केन्द्रीय भूमि जल बोर्ड

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भारत सरकार

Central Ground Water Board

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

AQUIFER MAPPING AND MANAGEMENT OF GROUND WATER RESOURCES

Kaimur District
Bihar

मध्य पूर्वी क्षेत्र, पटना
Mid Eastern Region,Patna

AQUIFER MAPPING REPORT ON KAIMUR DISTRICT

(AAP 2018-19)

CENTRAL GROUND WATER BOARD

MINISTRY OF JAL SHAKTI

MID-EASTERN REGION, PATNA

JUNE-2022

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(AAP 2018-19)

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CHAPTER 1

INTRODUCTION

1.0 INTRODUCTION

The vagaries of rainfall, inherent heterogeneity, over exploitation of once copious aquifers, lack of regulation mechanism etc 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. This leads to concept of Aquifer Mapping and Ground Water Management Plan. 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 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.

During XII five year plan (2012-17) National Aquifer Mapping (NAQUIM) study was initiated by CGWB to carry out detailed hydrogeological investigation. The Aquifer Mapping programme has been continued till 2023 to cover whole country. The present studies of Kaimur district, Bihar have been taken up in AAP 2018-19 as a part of NAQUIM Programme. The aquifer maps and management plans will be shared with the administration of Kaimur district and other user agencies for its effective implementation.

1.1 Objective and Scope of the Study:

The major objectives of aquifer mapping are

- Delineation of lateral and vertical disposition of aquifers and their characterization
- Quantification of ground water availability and assessment of its quality to formulate aquifer management plans to facilitate sustainable management of ground water resources at appropriate scales through participatory management approach with active involvement of stakeholders.

The groundwater management plan includes Ground Water recharge, conservation, harvesting, development options and other protocols of managing groundwater. These protocols will be the real derivatives of the aquifer mapping exercise and will find a place in the output i.e, the aquifer map and management plan.

The main activities under NAQUIM are as follows:

a). Identifying the aquifer geometry

b). Aquifer characteristics and their yield potential

c). Quality of water occurring at various depths

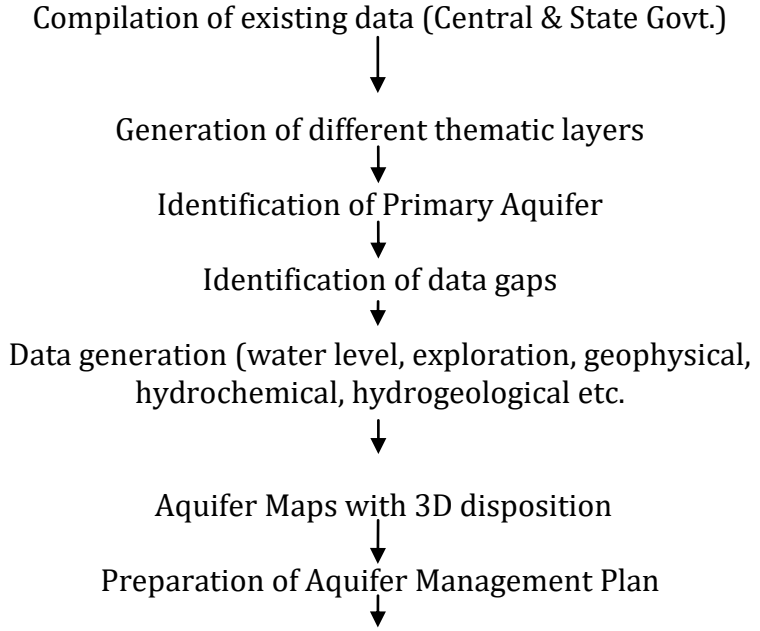
d). Aquifer wise assessment of ground water resources

e). Preparation of aquifer maps and
f). Formulate ground water management plan.
The demarcation of aquifers and their potential will help the agencies involved in water supply in ascertaining, how much volume of water is under their control. The robust and implementable ground water management plan will provide a "Road Map" to systematically manage the ground water resources for equitable distribution across the spectrum.

1.2 Approach and Methodology:

The on going activities of NAQUIM include hydrogeological data acquisition supported by geophysical and hydro-chemical investigations supplemented with ground water exploration down to the depths of 200 meters in hard rock and 300 m in soft rocks

Considering the objectives of the NAQUIM, the data on various components was segregated, collected and brought on GIS platform by geo-referencing the available information for its utilization for preparation of various thematic maps. The approach and methodology followed for Aquifer mapping is as given below:



1.3 Area Details

The study area forms part of South Bihar Alluvial Plain and bounded by 24.9 to 25.33 North latitudes and 83.33 to 83.66 East longitude. Kaimur district covers an area of 3362.06 Sq. Km and located in Western part of Bihar state bordering Uttar Pradesh. The district with it's headquarter at Bhab ua, is divided into 11 administrative blocks. It is bounded in the north by Buxar district, in the west by Varanasi district (U.P state) and in the south and east by Rohtas district. Total population of the district is 1626384 (Census 2011). Majority of population are in

rural areas (1560813) . The decadal variation of the district has been seen at 27.5 percent during the decade 2001-2011.

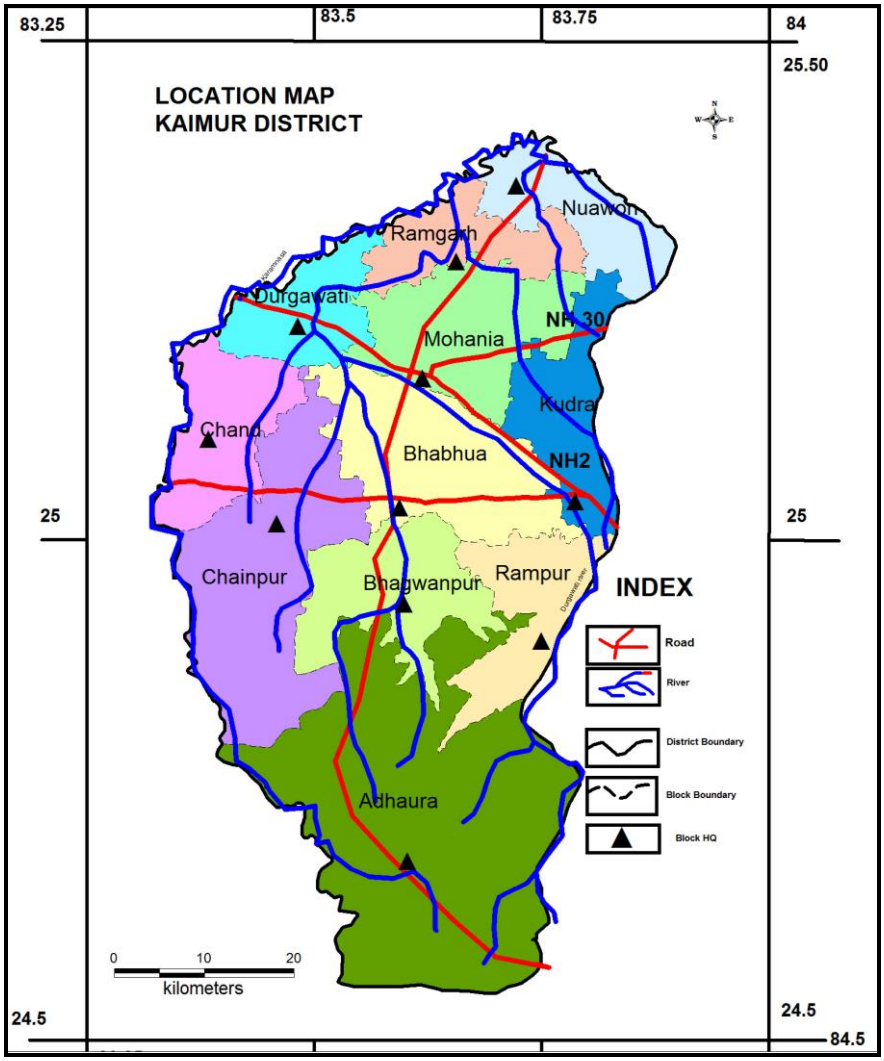


Figure 1 Location map of kaimur district

1.4 Brief Description

National Aquifer Mapping Programme (NAQUIM) Phase VI covers 4 districts namely Arwal, Aurangabad, Kaimur(Bhabua) and Rohtas. Sone river passing through the axial part of NAQUIM area divides the area into eastern and western half. Arwal and Aurangabad on eastern part of Sone, Rohtas and Kaimur on its western portion. The study area is marked by varied geology mainly Quaternary alluvium, Vindhyan formation and Chota Nagpur Gneissic Complex.

The study area of Kaimur is mainly occupied by two geological succession viz. Vindhyan Supergroup and Quaternary Alluvium. Karamnasa and Kudra river marked the western and eastern boundary of the district.

1.4.1 Data Availability

Ground water regime monitoring and ground water exploration work has been carried out in the district. Under National Hydrographic Station monitoring ground water level monitoring is carried out on regular basis. Data from previous work done on this area has been compiled. Based on the available dataset and data further required for detail study data gap analysis has been done.

1.4.2 Rainfall - Spatial and temporal distribution

Rainfall commences from mid june with the outburst of rain through south west monsoon. Average rainfall in Kaimur district is 837.5 mm, about 80% of rainfall occurs during mid june to September. Average number of rainy days in the district is 36.4. **(Reff)** Block wise assessment of monthly rainfall data for period of 5 years (2013-2017) indicates that there was percent deparature of annual rainfall from normal i.e >-25 in Adhaura,Chainpur, Chand, durgawati, Mohania, Rampur during the year 2014 as given in fig 3

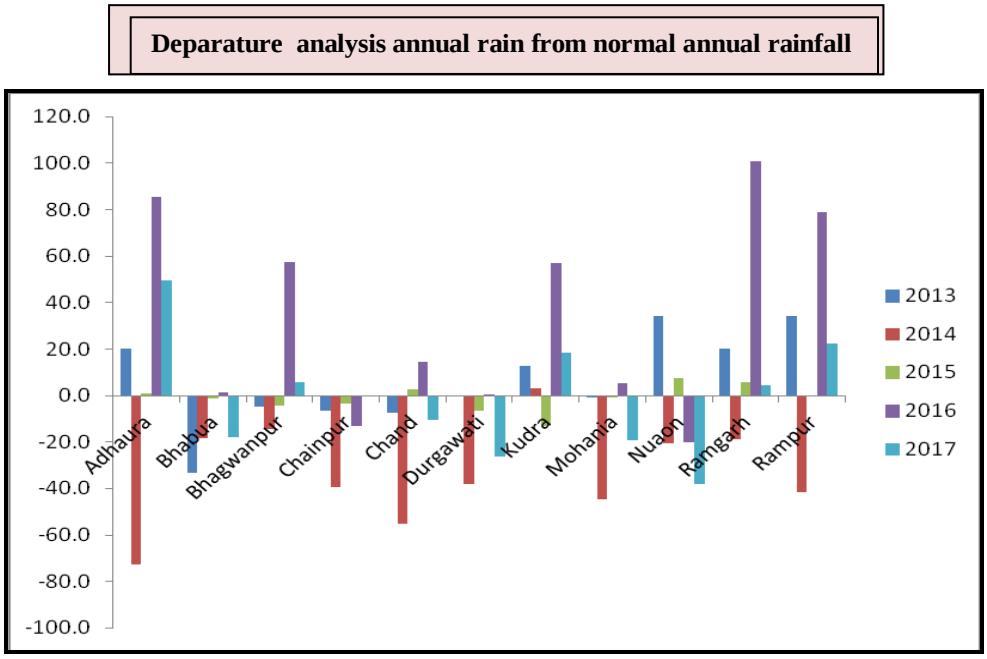


Figure 2: Deviation of annual rainfall from mean rainfall

1.4.3 Physiographic set up

Study area represents two distinct physiographic division viz. flat alluvial plain on the northern fringe and high Kaimur plateau on the southern part. General elevation

of alluvial plain varies from 65m to 90m amsl while top of Kaimur plateau is of the order of 500 m amsl. Towards north and north east the plateau exhibit undulating topography.

Peidmont zones have been observed in the central part of the district along the base of Adhaura Plateau namely in Bhagwanpur, Rampur, Chainpur blocks.

