20	15.41
Harinarayanpur TW	22.804486	87.627838	20.2	9	11.17
Satitetul TW	22.765055	87.672004	16.7	17	0.15
Kuapur TW	22.692637	87.511318	23.8	10	13.8
Saguna TW	22.243116	87.49981	19	12	7.3
Manikpur TW	22.266612	87.439121	23	11	12.5
Changual TW	22.309389	87.381156	30.2	14	15.86
Paniseuli TW	22.307134	87.475287	20.9	13	8.4
Konkasol TW	22.3335252	87.45687	22.6	13	9.8
Kanikha TW	22.376004	87.476564	22.6	17	5.95
Hajichak TW	22.38019	87.341992	29.6	10	19.5
Hosnabad TW	22.411314	87.341595	31.7	9	22.81

Annexure-V

Water Level data of Key-wells (Shallow Aquifers) established in Paschim Midnapore (Post-monsoon, November 2022)

Location	Latitude	Longitude	Altitude (m)	DTWL (mbgl)	GWT(m)
Jagannathpur DW	22.58136	87.45567	20.7	3.80	16.9
Daumabari DW	22.7362	87.54098	31.1	1.82	29.28
Kashijora DW	22.28764	87.33514	36.7	1.38	35.32
Saibandh DW	22.21709	87.19545	51.3	1.37	49.93
Kiarchandra DW	22.17112	87.17459	43.3	1.23	42.07
Jharia DW	22.14122	87.21982	45.5	1.48	44.02
Dainbari DW	22.07249	87.18246	32.7	1.87	30.83
Harinakhuri DW	22.19096	87.28564	35	1.50	33.5
Bhadutala DW	22.48493	87.32658	46.1	4.32	41.78
Benucha DW	22.52468	87.30036	45.4	6.15	39.25
Tilakhula DW	22.64413	87.31774	43.5	5.21	38.29
Pathardaha DW	22.62831	87.26459	64	11.28	52.72
Borosijua DW	22.64945	87.18689	60.6	2.93	57.67
Pirakata DW	22.56051	87.18184	64.2	2.43	61.77
Mugardihi DW	22.51369	87.2491	54.6	4.15	50.45
Siyarboni DW	22.49469	87.10858	55.2	4.79	50.41
Goaltore DW	22.70566	87.16933	69.4	5.24	64.16
Maharajpur DW	22.68949	87.24326	61.5	5.15	56.35
Sundara sayedpur DW	22.58399	87.33179	39.1	1.25	37.85
Darkhola DW	22.69038	87.30033	49.9	4.13	45.77
Gohaldanga DW	22.75566	87.23541	76.2	2.80	73.4
Gotsol DW	22.80164	87.19011	77.1	4.36	72.74
Aulia DW	22.85955	87.1613	71.5	2.13	69.37
Kunarpur DW	22.81134	87.11851	75.5	1.68	73.82
Jara DW	22.52663	87.25044	54.1	4.13	49.97
Bagpichla DW	22.6081	87.23414	72.6	5.78	66.82
Kusumdahari DW	22.77236	87.29647	62.4	3.78	58.62
Keshia DW	22.80358	87.33696	63.8	4.35	59.45
Fatesinghpur DW	22.84642	87.30339	54	9.48	44.52
Balarampur DW	22.40954	87.41438	29.5	1.79	27.71
Deulbar DW	22.55001	87.37095	36	2.95	33.05
Moulapota DW	22.8638	87.42223	41.5	4.57	36.93
Chaukighata DW	22.50573	87.37145	37.4	2.87	34.53
Chattraganj DW	22.77769	87.51961	32.1	1.78	30.32
Gargarighati DW	22.80942	87.48828	35.1	1.38	33.72
Jorakushmi DW	22.50686	87.27638	50.7	3.79	46.91
Bhangabandh DW	22.52037	87.19755	71.6	3.89	67.71