1.4.4 DEM

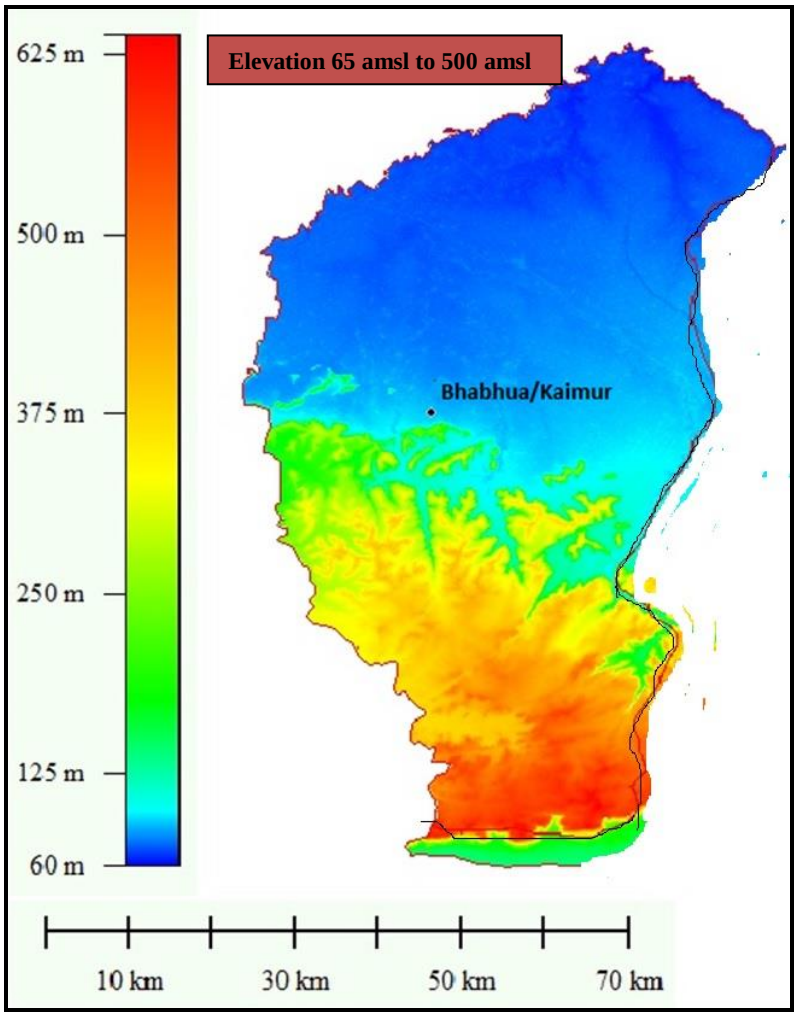


Figure 3:Digital elevation map of Kaimur

General elevation of the district ranges from 65m to 500m above m.s.l. Two distinct physiographic pattern have been observed Adhaura plateau of Vindhyan formation towards south and flat alluvial terrain towards northern part (fig 4)

1.4.5 Geomorphology

Study area is marked by two prominent geomorphological units *i.e.* geomorphic features of alluvial plain and geomorphic features of Vindhyan

plateau. The northern part of the district is underlain by alluvium of quaternary age. It is mainly consists of unconsolidated sediments such as clay, sand and gravel deposited by Ganga, Karamnasa and Durgawati rivers . Thickness of alluvium increases in the northern part of the district. Alluvial deposits can be sub divided into two types viz. Older alluvium and younger alluvium.

(a) Older alluvium:- Older alluvium comprises of coarse grained gravel with some calcareous nodules. Kankar is remarkably found in the soil.

(b) Younger alluvium:- It occupies the northern part of the district consisting of thick sequence of clay. Thickness varies from 6.0 metres to 30 metres .

Vindhyan plateau is mainly composed of fluvio-marine deposit which have been uplifted and peneplained. Geomorphic features observed in Vindhyans are dissected plateaus, escarpments, denudational hills, pediments. Due to differential weathering and erosional pattern it has resulted in dissected plateau .Dissected plateau is criss cross by various streams resulting in various features like intermontane valley ,escarpment.

Structural or residual hills are observed on the northern part of Adhaura plateau . They are the end product of the process of pediplanation. The isolated low relief hills formed due to differential weathering and the more resistant formation stand as residual like small hill.

Pediment zone is observed near the boundary of vindhyans. It is mainly eroded bedrock surfaces with gentle slopes. The process of pediment formation involves weathering , rill wash, mass wasting , sheet wash etc. Pediment zones are characterise by flat surfaces with thin to thick veener of weathered and unconsolidated materials. Geomorphic map of kaimur is depicted given in fig 1.5.

1.4.6 Land Use Pattern:

Land use pattern of an area has a intrinsic relationship to geology and lithology of the area. Water demand of an area depends on the utility of the land for various purposes. From district agricultural recordsit has been found that the total geographical area of Kaimur district is 3339.31 Sq.Km out of which 1673.01 Sq.Km area is net sown area . The net sown area constitute 50% of the total area

of the district. The cropping intensity in the district is 129% with Rampur block accounting for 182% cropping intensity (Table1.4). 27% of total geographical area is covered by forest . Adhaura block with forest area of 641.68 Sq.Km covers 73% of total forest area of the district. The land use land cover map of Kaimur is prepared based on NRSA data. Land use land cover map produced based on NRSA data is as under fig 6

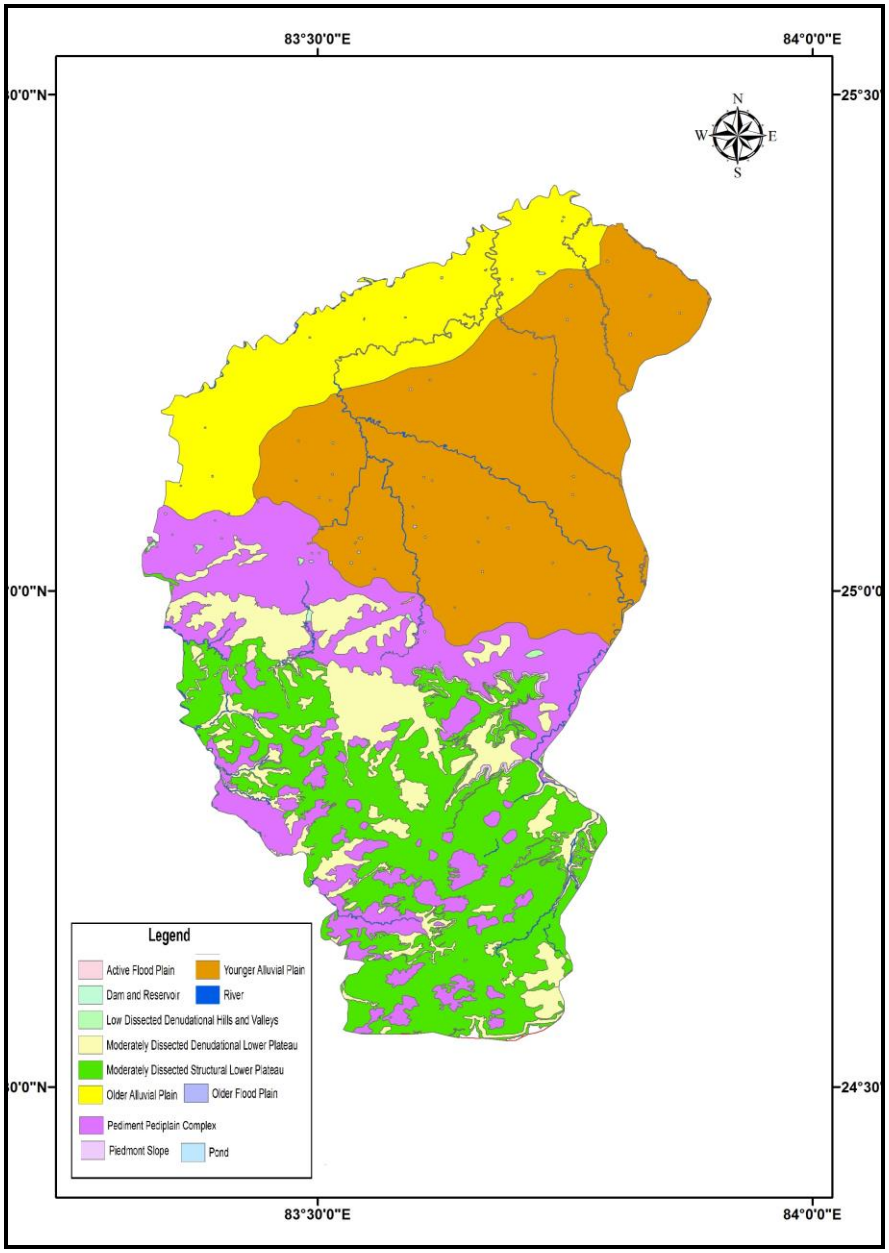


Figure 4: Geomorphology map of Kaimur

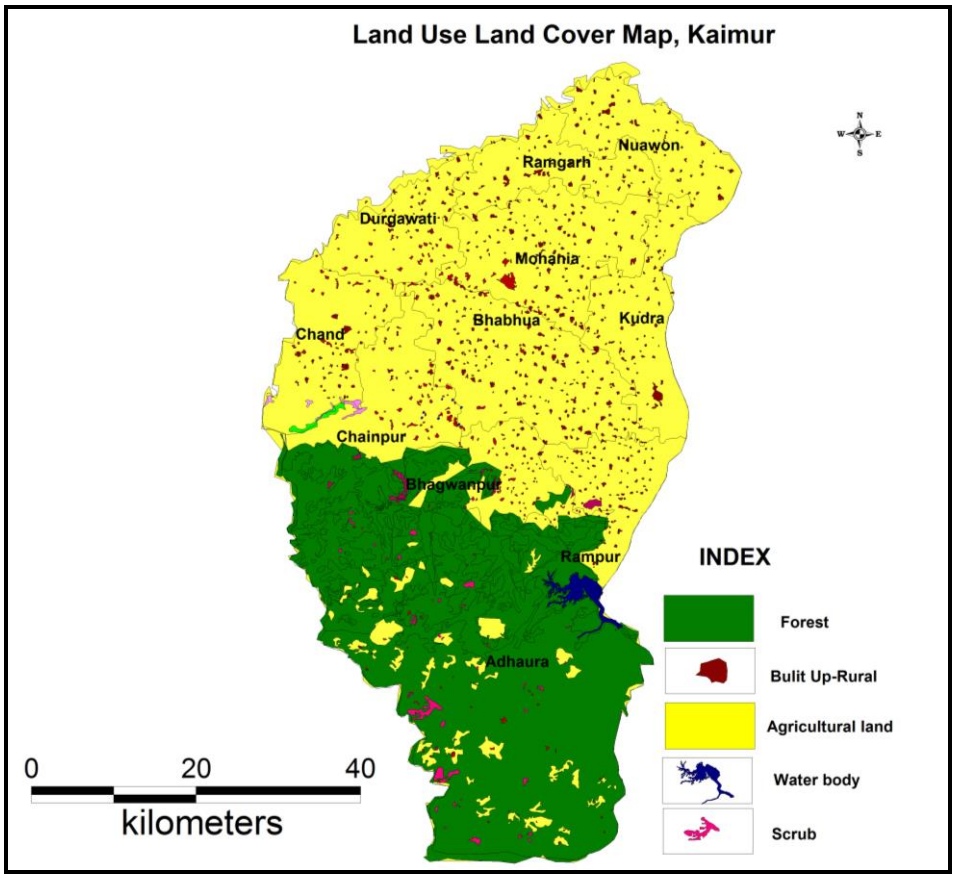


Figure 5: Landuse map of Kaimur

Table 1: Land Use Pattern of Kaimur District

Block	Total Geographical Area	Gross cropped Area	Net Sown Area	Area Sown more than once	Cropping Intensity	Area under Forest	Area under Wasteland	Area under other uses
Adhaura	91591	2561	2240	321	114	64168	1326	2449
Bhabua	32985	33662	28928	4734	116	0	0	54
Bhagwanpur	23546	11987	11529	459	104	9384	1674	0
Chainpur	45280	18724	18358	366	102	10893	1268	81
Chand	20322	14331	13848	483	103	0	1307	425
Durgawati	17382	18313	15199	3113	120	0	315	24
Kudra	21360	26011	15553	10458	167	0	1760	400
Mohania	28715	38237	24611	13626	155	0	873	240
Nuaon	19384	19676	16055	3621	123	4	660	40
Ramgarh	16979	19992	13790	6202	145	0	91	170
Rampur	16387	13110	7188	5922	182	6245	671	24
Total	**333931**	**216605**	**167301**	**49305**	**129**	**90694**	**9947**	**3907**

(Source: DIP Kaimur 2016-20)

1.4.8 Hydrology and Drainage

Drainage of Kaimur district can be divided into two parts , Karamnasa river forms the catchment in western part of the district and the eastern part includes the drainage of Durgawati river. The Karamnasa river originates at Adhaura plateau and flows in north to south direction and further along south west to north east direction. Durgawati river is a tributary of karamnasa river and originates in Adhaura plateau. The tributaries of Durgawati nadi are Kudra, Gahuman, Koel, Bajra, Halat nadi and Sura nadi.Drainage of the area is controlled by lithology, fractures and joints. Rectangular drainage pattern is observed in Adhaura plateau whereas in alluvium tracts below the plateau, sub-parallel to converging and braided streams are found .Drainage pattern of the district is shown in fig 8

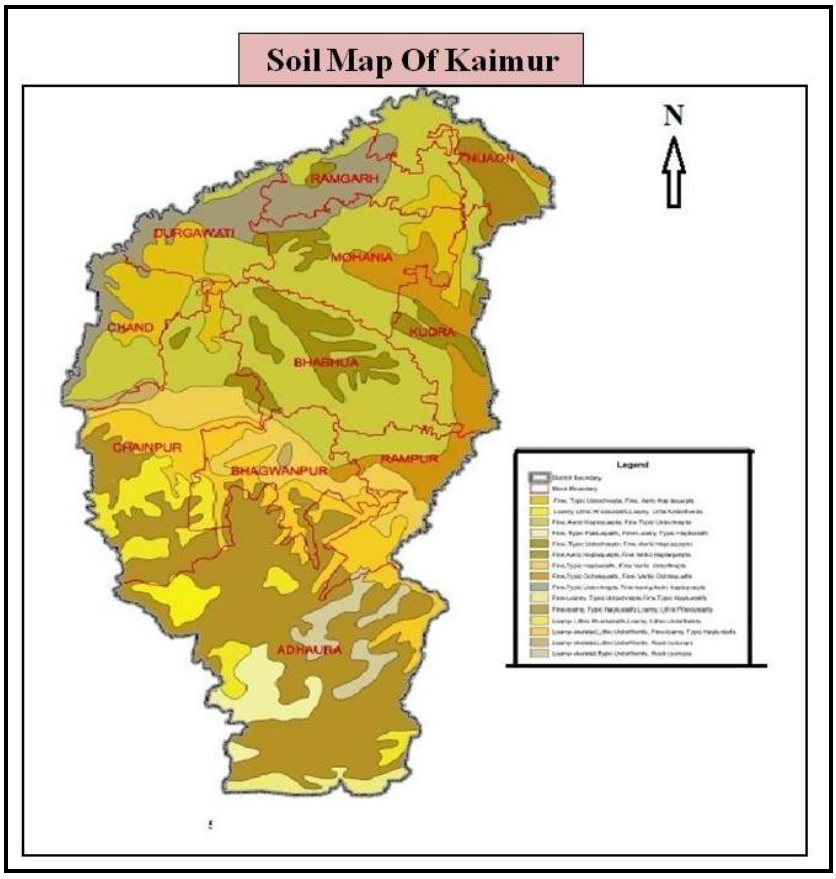


Figure 6: Soil map of Kaimur

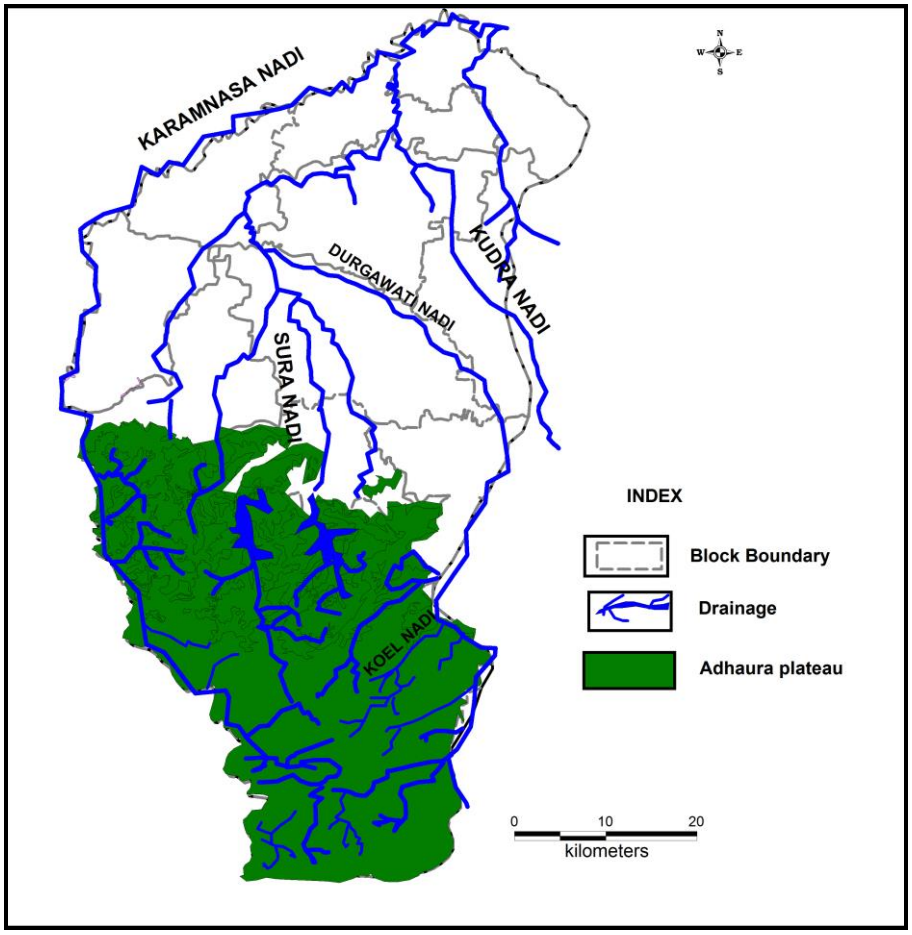


Figure 7: Drainage map of kaimur

1.4.9 Agriculture

Agriculture is the backbone of economy in the district. The region falls on Agro Climatic Zone III. Agriculture production is limited to cereals and pulses. Sowing season for kharif crops starts in mid may and harvesting is done on October. The principal kharif crops are maize, arhar , rice etc. Rabi cropping season starts from mid October and harvesting is done on march. Important rabi crops are wheat, paddy, green gram,peas etc. From district irrigation plan data it has been observed that total irrigated area in the district is 1.94 lakh hectare. The maximum extent of irrigated area is in kharif season (1,13,653 ha) followed by rabi season (80,507.6 ha).

1.4.10 Irrigation

In an agriculture based economy, irrigation is one of the main commodity. Canals and tubewells are the main source of irrigation in the district. The main irrigation projects are Sone High Level Canal, Karmansa irrigation project, Durgawati Irrigation project, Kohira reservoir project. The gross irrigated area by canals as on 2013-14 year is 1.02 lakh hectare and net irrigated area is 0.53 lakh hectares (as per Bihar Statistical Report ,2016).

Karamnasa irrigation project was design to irrigate the Chand, Durgawati and Ramgarh block. The projected culturable command area (CCA) is 13213 ha. However, as per 2nd Bihar Irrigation Commission report, tail end of the command area in Ramgarh block doesn't receive sufficient amount of water for irrigation. Durgawati irrigation project with a main canal length of 34.8 Km designed to irrigate the Kudra, Mohania and Durgawati blocks. Culturable command area as is 33.47 thousand hectare (WRD, Bihar 2016). Western Sone High Level canal irrigates Kudra and Bhagwanpur blockds of the district.

Kohira reservoir project was design to provide water supply to drought affected blocks in southern part of district namely, Chainpur and Chand block. Designed annual irrigation potential of the project was 13,455 ha.

Tubewell is another major source of irrigation. Dugwells and tubewells with submersible and centrifugal pump are used for the purpose. Gross irrigated area by tubewells is 87000 hectare (Bihar Statistical handbook, 2016). Density of tubewells is more on the northern part of district on the alluvium tract. It has been observed that there is a mark shift in depth of tubewells, wells tapping deeper aquifer zone (>100 mbgl) has increased from 4th MI (Minor Irrigation) census to 5th MI census. Shallow tubewells is mostly used for irrigation in the district as its culturable command area is 63948 hectares (Table 1.2). Net area irrigated by tubewell and canal for the period 2012-17 is shown in fig 9

Table 2 :Source wise irrigation potential created and CCA of Kaimur district (in hectares)

Source	Culturable command Area	Irrigation potential created - kharif	Irrigation potential created - rabi
Dug well	15402.49	7570.12	5594.78
Shallow Tube wells	63948.47	28225.21	22433.81
Medium tube wells	22197.38	9427.42	7221.71
Deep tube wells	8145.81	3972.75	3134.96

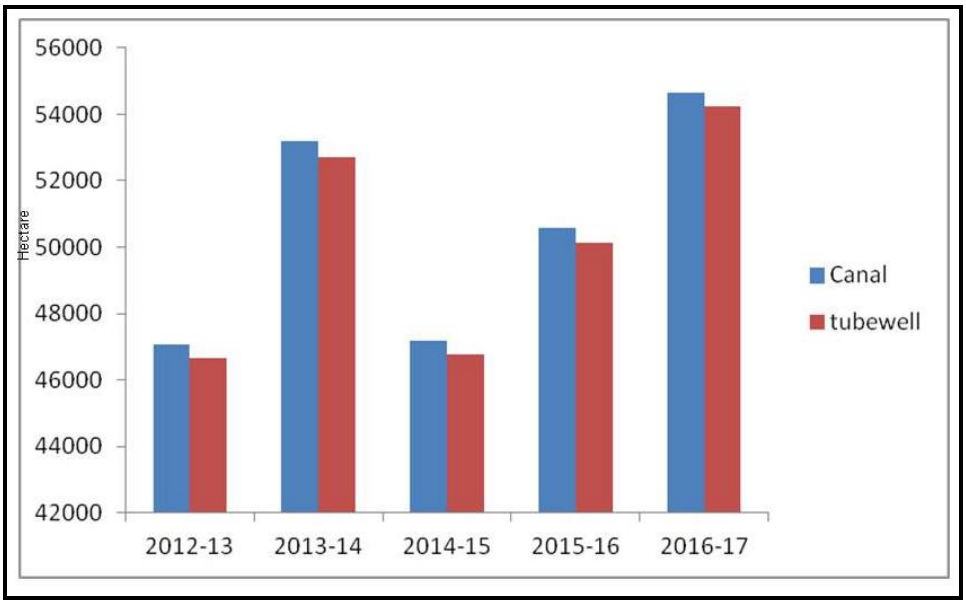


Figure 8: Bar graph showing net irrigated area by canal.