Location	Latitude	Longitude	Altitude (m)	DTWL (mbgl)	GWT(m)
Golakchak DW	22.49183	87.18114	76.1	6.72	69.38
Srikrishnapur DW	22.53672	87.15816	91.4	9.87	81.53
Murakata DW	22.53328	87.16704	85.2	2.43	82.77
Kadmasole DW	22.55528	87.1407	81.6	3.79	77.81
Mushina DW	22.60333	87.14501	69	2.14	66.86
Birbhanpur DW	22.65058	87.11256	87.7	8.48	79.22
Sandhipur DW	22.85087	87.50739	38.9	1..48	37.42
Nischintapur DW	22.89544	87.50914	55.5	1.82	53.68
Pachadahara DW	22.92182	87.38984	53.7	4.85	48.85
Ramjibanpur DW	22.82914	87.60198	32.9	1.78	31.12
Rangamatia DW	22.26683	87.31918	37.2	5.12	32.08
Ambasole DW	22.32256	87.26929	56.8	4.25	52.55

Annexure-VI

Water Level data of Key-wells (Deeper Aquifers) established in Paschim Midnapore (Post-monsoon, November 2022)

Location	Latitude	Longitude	Altitude (m)	DTWL (mbgl)	GWT(m)
Mohbani TW	22.643448	87.47709	25.1	15.95	9.15
Uttar Baharat TW	22.680407	87.452486	32.5	15.12	17.38
Tathua Patna TW	22.679333	87.49229	25.5	11.24	14.26
Bhogoban Chak TW	22.624931	87.54145	16.1	11.53	4.57
Damodarpur TW	22.649762	87.564517	16.7	14.57	2.13
Kenchkapur TW	22.688153	87.575869	20.6	14.16	6.44
Bhabanipur TW	22.7264	87.584647	17.7	13.98	3.72
Jakpur TW	22.373191	87.393091	27.7	7.58	20.12
Paikara TW	22.402566	87.382665	29.4	8.19	21.21
Magaria TW	22.356246	87.434839	26.9	11.92	14.98
Goalara TW	22.338464	87.408697	28.1	8.76	19.34
Gangarampur TW	22.333382	87.368497	31.6	10.87	20.73
Sikharpari TW	22.257822	87.370924	38.7	18.58	20.12
Sakoalok TW	22.283573	87.41871	25.7	10.65	15.05
ChheruaTW	22.409123	87.379819	27.7	10.11	17.59
Malida TW	22.437872	87.426426	26.8	12.8	14
Chakla Mark ll	22.130237	87.195945	34.9	10.89	24.01
Kharipura TW	22.127507	87.162397	35.6	6.89	28.71
Gholardanga TW	22.137764	87.295091	32.9	8.75	24.15
Belar TW	22.076307	87.303405	31.3	14.85	16.45
Naraharimunda TW	22.065599	87.272731	28.2	12.97	15.23
Kharat TW	22.034805	87.278479	29.8	8.67	21.13
Dakshinadiha TW	22.043858	87.230525	27.8	7.95	19.85
Dangarpara TW	22.502216	87.349678	37.4	8.89	28.51
Karnagar Mark II	22.508446	87.355966	37.9	7.86	30.04
Birbhanpur TW	22.628161	87.321347	41.5	8.53	32.97
Mugardihi TW	22.513634	87.249529	54.7	5.76	48.94
Manidaha Mark II	22.407797	87.184755	42.9	7.39	35.51
Bakshibandh TW	22.5253	87.109781	81.3	21.69	59.61
Gotshingla TW	22.724227	87.217039	66.7	18.38	48.32
Nalbona TW	22.744467	87.27606	64.5	24.15	40.35
Kantore TW	22.8858	87.186808	52.9	4.92	47.98
Patharberia TW	22.836512	87.245534	46.4	9.16	37.24
Saltora TW	22.807698	87.169608	82.4	4.79	77.61
Gachh Gerya TW	22.4678	87.4864	18.9	10.79	8.11
Gopalchowk Mark II	22.502134	87.466223	18.7	10.58	8.12