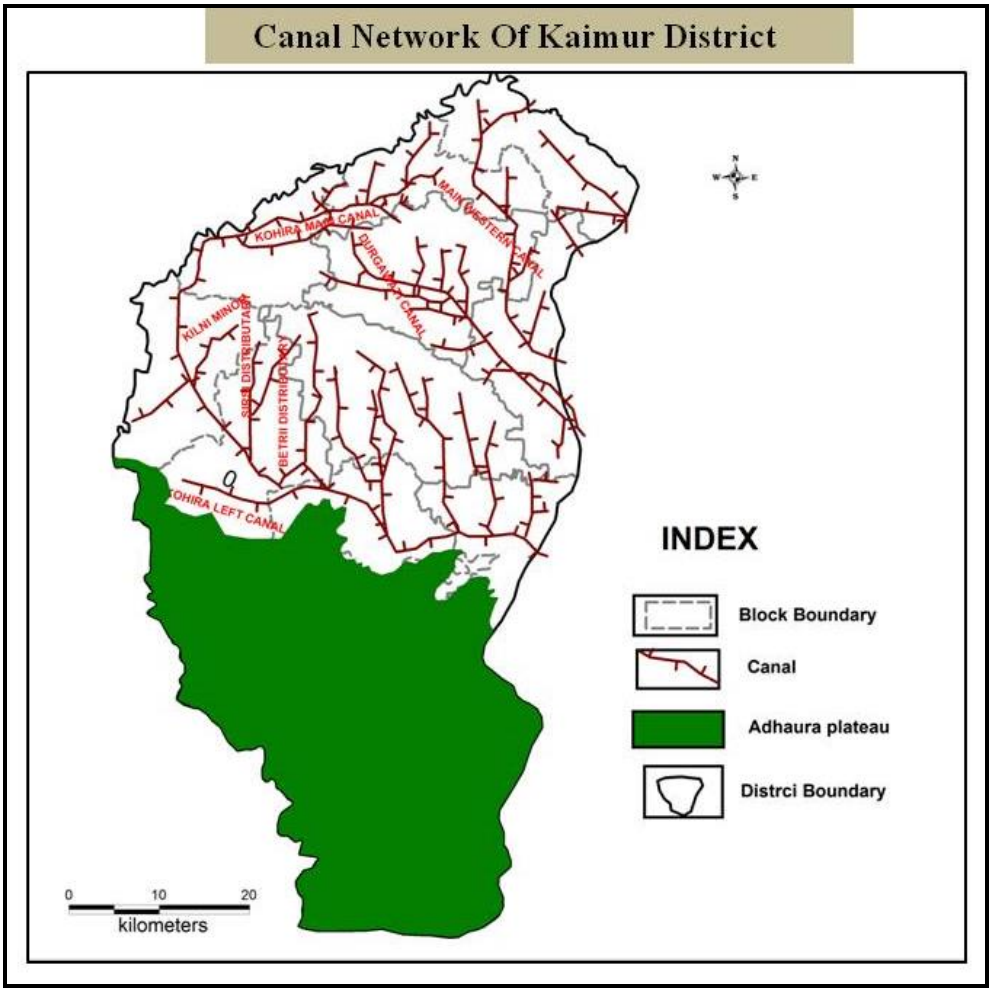


Figure 9: Canal network of Kaimur district

1.4.11 Geology

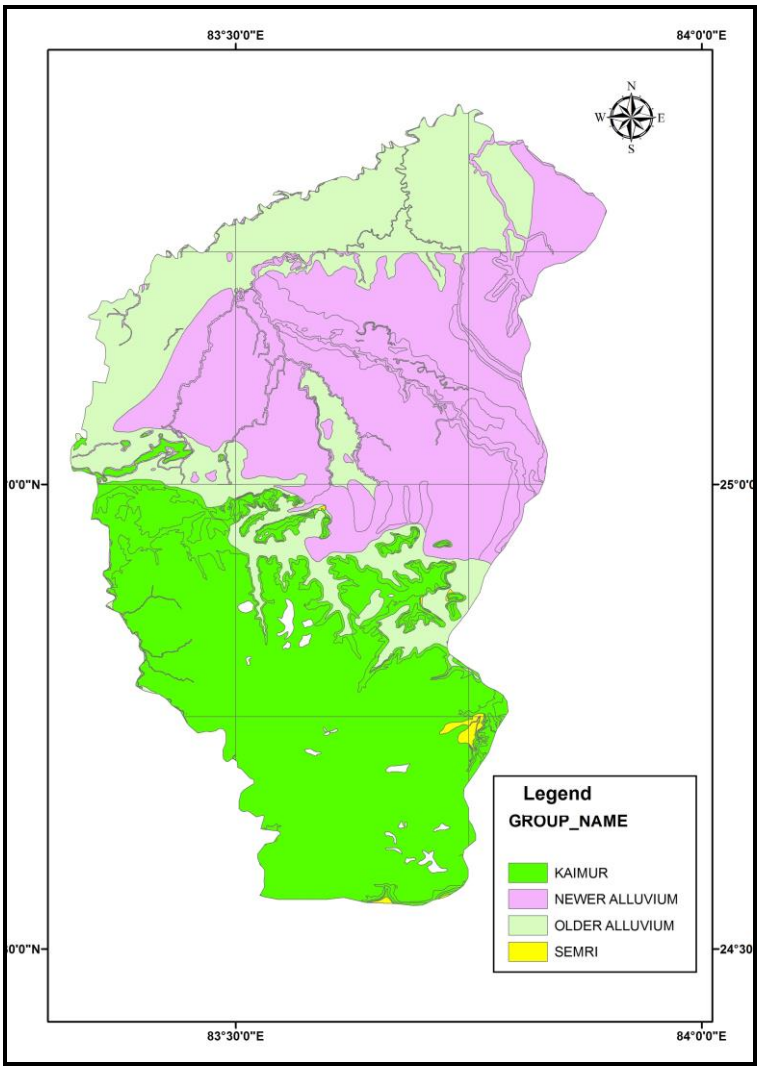


Figure 10: Geology map of kaimur district

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Kaimur district is mainly occupied by two distinct geological succession viz. Vindhyan Supergroup and Quaternary Alluvium. Vindhyan supergroup of rocks are exposed as plateau in southern part of the district . The rock formation are mainly lime-stone, shale, quartzite and sandstone of Semri group and Quartzite and Sandstone of Kaimur

Rocks belonging only to the Semri and Kaimur Groups of the Vindhyan Supergroupare exposed in the area. Of the Semris, only the Kheinjua and Rohtas Subgroups are exposed, the underlying formationsbeing not exposed in the area. The Kheinjua Sub-group includes Olive Shale, FawnLimestone and Grauconitic

sandstone formations which are overlain by well beddedlimestone and shale alternations belonging to the Rohtas Subgroup.The limestone and shale alternations, in turn, areoverlain by the Kaimur Group comprising sandstone, quartzite and shale. Depositional environment of Kaimur group is fluviatile in nature formed under arid to sub-arid condition

Table 3 Stratigraphic sequence of rock formation in Kaimur district

Vindhyan Super group	**Recent**			**Alluvium Laterite calc-Tuffa**
	Upper Vindhyan	**Kaimur Group**	**Upper Kaimur**	**Dhandraul quartzite formation,Scrap Sandstone formation**
			Lower Kaimur	**Bijaigarh Shale formation,Lower Kaimur Sandstone formation**
	Lower Vindhyan	**Semri Group**		**Rohtas Formation**

CHAPTER II

DATA COLLECTION AND GENERATION

2.1 Hydrogeology

The area falls under South Bihar Plain. Hydrogeology of the area shows variation according to change in geology . Assessment of sub surface data has revealed a thick pile of alluvium sediments on northern part of the district which are important reservoir of ground water. The composition of sediments are not uniform, thus there is wide diversity in ground water condition. Unconsolidated materials are composed of sands of varying grades and pebbles of different size.

Available data indicates that north of G.T road there is presence of second aquifer system upto depth of 130 m. Multiple aquifer system has been observed in Ramgarh and Nuaon blocks where exploration has been carried out upto depth of 300 m. Thickness of alluvial sediments increases further north towards confluence of Karamnasa and Ganga river.

South of G.T road there is shift in hydrogeological pattern . Subsurface data has reaveled presence of thick clay overburden in the range of 40-70 m. Prominent aquifer system has not been encountered. Ground water occurs in weathered mantle and fractures in Vindhyan sandstone formation. Fracture zones has been recognised from exploratory well at Adhaura and Rampur block. The recharge, storage and yield capacity are guided by the prevalent lithology and lineaments

2.1.1Water level, Pumping test

Water Level

To study the behavioural pattern of water level during pre and post monsoon 38 key wells were established in Kaimur district. The general formation wise depth to water level is tabulated in Annexure (I)

Table 4 :Summary of depth to water level and fluctuation of monitoring wells .

Formation	Range of total depth of well (mbmp)	Depth to water Level		Fluctuation (mbgl)
		Pre (mbgl)	Post(mbgl)	
Vindhyan	4.50 to 12.10	3.6 to 10.8	3.05 to 7.73	1.57 to 4.70
Alluvial	5.30 to 13.20	4.4 to 11.4	2.42 to 10.2	0.78 to8.15

Depth to water level in alluvium varies between 4.4 mbgl to 11.4 mbgl during post monsoon and 2.42 mbgl to 10.2 mbgl during post- monsoon period, while in Vindhyan's depth to water level is between 3.6 mbgl to 10.8 mbgl and 3.05 mbgl to 7.73 mbgl during pre and post monsoon period respectively. Deeper water level of more then 8 mbgl is confined to north-western part of the district along the bank of Karmansha river.

Pumping test

Pumping test data of exploratory wells through outsourcing and historical data of wells constructed by CGWB and GSI indicates that the transmissivity value of aquifer ranges from 269.3 m^2/day to 6074 m^2/day. Storativity value ranges from $3.4 * 10^{-4}$ to $2.2*10^{-6.}$ Pumping test data of CGWB ,GSI and through outsourcing is summarized in Table 5.

Table 5 : Exploratory well details

Sl no	Location	Block	Depth Drilled	Depth range of Granular zones	Discharge	Drawdown	Transmissivity	Storativity
			(mbgl)	(m)	(m3/hr)	(m)	(m2/day)	
1	**Barahuli**	**Mohania**	125.05	10-24,80-100,105-115	36.79	10.11	269.3	
2	**Dahrak**	**Ramgarh**	259.69	32-60,72-100,126-139,142-160,170-180,190-200	124.46	4.58	6074	$3.4 * 10^{-4}$

3	**Nuaon**	**Nuaon**	310.44	25-30,47-57,61-70,87-94,115-125,135-140,150-172,177-196,210-240,245-260	164.875	8.35	2069	
4	**Jagaria**	**Chainpur**	91	24-26,39-48	79.25	3.76	4094	$2.2*10^{-6}$
5	**Ramgarh**	**Ramgarh**	295.95	35-46,76.20-85.34,124.96-152.39,164.58-176.77	159	5.84	2505	
6	**Piparia**	**Mohania**	188.98	10.66-14.02,27.73-55.27,62.78-73.76,89.77-111.86,115.66-132.99,136.73-157.88	245	5.33	4162	

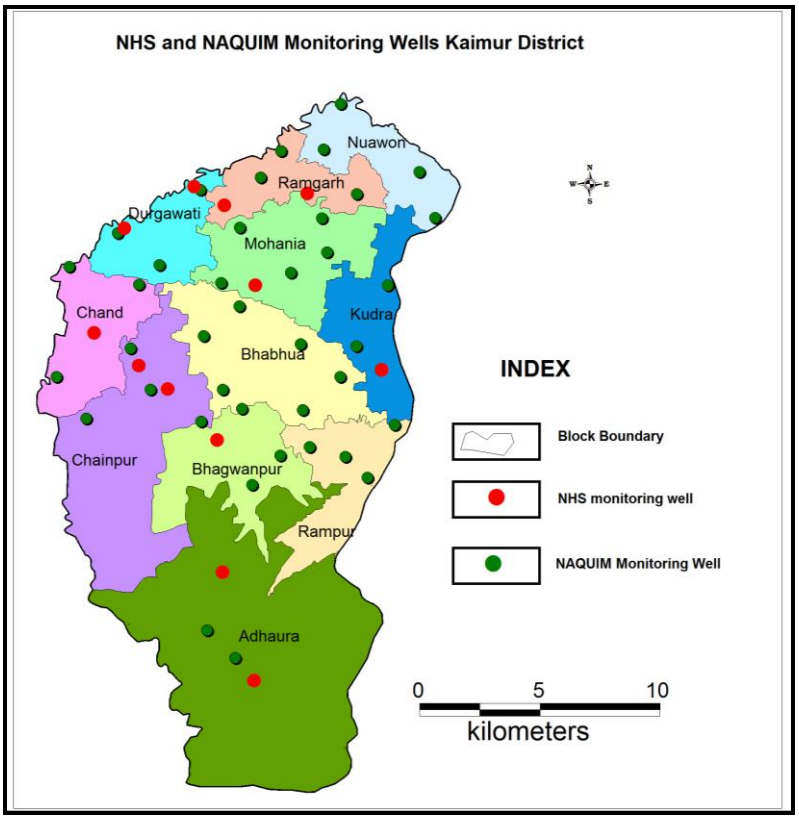

Figure 11: Locations of NHNS nad NAQUIM water level monitoring stations.

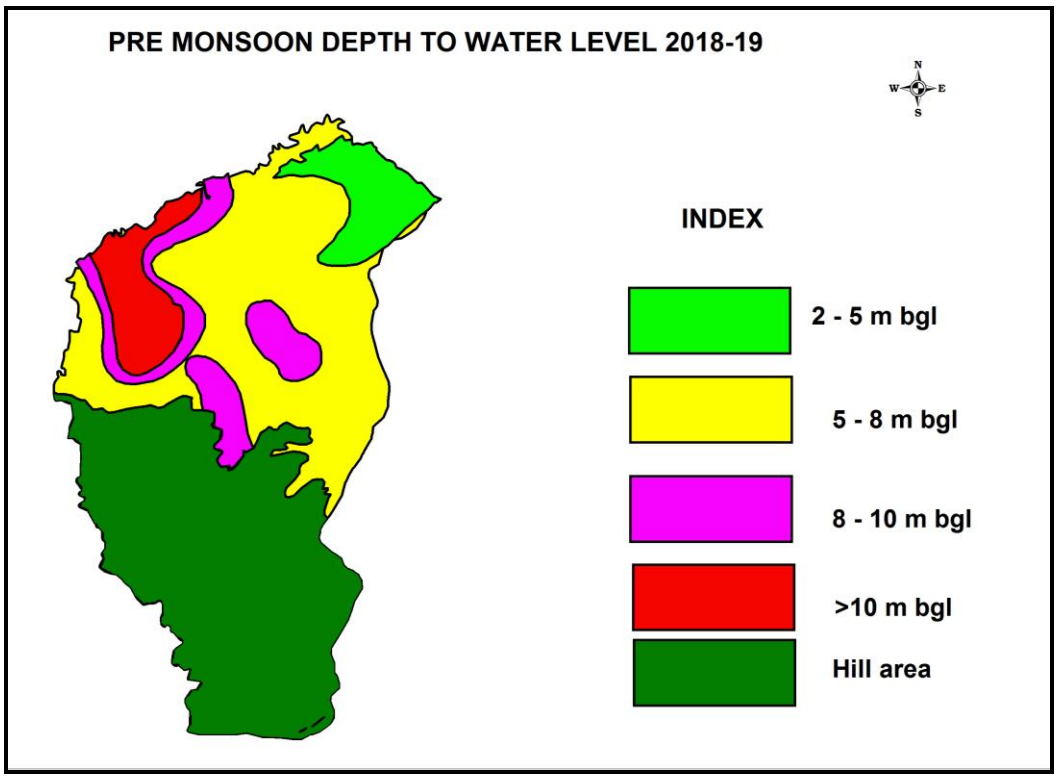

Figure 12: Pre-Monsoon depth to water level map

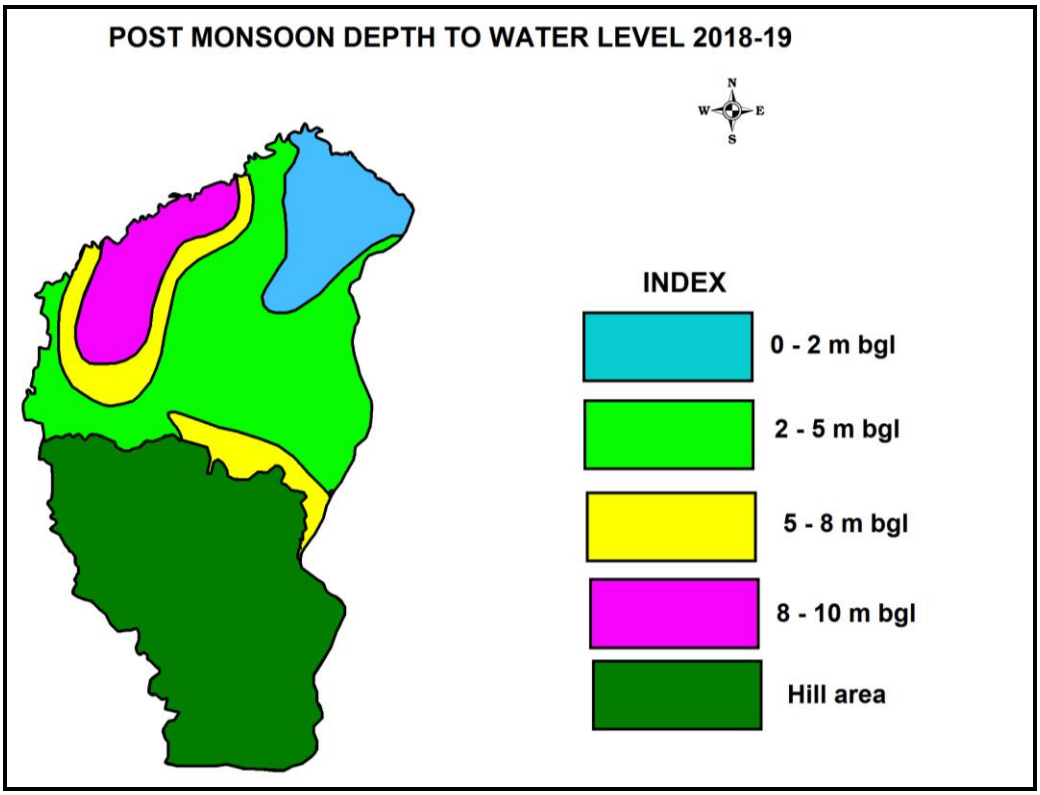

Figure 13: Post-monsoon depth to water level map

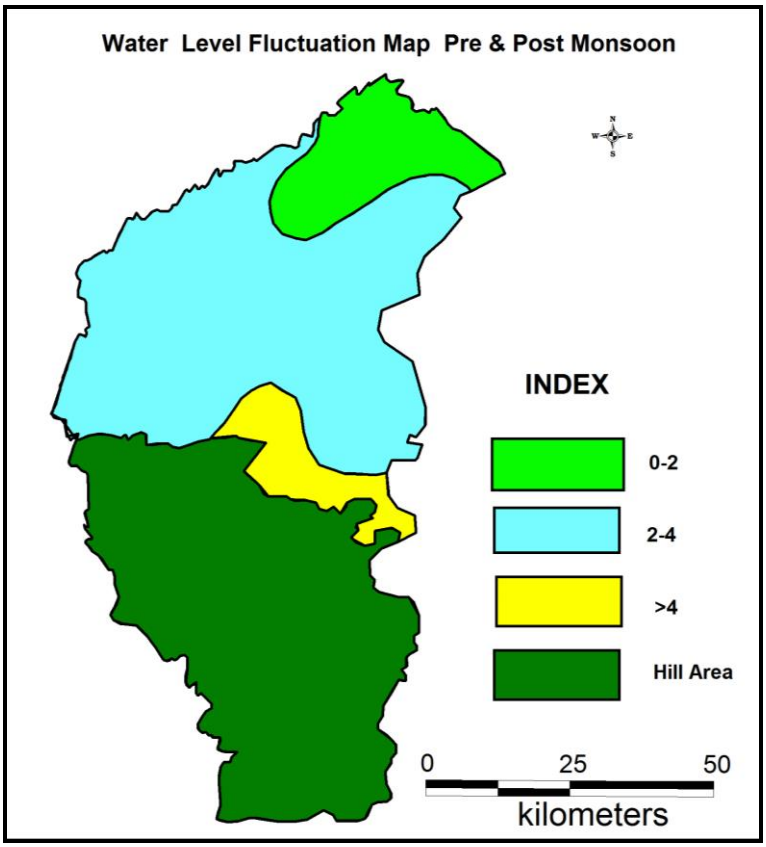

Figure 14: water level fluctuation map .

2.2 Hydrogeochemical Investigation

2.2.1 Water Quality Sampling, Number of Samples and Analysis Mechanism

Assessment of ground water quality is an integral part of any hydrogeological study. Qualitative estimation of physical and chemical quality of water is essential for assessing the suitability of water for drinking and irrigational purposes. Ground water quality of an area and its physical and chemical characteristics are greatly influenced by geological and anthropogenic factors. Concentration of major ions and dissolved ions are also influenced by the aquifer matrix through which the movement of groundwater occurred. Groundwater geochemistry helps to interpret the geological environment, source, direction and movement of ground water, recharge and discharge relationships.

2.2.2Ground Water Quality

To study the ground water quality of the study area water samples from dug wells and tube wells were collected during pre-monsoon and post monsoon seasons. A total

of 35 samples were collected during pre-monsoon. Chemical analysis of ground water samples is carried out by regional chemical laboratory of Central Ground Water Board, Mid Eastern Region, Patna. Samples were analyzed for the parameters like pH, EC, Turbidity, TDS, CO3, Cl, SO4, Na, K, HCO3, NO3, F, Ca, Mg, As and Fe. The chemical analysis data of groundwater samples from Kaimur district during pre-monsoon.

Table 6: Chemical quality of water samples Kaimur district pre-monsoon

SI.NO.	Chemical constituents (Concentrations in mg/l except pH, EC and As)	Maximum	Minimum
1	pH	8.2	7.1
2	EC (µs/cm) 25°C	1365	126
3	CO_3^{-2}	BDL	BDL
4	HCO_3^{-1}	622	61
5	Cl^-	35.5	3.55
6	SO_4^{-2}	65	5
7	NO_3^{-1}	73	8
8	F^-	0.94	0.13
9	Ca^{+2}	200	14
10	Mg^{+2}	44	2
11	TH (as $CaCO_3$)	500	55
12	Na	185	2.8
13	K	6.8	1.2

It is deciphered from table 6 that the all the samples have pH values in the range from 7.1 to 8.2 during pre-monsoon season. No sample has pH value less than 6.5. So it can be inferred that the nature of ground water is neutral to slightly alkaline.

2.2.3 Assessment of ground water quality with various chemical diagram

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

Piper diagram

In order to understand water composition and chemical relationship between dissolved ions, Pipers trilinear diagram for graphical analysis (Figure 14) is used. This diagram reveals similarities and differences among water samples. Most of the water samples analyzed fall within the calcium type in case of cations with few samples fall under no dominant type and Na-K type. In case of anions, most of the samples are under bicarbonate type. These trends are reflected in the central diamond of the diagram where most of the samples fall under the category of alkaline dominant field in case of cations within which around 90% of the samples falls under Magnesium bicarbonate (Mg-HCO3) type ,8% of the samples falls under mixed type and 2% both under calcium chloride (CaCl) type and sodium chloride (NaCl) type. In case of anions, most of samples are within weak acids (HCO3 - CO3) dominant field The results suggest that Magnesium bicarbonate and mixed type are the dominant hydro chemical facies for the studied groundwater samples.

Wilcox diagram

According to Wilcox diagram (US Salinity Laboratory's diagram) in Figure 15, salinity and alkalinity hazard class of water samples were C2–S1 (80 %) and C3–S1 (20 %). The result shows that a majority of the ground water samples possess medium salinity with low sodium (C2–S1)and few samples possess high salinity and low sodium (C3–S1). It can be inferred that salinity range of water for High-salinity water (C3) cannot be used on soils with restricted drainage. The calculated value of SAR in the ground water of the study area ranges from 0.11–3.37. The plot of data on the US salinity diagram, in which the EC is taken as salinity hazard and SAR as alkalinity hazard,

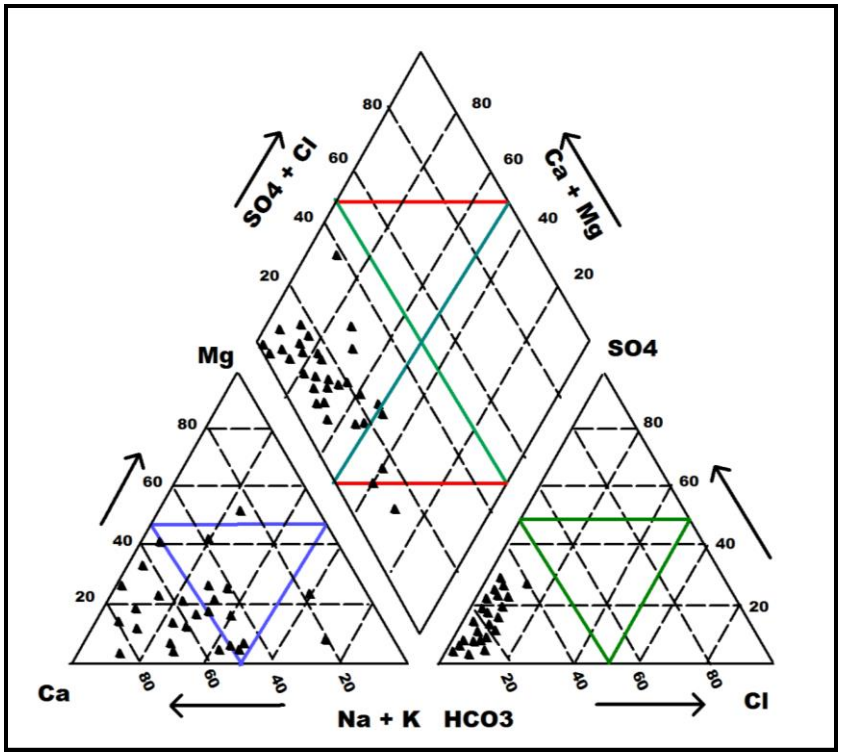

Figure 15: Piper diagram for representing ground water analysis

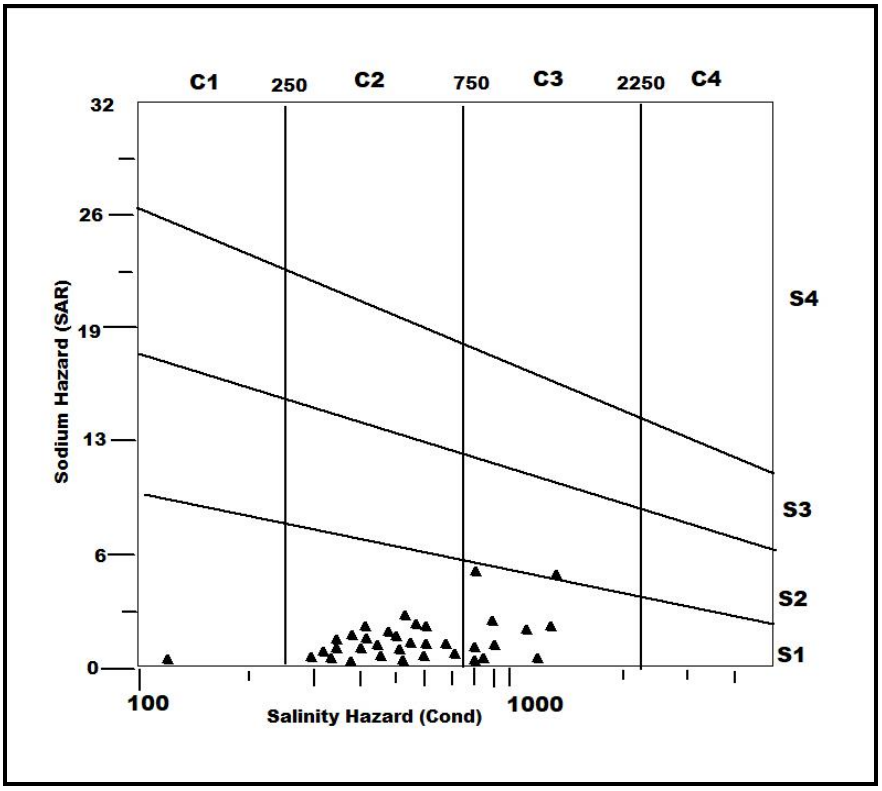

Figure 16: Wilcox diagram to represent relationship between salinity and sodium.

2.2.4 Water quality evaluation for irrigation purpose

To study the water quality for irrigation purpose, 35 water samples (both DW and TW) are collected during pre-monsoon. Different chemical parameters like pH, electrical conductivity(EC), total dissolved solids (TDS), Ca2+, Mg2+, Na+, K+, Cl-, HCO3,CO3, SO4, F- and various chemical index such as sodium absorption ratio.

Alkalinity Hazard (SAR)

Irrigation water is classified on the basis of SAR. Hence, the assessment of sodium hazard is necessary while considering the suitability for irrigation. The SAR values of the groundwater samples varies from 0.16-10.5 respectively. The SAR values of the water samples of the study area less than 10 and are classified as excellent for irrigation.

Residual Sodium Carbonate (RSC)

Bicarbonates (HCO3-) occur in low salinity water and its concentration usually decreases with an increase in EC. The proportion of bicarbonate ion is higher than calcium ions are considered undesirable, because after evaporation of irrigation water bicarbonate ions tend to precipitate calcium ions. Hence, the effect of bicarbonate together with carbonates evaluated through RSC.