Location	Latitude	Longitude	Altitude (m)	DTWL (mbgl)	GWT(m)
Dhamshai TW	22.506591	87.515443	18.8	10.11	8.69
Kanakhali Mark II	22.585507	87.545206	13.4	7.97	5.43
Kanchantala TW	22.532799	87.567324	17.9	12.86	5.04
Bagargerya Asti TW	22.454406	87.459173	21.3	10.78	10.52
Mirga TW	22.642959	87.28508	56.6	13.88	42.72
Kusumdahari TW	22.772023	87.296995	62.6	6.98	55.62
Sholdiha TW	22.632638	87.406475	35.6	17.75	17.85
Tatarpur TW	22.607024	87.438666	27.1	14.23	12.87
Dingal TW	22.649434	87.597225	18.7	11.80	6.9
Bashberia nonadanga TW	22.74022	87.662319	17.4	18.29	0.89
Narayanpur TW	22.785774	87.578322	28	12.87	15.13
Fatehganj Bankati TW	22.691299	87.48285	33.5	15.76	17.74
Chattraganj Basanchera TW	22.77827	87.52128	32.9	4.68	28.22
Keshedal TW	22.810145	87.519852	29.2	6.79	22.41
Chandabila TW	22.84349	87.452765	46.6	20.48	26.12
Godamouli TW	22.475345	87.272555	56.5	11.76	44.74
Dakshinsol TW	22.54152	87.212976	63.9	6.91	56.99
Golakchak TW	22.49246	87.180668	72.2	6.49	65.71
Mushina TW	22.604753	87.141091	73.5	5.11	68.39
Raikhan TW	22.85687	87.529708	46.8	21.14	25.66
Sandhipur TW	22.850615	87.509079	38.1	15.98	22.12
Mohanpur TW	22.894808	87.471153	46.1	9.68	36.42
Namjaba TW	22.898782	87.431807	42.9	12.9	30
Gilabani TW	22.916274	87.310239	62.9	6.79	56.11
Maita TW	22.870674	87.276428	50.8	13.11	37.69
Bagchari TW	22.83977	87.562912	35.7	18.19	17.51
Harinarayanpur TW	22.804486	87.627838	20.2	7.6	12.6
Satitetul TW	22.765055	87.672004	16.7	15.94	0.76
Kuapur TW	22.692637	87.511318	23.8	8.49	15.31
Saguna TW	22.243116	87.49981	19	11.17	7.83
Manikpur TW	22.266612	87.439121	23	9.18	13.82
Changual TW	22.309389	87.381156	30.2	12.69	17.51
Paniseuli TW	22.307134	87.475287	20.9	11.98	8.92
Konkasol TW	22.3335252	87.45687	22.6	12.08	10.52
Kanikha TW	22.376004	87.476564	22.6	16.09	6.51
Hajichak TW	22.38019	87.341992	29.6	8.9	20.7
Hosnabad TW	22.411314	87.341595	31.7	7.96	23.74

Annexure-VII

Rural and Urban Water Supply Schemes in NAQUIM 2022-23 area (PHED, Govt of W.B)

Block	Scheme Name	Census Population	Design Pop.	Total Household
Chandrakona-I	Ground WaterBased PipedWater SupplyScheme ForBhabanipur	4709	6467	1055
Chandrakona - I	Ground Water Based PipedWater SupplyScheme ForKasanda	2568	3212	558
Chandrakona–I, Chandrakona -II	Srinagar WaterSupply Scheme	17401	17401	4025
Garbeta - I	Amlagora Water Supply Scheme	20682	20682	4387
Garbeta - I	Daldali	1451	0	277
Garbeta - I	Garhbeta(Nm)	17492	0	3860
Garbeta - I	Ground Water Based Piped Water Supply Scheme For Sandhipur	3827	5078	835
Garbeta - I	Kastogora Water Supply Scheme	1603	1974	349
Garbeta - I	Kharkata Water Supply Scheme	1117	1974	229
Garbeta - I	Malara Piped Water Supply Scheme	2176	3151	455
Garbeta - II	Betijharia Water Supply Scheme	691	942	143
Garbeta - II	Chekuasole-Dhobasole Water Supply Scheme	1278	1573	263
Garbeta - II	Goaltore Water Supply Scheme	14604	14604	3130
Garbeta - II	Piped Water Supply Scheme For Chatra Mouza	507	862	108
Garbeta - II	Piped Water Supply Scheme For Hatimasan Mouza	888	1407	172
Garbeta - II	Piped Water Supply Scheme For Sutkujhuri Mouza	615	1058	124
Garbeta - II	Piped Water Supply Scheme For Ukhla Mouza	1230	1890	262
Garbeta - III	Chandrakona Road Rly Station Water Supply Scheme	39126	17691	8063
Garbeta - III	Ground Water Based Piped Water Supply Scheme For Raskundu & Adj. Mouzas.	4224	7002	886