The RSC values varies from -1.7 to 5 ppm for pre monsoon water samples respectively.88% of the pre monsoon water samples are suitable for irrigation, 14% are marginally suitable and 2% are unsuitable for irrigation.

Magnesium Ratio

In the study area, nearly 80% of the pre monsoon water samples monsoon samples has Mg ratio less than 50 % which is suitable for irrigation, as magnesium ratio of more than 50% indicate that the soil is more alkaline which adversely effects the crop yield

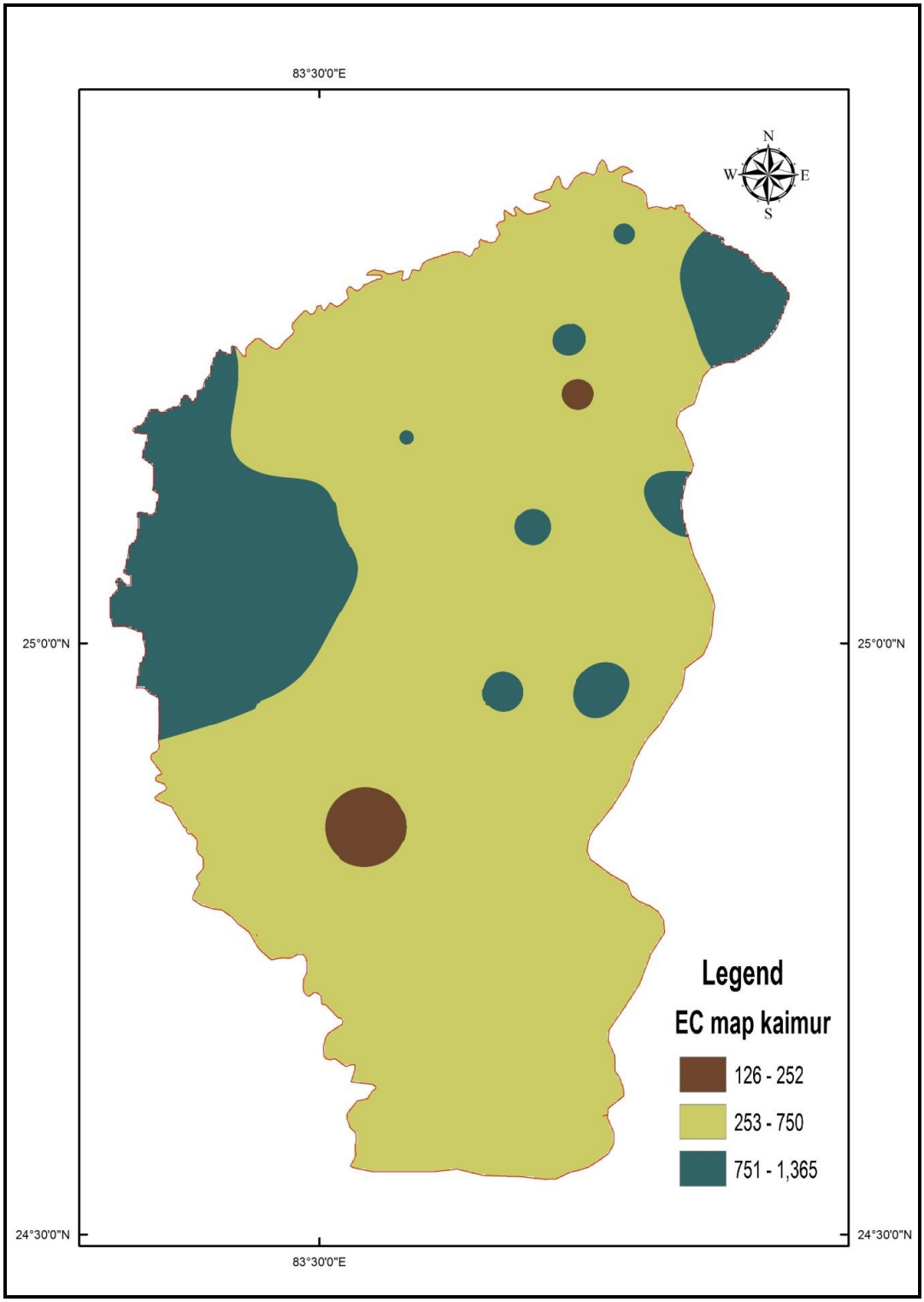

Figure 17: Electrical Conductivity map of Kaimur

2.3 Geophysical Investigation

2.3.1 Location, Number, Analytical Techniques

As a part of NAQUIM programme 17 Vertical Electric Sounding (VES) resistivity method was carried out in study area. VES survey was mostly carried out in alluvial areas; previously VES survey was carried out in Adhaura plateau as a part of special study. Data was initially interpreted manually by matching two layer standard curves, detail interpretation was made with the help of computer programme.. Locations of VES points are shown in Fig 2.4.

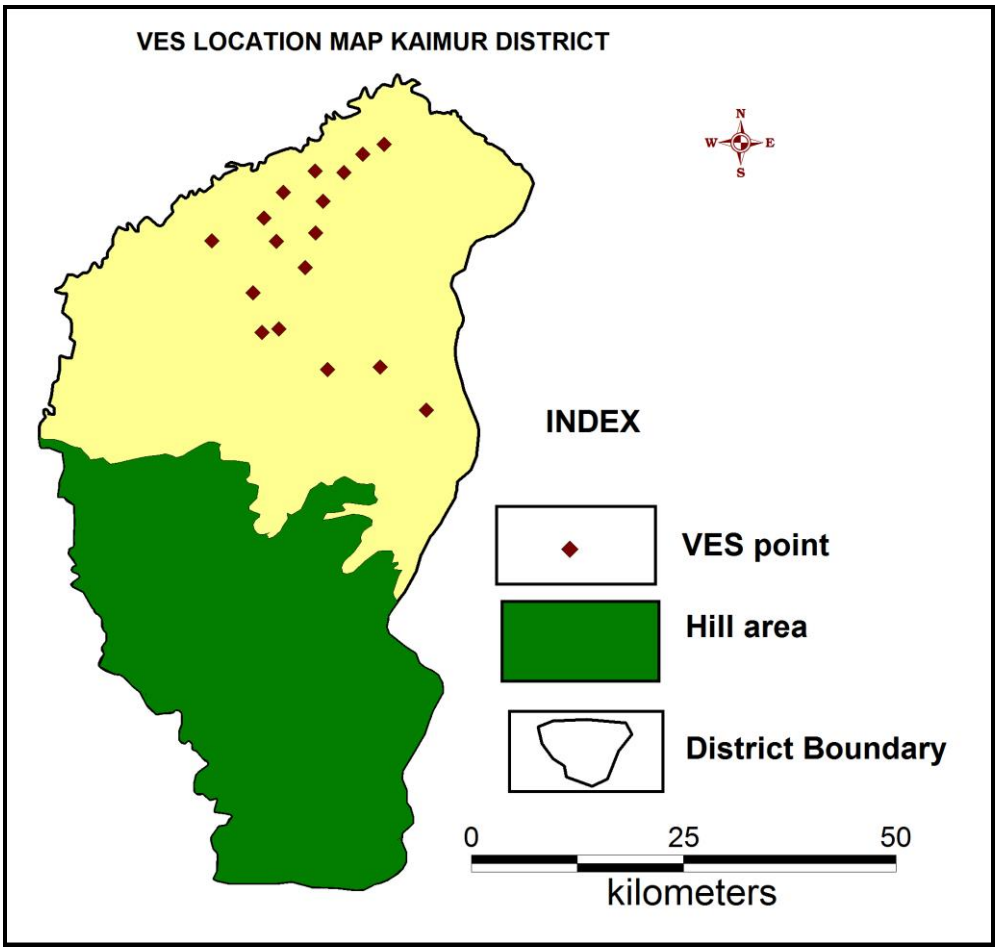

Figure 18: VES location map of Kaimur

Analytical Techniques:

Electrical Resistivity of water bearing formation is goverened by resisitivity of water in aquifer matrices. It is also dependent on effective porosity and amount of clay material remain within. In resistivity method of traversing two methods of investigation is applied (a) Resisitivity depth probing or sounding (b) Traversing or profiling method.

Resistivity data may be interpreted from master curves for a small number of earth layers assuming them as horizontal layer of uniform thickness and resistivity. They are prepared for particular electrode configuration, like, Wenner, Schlumbereger, various thicknesses and resistivity ratios being assumed for individual layers.

All the curves are interpreted with the help of partial curve matching technique and also by the resistivity sounding interpretation software. The interpreted data is correlated with the available borehole information near by the survey area and utilised resistivity range with respect to lithology is given below. Interpreted VES results are tabulated in **Annexure-III.**

Table 7: Resistivity range and litholog

Resistivity Range (Ω-m)	Lithology
9-15	Clay
14-30	Sand mixed with clay
16-25	Medium to coarse sand
60-200	Coarse sand mixed with gravel/kankar
200-500	Unsaturated sand

2.4 Exploratory Drilling - State Govt., CGWB and Private Wells

2.4.1 Number, Location, Depths, Well Design

Subsurface lithological information and delineation of aquifer system down to the depth of 300 mbgl has been obtained through exploratory drilling by CGWB and GSI. Drilling was confined mostly to Quaternary Alluvium formation. Location and depth of drilling is given in tabular format on Table 7.

Table 8: Location details exploratoey wells by CGWB and GSI

DISTRICT	BLOCK	LOCATION	LONG	LAT	DEPTH DRILLED (mbgl)
Kaimur	Ramgarh	Ramgarh	83.65	25.28	295.95
Kaimur	Mohania	Mohania	83.60	25.16	135.02
Kaimur	Pachilakhi	Durgawati	83.52	25.27	86.86
Kaimur	Piparia	Mohania	83.54	25.18	188.98

Exploratory drilling was carried out through outsourcing by WAPCOS .About 8 exploratory wells has been drilled and maximum drilling depth is 310 mbgl. Wells have tapped different geological setting of Kaimur i.e the Quaternary alluvium and Vindhyan sandstone formation. Location and depth of drilling is mentioned in Table 7. Exploratory wells by all agencies has been shown in map in Fig 17. Lithological information is mentioned in ANNEXURE IV.

Table 9: Location details of exploratory wells through out sourcing

DISTRICT	BLOCK	LOCATION	LONG	LAT	DEPTH DRILLED (mbgl)
Kaimur	**Chainpur**	**Jagaria**	83.51	25.04	93
Kaimur	**Mohania**	**Barahuli**	83.70	25.10	125.05
Kaimur	**Nuon**	**Nuon**	83.74	25.35	310.44
Kaimur	**Ramgarh**	**Dahrak**	83.64	25.29	259.69
Kaimur	**Bhagwanpur**	**Mundeshwari sthan Park**	83.57	24.98	46

Kaimur	**Bhagwanpur**	**Paryatan Dharmshala**	83.58	24.99	70
Kaimur	**Rampur**	**Shree Nehru +2 School**	84.22	24.82	102
Kaimur	**Rampur**	**Rajkiya Krit Madhya Vidyalaya**	84.17	24.19	45.4

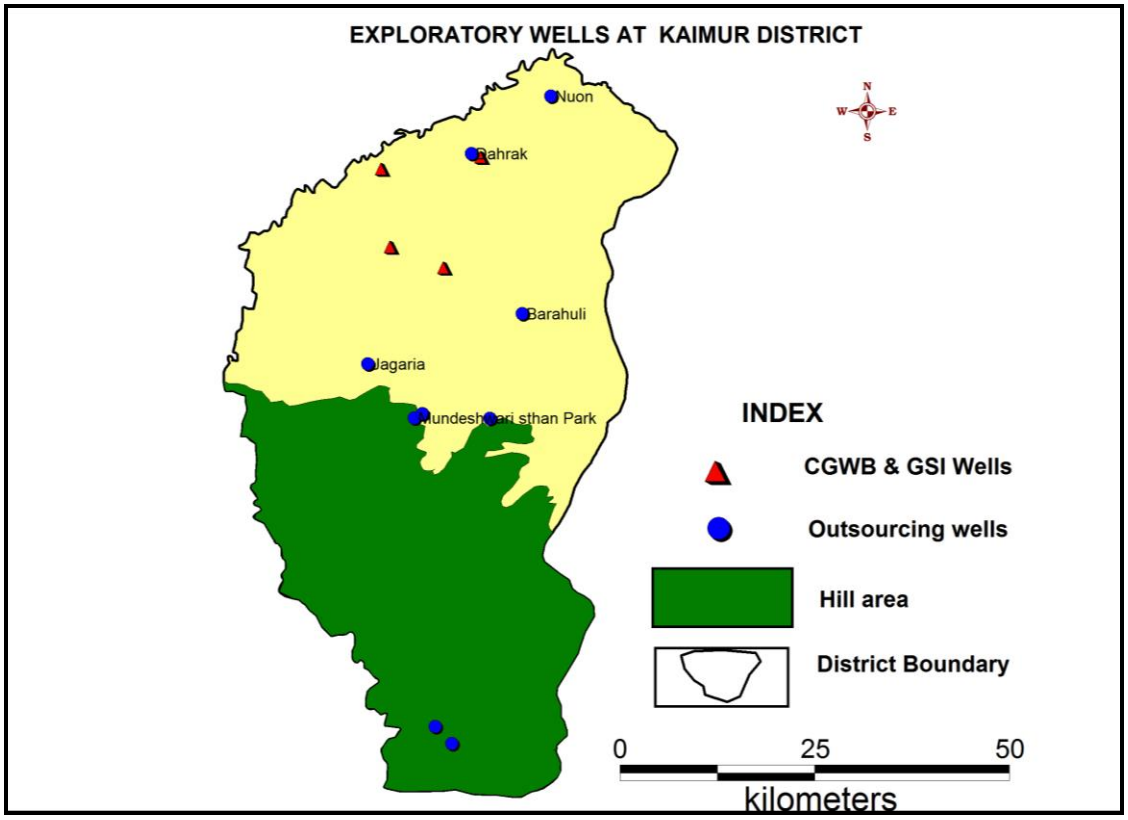

Figure 19: Locations of exploratory wells at kaimur

CHAPTER-III

GENERATION OF AQUIFER MAP

3.1 Aquifer Disposition

Aquifer disposition in Kaimur district can be characterised based on geological succession viz Vindhyan Supergroup and Quaternary alluvium. Water bearing formation in Vindhyan Supergroup in southern part of the district occurs in the planar features such as joints fractures etc. Northern part of the district is underlain by Quaternary alluvium formation. Alluvium forms the most important reservoir for ground water. Aquifer zones in alluvium formation are composed of granular sediments separated by impervious clay layers. Unconsolidated materials are composed of sands of varying grades.