Garbeta - III	Guaphela PatharkundaWater Supply Scheme	2891	1777	511
Garbeta - III	Narayanpur Nerakupa Water Supply Scheme	6521	1703	592
Garbeta-III, Keshiary, Midnapore, Salbani	32 Pwss & 69 Stand Alone Pwss System For Drought Like Situation Prone Blocks Of Paschim Medinipur District (MidTerm Plan Under Master Plan)	158265	0	35494
Keshiary	Keshiari Water Supply Scheme	16564	16564	3994
Keshpur	Anandapur Water Supply Scheme	11461	15408	2424
Keshpur	Dalang Piped Water Supply Scheme	4244	6022	797
Keshpur	Ground Based Piped Water Supply Scheme For Amrakuchi Mouza.	2598	3982	486
Keshpur	Ground Water Supply Based Piped Water Supply Scheme For Dhamsai	1861	2531	374
Keshpur	Keshpur Water Supply Scheme	16451	16451	3259
Keshpur	Mugbasan Piped Water Supply Scheme	8034	11515	1458
Kharagpur-I	Kalaikunda Mouza Water Supply Scheme	9344	9150	2058
Kharagpur-I	Paschim Pathri Water Supply Scheme	2855	0	665
Kharagpur-I	Rejuvenation-E. F.R. Salua Water Supply Scheme	4430	0	986
Kharagpur-I	Satkui Water Supply Scheme	6257	7414	1348
Kharagpur-II	BalarampurPiped WaterSupply Scheme	5416	7685	2685
Kharagpur-II	Ground WaterBased PipedWater SupplyScheme ForChakmakrampur & Adj. Mouzas	10070	14676	2656
Kharagpur-II	Ground Water Based Piped Water Supply Scheme For Chaupanya & Its Adj. Mouzas	8460	12378	1959
Kharagpur-II	Ground Water Based Piped Water Supply Scheme For Gokulpur & Its Adjoining Mouzas	7040	9592	1804
Kharagpur-II	Madpur WaterSupply Scheme	6827	9500	2028

Kharagpur-II	Warda Piped Water Supply Scheme	6867	10041	1711
Medinipur	Bajpara Piped Water Supply Scheme	6548	9385	1554
Medinipur	Bhabaninagar Piped Water Supply Scheme	9474	13579	2216
Medinipur	Ground Water Based Piped Water SupplyScheme For Biswasuk Sevashram Sangha & Its Adjoining Habitation	1004	600	205
Medinipur	Jagul Piped Water Supply Scheme	4566	6479	1109
Medinipur	Khairullachak Water Supply Scheme	8576	8968	1923
Medinipur	Piped Water Supply Scheme For Abasgarh Mouza	3324	4000	764
Medinipur	Piped Water Supply Scheme For Maliara & Its Adj. Mouzas	4363	6048	959
Medinipur	Piped Water Supply Scheme For Nayagram & Its Adj. Mouzas	5547	8199	1181
Medinipur	Piped Water Supply Scheme For Pathra Mouza	1678	4676	701
Medinipur	Sub-Surface Water Based Piped Water Supply Scheme For Dherua & Its Adjoining Mouzas	32701	51560	6837
Salboni	Bhimpur W/S Scheme	1862	2900	418
Salboni	Chaita Piped Water Supply Scheme	3520	4995	713
Salboni	Ground Water Based Piped Water Supply Scheme For Jambani	1349	1892	274
Salboni	Ground Water Based Piped Water Supply Scheme For Kalaberya Bhadutala & Its Adj. Mouzas.	6094	7733	1261
Salboni	Ground Water Based Piped Water Supply Scheme For Tilabani & Its Adjoining Mouzas	3305	5084	694
Salboni	Kashijora Piped Water Supply Scheme	4484	6362	910
Salboni	Piped Water Supply Scheme For Dhengasole Mouza	1175	1974	222
Salboni	Piped Water Supply Scheme For Jamdoba And Godamauli Mouza	518	869	103
Salboni	Piped Water Supply Scheme For Jatra	875	2925	337

	& Banshiroysol Mouza			
Salboni	Piped Water Supply Scheme For Kalaimuri Mouza	1096	1746	226
Salboni	Piped Water Supply Scheme For Kalshibhanga Mouza	280	382	57
Salboni	Piped Water Supply Scheme For Keudi Mouza	194	385	41
Salboni	Piped Water Supply Scheme For Sitanathpur Mouza	362	558	79
Salboni	Pirakata W/S Scheme	4178	5850	824
Salboni	Salboni Water Supply Scheme	12294	12294	2621

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