3.1.1 Aquifer disposition in the area

To study the aquifer disposition and its lateral variation exploratory drilling was carried out by CGWB and other agencies along with VES survey. Based on lithological information obtained through exploratory drilling, sections and fence diagrams were prepared to establish the aquifer geometry. Aquifer geometry is delineated based on geological formations:

1. **Quaternary alluvium:**

Two aquifer systems have been observed in the alluvium terrain on the northern part of the district. These aquifer systems are as below:-

(a) Shallow aquifer:

Depth of phreatic aquifer from 10-60 mbgl with an average thickness of 20m. The shallow aquifer constitute of silt,sand and calcareous nodules. Groundwater generally occurs in semi-confined condition.

(b) Deeper aquifer:

The depth of deeper aquifer ranges from 72-100 mbgl; 105-140 mbgl; 150-190 mbgl; 210-250 mbgl. As one proceeds towards north of G.T road multiple aquifer system is encountered at Ramgarh and Nuaon blocks. Exploratory drilling upto 300 mbgl in Nuon and Ramgarh block reveals multiple aquifer system with depth range upto 210-250 mbgl.

In alluvium formation different granular formation has been identified within depth range of 300 mbgl. The depth of formation and its thickness vary laterally. A great deal of facies variation and lateral accretion is prominent.

2. **Vindhyan formation:-**

The depth and lateral extent of aquifers in consolidated sedimentary rocks of Vindhyan formation is governed by tectonic history and geological structure.

In consolidated Vindhyan sandstone water bearing formations are encountered in fracture zones. Through exploratory drilling at Adhaura plateau down to depth of 133 mbgl and 157 mbgl fracture plane has been observed at 97 mbgl; 110 mbgl and 128 mbgl.

At the pediment zone there is a thick overburden of clay and shale down to depth of 66 mbgl . Fracture bearing aquifer zone is encountered at depth of 35 mbgl at shale and 75 mbgl on sandstone formation at Rampur block. Through exploratory well drilled at Bhagwanpur and Chainpur block it has been noticed that there is a thick overburden of clay layer in the range 45-70 mbgl .The thickness of clay overburden increases as one traverse further south of G.T road.

3.1.2 Aquifer Characterizations

Characterization of aquifer down to 300 mbgl in the study area have been arrived at byconvergence of the observations from the study of the different lithological sections, fence diagrams, geoelectrical sections, sections based on e-logs and overall lithological model of the area. On the north of G.T road different granular zones has been identified within depth of 300 mbgl. A great deal of facies variation and lateral accretion is prevalent .Multiple aquifer zones are encountered as one traverse further north toward Ramgarh and Nuaon blocks. South of G.T road there is a thick overburden of clay layer down to depth of 75 mbgl. Fracture bearing aquifers are observed in Vindhyan sandstone and in the pediment zone.

3.1.3 Aquifer hydraulic characteristics

Pumping test data of the exploratory wells drilled by CGWB and other agencies has been analysed to delineate the hydraulic characteristic of the aquifer system. In quaternary alluvium shallow tube wells upto depth of 50 mbgl yield 27 m^3/hr to 60 m^3/hr for draw down of 3-11 m. Deep tube wells constructed in alluvium sediments upto depth of 300 mbgl usually sustain a yield of 159 m^3/hr to 3957 m^3/hr for a draw down of 4.25 to 10.11 m. Transmissivity of aquifers are in the range of 1706 m^2/day to 5466 m^2/day. Storativity value of deeper aquifer is $3.4*10^{-4}$ which suggest that the aquifer is in confined to semi-confined condition.

Fracture zones encountered in vindhyan sandstone yields a discharge of 39 m^3/hr . Through preliminary yield test conducted at wells tapping Vindhyan sandstone the fracture zones yield a discharge of 97.76 m^3/hr for a drawdown of 23.97 m. Transmissivity of wells are in range of 11 m^2/day to 395 m^2/day.

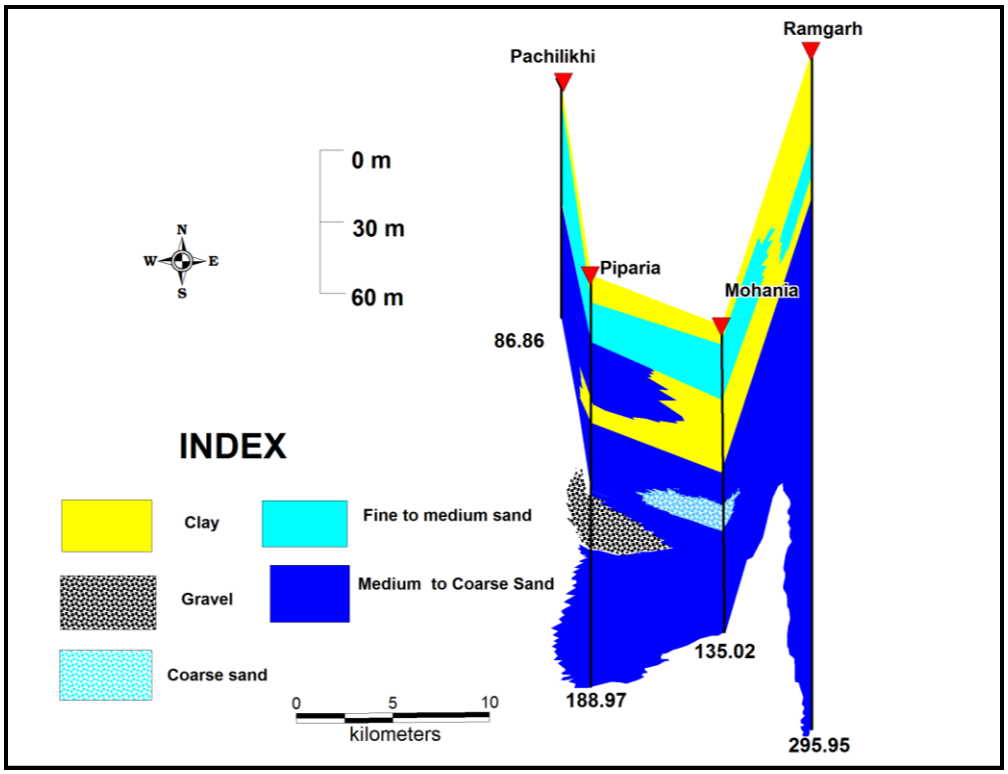

Figure 20: 2D Hydrogeological section from Pachilakhi to Rampur

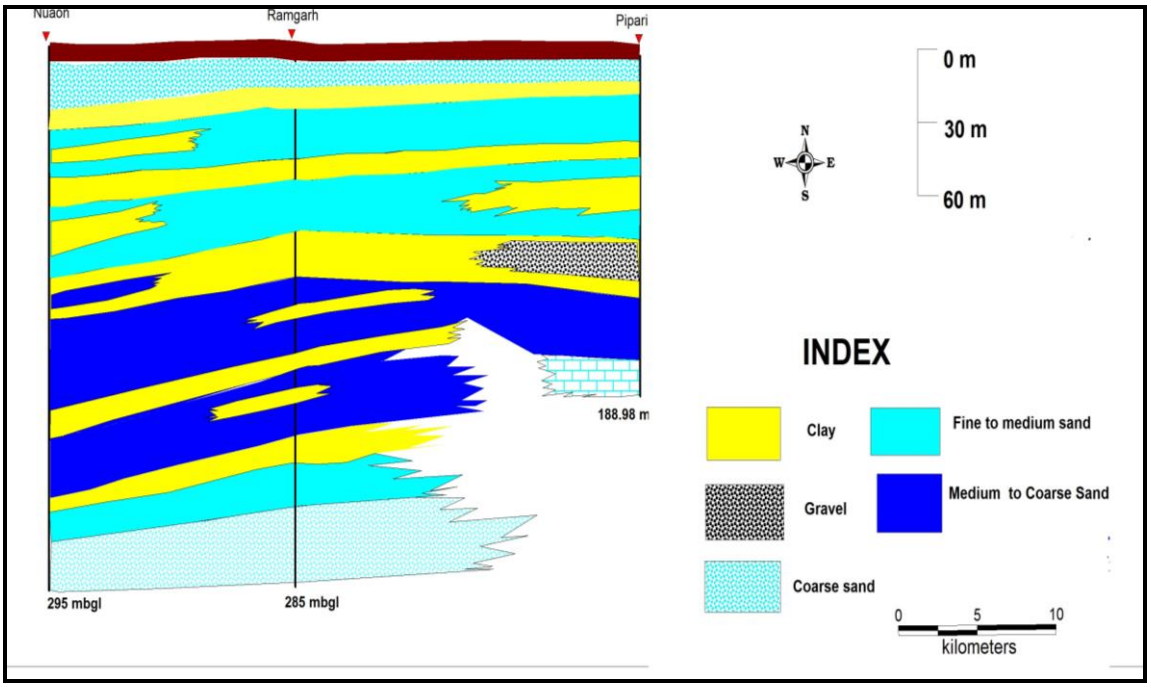

Figure 21: Hydrogeological section along north-south transect from Nuaon to Piparia

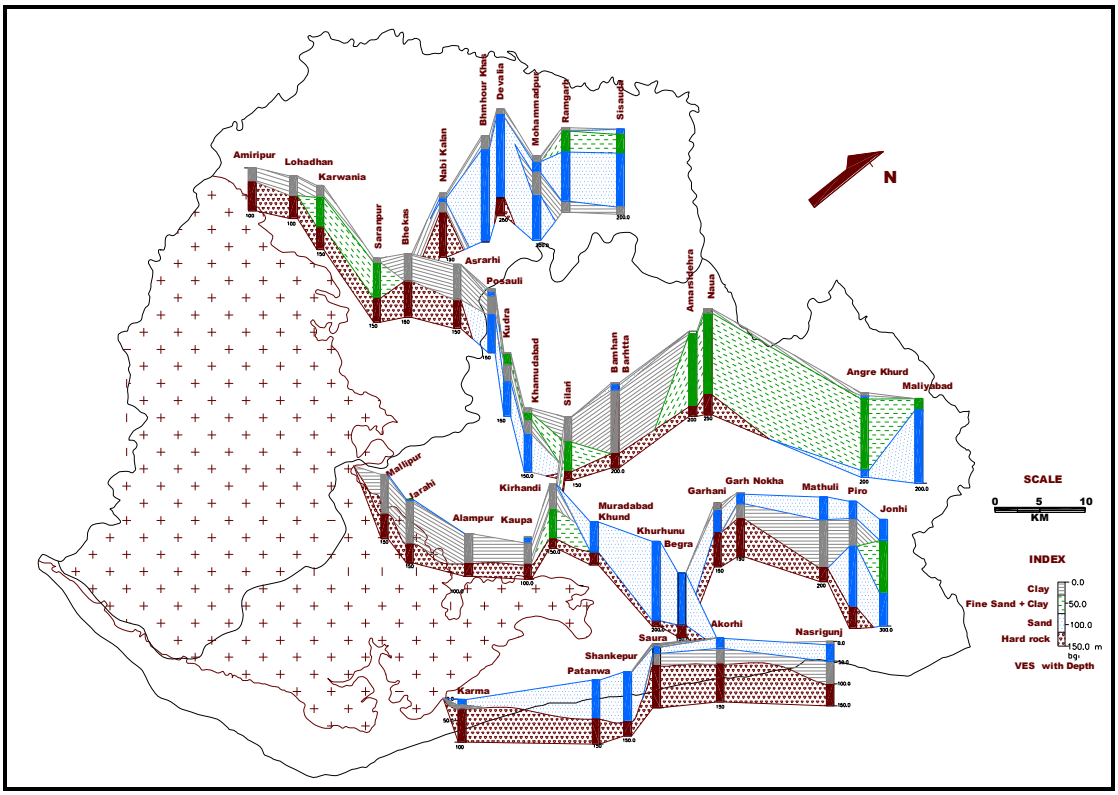

Figure 22: 2D Geophysical section along Kaimur to Rohtas district

CHAPTER –IV

GROUND WATER RESOURCES

4.1 Dynamic Ground Water Resources

Dynamic groundwater resource of Kaimur district has been assessed as per GEC-2017. Blockwise ground water assessment report has been mentioned in annexure IV. Summary of ground water estimation of the district is mentioned in table 4.1:-

Table 10: Summary of Dynamic Ground Water Resource Estimation of Kaimur District

	Dynamic GW Resource (in BCM)
Total Ground water Recharge	0.99
Provision of Natural Ground water Discharge	0.09
Net Ground Water Availability	0.90
Gross Ground water Draft for all uses	0.30
Current annual Ground Water draft for irrigation	0.26
Current annual Ground Water draft for domestic and industrial uses	0.03
Stage of Ground Water development (%)	33.19 %
Annual Allocation of Ground Water for domestic & industriall water supply for 2042	0.01
Net Ground Water Availability for 'Future Irrigation Use'	0.63

The overall stage of development in the district is 33.19%. All the blocks in the district has been categorised under safe category. There is spatial variation in the stage of development within the district Mohania block (SOD 54%) has the highest development of ground water resource and Adhaura block (SOD 7.8%) has the lowest development.

Principal source of ground water recharge is precipitation in the area. Rainfall infiltration contributes to about 60% of ground water recharge The other sources of recharge in the district include return flow of irrigation, seepage from canal, tanks etc. About 27% of ground water recharge is contributed by return flow from ground water irrigation.There is wide variation in ground water potential of the district. The variation is due to variation in nature of lithological units, geology and aquifer system in the area. In hard rock terrain the aquifer is confined to weathered mantle and fracture zones. The

alluvial sediments in forms viable water table aquifer and semi confined to confined aquifer**.**

4.2 Static Ground Water Resources

Static ground/in storage ground water resources has been computed blockwise. The methodology applied is as per GEC-2017 norms . The base of unconfined aquifer blockwise has been assessed through available ,lithologs, VES survey data. The availability of static ground water in Aquifer I, considering an specific yield of 6% for alluvial areas and 3% for sandstone formation is 4.8 BCM. Block wise estimated resource of Aquifer I is given in table 4.2

Table 11: Estimated block wise storage of Aquifer I

Administrative Units	Ground water Assessment Sub-Unit	Bottom of Unconfined Aquifer	GW Worthy Area	Pre-Monsoon Water Level	Specific Yield	In-Storage Resource	In-Storage Resource
		(m bgl)	(ha)	(m bgl)	(%)	(ham)	(bcm)
Adhaura	Vindhyan sandstone	40	72249	9.27	0.03	66606.4	0.7
Bhabhua	Alluvium	35	33449	8.27	0.06	53645.5	0.5
Bhagwanpur	Alluvium	25	4900	7.78	0.06	5062.7	0.1
Bhagwanpur	Vindhyan sandstone	20	6126	8.78	0.03	2062.0	0.0
Chainpur	Alluvium	50	40768	8.43	0.06	101683.6	1.0
Chainpur	Vindhyan sandstone	20	559	8.43	0.03	194.0	0.0
Chand	Alluvium	30	20670	8.45	0.06	26726.3	0.3
Durgawati	Alluvium	60	16764	7.09	0.06	53219.0	0.5
Kudra	Alluvium	35	21054	7.03	0.06	35332.8	0.4
Mohania	Alluvium	45	28552	6.99	0.06	65115.7	0.7
Nuaon	Alluvium	35	18900	5.72	0.06	33203.5	0.3
Ramgarh	Alluvium	25	16852	5.9	0.06	19312.4	0.2
Rampur	Alluvium	25	13251	8.24	0.06	13325.2	0.1
Rampur	Vindhyan sandstone	20	3946	9.24	0.03	1273.8	0.0
Total							**4.8**

(Based on Ground Water Estimation-2015)

CHAPTER - V

GROUND WATER RELATED ISSUES

5.1 Identification of issues

The major groundwater issue identified in the district are deeper water level at northwestern part ; shortage of water supply for irrigation and drinking purpose in plateau .Flouride and nitrate contamination of ground water has been reported.

5.1.1 Major Ground Water Issues

The major ground water issues are listed below:

(1) Deeper water level in north western part of district:

During pre and post monsoon monitoring deeper water level of 8-11 mbgl was noticed in Durgawati, Rampur blocks. The area has high cropping intensity and paddy is cultivated before the onset of monsoon. Due to erratic rainfall and pattern and uncertainity inthe release of canal water, farmers has resorted to using borewells . There is a mark significant increase in the number of borewells as well as the tube wells tapping deeper aquifer has been on significant rise.

(2) Shortage of drinking water supply for drinking and irrigation purpose in Adhaura plateau:

Ground water prospect in dissected plateau is poor whereas it is moderate along lineaments. The major source of rural water supply is based on ground water exploitation. Undulating topography and disperse habitation cause hindrance in water supply.

(3) Nitrate and fluoride contamination

Flouride and nitrate contamination has been reported from Kaimur through analysis of water samples by CGWB and PHED, Bihar. Flouride contamination is within the permissible limit (>1.5 mg/l) as per WHO recommendation. Nitrate contamination has been reported in Kaimur ,the possible contributor of nitrate to ground water is from decaying organic matter, sewage and barnyard waste and nitrate fertiliser.

Table 12 :Feasible Numbers of Additional Shallow Tubewells in Kaimur District

Block	Sub- Unit	Total Annual Recharge(ham)	Net Resource(ham)	Gross Draft All Uses(ham)	SOD(%)	Existing STW	Ground water draft at 70% SOD(ham)	Additional Resource Available(ham)	Feasible no. Of tubewells considering ground water availability
Bhabhua	Alluvium	11318.92	10187.03	5767.23	56.61	3099	7130.92	2909.64	1790
Chand	Alluvium	7292.83	6563.55	3421.11	52.12	1858	4594.48	1891.13	1163
Durgawati	Alluvium	5646.21	5081.59	1860.62	36.61	912	3557.11	1444.64	889
Kudra	Alluvium	15726.47	14153.82	3333.14	23.55	1639	9907.68	4149.88	2553
Mohania	Alluvium	9048.76	8596.32	4884.25	56.82	2577	6017.43	2447.63	1506
Nuaon	Alluvium	6050.44	5747.92	3043.05	52.94	1666	4023.54	1662.28	1022
Ramgarh	Alluvium	4056.76	3651.08	1454.97	39.85	245	2555.76	1017.99	626

(Based upon Groundwater Resource Estimation of Bihar, 2015, CGWB and MI Census 2013-2014)

***Estimation done only for alluvial areas**

CHAPTER - VI

MANAGEMENT STRATEGIES

Managment staretegies has been prepared considering the sustainability and equitability of ground water resource. Approximetely 45% of total land area is under cultivation so optimal utilisation of groundwater resource considering sustainability of aquifers and productivity of agriculture. The area is interspersed with different geological conditions so a uniform management pattern is not suitable. Demand of ground water for drinking and irrigation purpose in Vindhyans and Alluvium area is different. A broad management strategy has been prepared , taking into consideration that the management strategy can be suitably modified according to manifestation of area specific issues.

6.1 Ground water issue of plateau:

There is shortage of water for irrigation in plateau area. Storage scheme work to harness the available water resource in the headward region of Karmansha and Durgawati river. Storage scheme work in upper catchment can be constructed as the topography seems favourable for building of small reservoirs and tanks. It will help in ground water recharge apart from providing viable water source for drinking water and irrigation. The soil moisture in the plateau region is poor ;for proper ground water management micro-level ecological planning involving afforestation, soil and moisture conservation and artificial recharge techniques like creation of mini reservoir, construction of small weirs. Optimal beneficial development can be realized by conjuctive and systematic use of ground water.

6.2 Deeper water level in north western part of district:

Intensive agricultural practices are applied in alluvium areas due to availability of potential ground water resources. Paddy is majorly cultivated in this area. Depleting rainfall pattern during the sowing season and canal water source being not available, farmers resort to tube wells. It has been observed that abstraction structures has increased over the years along with increase in depth of penetration of deeper aquifer system. Economically well off farmers avail heavy duty tube wells which leads to hand pump at 60-70 feet go dry.

Sustainable agriculture is key to the future. An assessment of crop water requirement is needed so that ground water resources could be better managed. Shallow tubewells in alluvium zone has high yield potential so it must be used for irrigation. Deeper aquifers may be used only for drinking purpose. Water use efficiency techniques such as drip and sprinkler irrigation facilitates continuous availability of water to the root vicinity, thus plants grows with optimum soil moisture and proper aeration of the soil.

System of Rice Intensification (SRI) practices could be applied in near future for better conservation of resources. Under SRI paddy cultivation, paddy fields are not flooded but kept moist during the vegetative phase. Only one inch of water is maintained during later phase. The practice requires only about half as much water as normally applied in irrigated field. It helps in ground water conservation and involves less expenditure and gives more yields. It is beneficial for small and marginal farmers.

6.3 Management plan for drinking and domestic purpose:

Pipe water supply scheme is considered under mini –water supply scheme. To cover the 100% population of the blocks considering 40 lpcd of drinking water need. Considering the prevailing hydrogeological condition the average discharge of the wells ranges from 40m^3/hr to 100 m^3/hr and accordingly a unit draft one tubewell has been arrived at 8 hours running per day. Blockwise average number of tube wells has been arrived at and mentioned in table 12.

The northern part of the district has prominent water bearing zones and development for drinking purpose can be tapped from 1st and 2 nd aquifer. The 2nd aquifer may be developed for drinking and pipe water supply purpose. In marginal alluvium and hard rock areas potential fractures and interconnections may be possible source . Water development plan may be prepared keeping in view the hydrogeological condition, yield potential, and possible granular and water bearing fracture zones.

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Table 13: Fesible number of tubewells for pipe drinking water supply in Kaimur district

Block	Geology	Population	Annual resource required to cover total population(40 lpcd)ham	Unit draft of one TW in ham(considering average discharge and 8 hrs/day of running)	No. Of tubewells/bore wells required to cater to total population of the block
Adhaura	Hard Rock	57100	0.228	0.001	159
Bhabhua	Alluvium	301440	1.206	0.032	38
Bhagwanpur	Alluvium / Hard rock	91113	0.364	0.001	253
Chainpur	Alluvium / Hard rock	133682	0.535	0.032	17
Chand	Alluvium	187692	0.751	0.032	23
Durgawati	Alluvium	136962	0.548	0.080	7
Kudra	Alluvium	165145	0.661	0.080	8
Mohania	Alluvium	225181	0.901	0.080	11
Nuaon	Alluvium	106530	0.426	0.080	5
Ramgarh	Alluvium	132663	0.531	0.080	7
Rampur	Alluvium / Hard rock	88876	0.356	0.032	11

Stress aspect against future demand:

Demand of water is increasing day by day against the increasing population Demographic pattern is forecasted till 2030 based on census 2011. Consideringh water demand of 130 lpcd and 55 lpcd (according to MOHUA) for urban and rural areas, water demand for 2030 is projected. Projected demand of ground water for drinking purpose is 5457 Ham. The demand of water is increasing due to highly increasing of population. Thus, recommended for alternate surface water supply from river to reduce the stress of ground water

Table 14: Projected water demand

	2011				Population projection 2030		Water Demand (2030)	
Block	Total	Rural	Urban	Decadal growth	rural	urban	rural	urban
Ramgarh	132663	123973	8690.00	27.1	195233	13685	392	67
Nuaon	106530	106530	0.00	26.6	165263	0	332	0
Kudra	165145	165145	0.00	29.2	267908	0	538	0
Mohania	225181	218479	6702.00	28.3	349228	10713	701	53
Durgawati	136962	136962	0.00	23	202964	0	407	0
Chand	133682	133682	0.00	32	226550	0	455	0
Chainpur	187692	187692	0.00	28.8	300016	0	602	0
Bhabua	301440	251261	50179.00	27.6	395687	79022	794	389
Rampur	88876	88876	0.00	20.8	125669	0	252	0
Bhagwanpur	91113	91113	0.00	28.3	145640	0	292	0
Adhaura	57100	57100	0.00	27.8	89921	0	181	0
Total	1626384	1560813	65571.00		2464080	103420	4947	510

Block wise
Block Wise Aquifer Maps and Management plans

Salient Information
Name of the Block and Area (in km^2)
ADHAURA (923.42 sq. km)

District/ State
Kaimur/Bihar

Rainfall

The normal annual rainfall of Adhaura block is 1387 mm of which 95% occurs during the monsoon season. The normal rainfall during monsoon season is 1324 mm and during non monsoon season is 63 mm.

Agriculture and Irrigation

The block falls in the Agro-climatic Zone III. The cropping sequence followed in this zone is Rice – Wheat, Rice – Maize, Rice – Lentil, Rice – Rai. Principal crops sown are paddy, wheat, sugarcane, potato and vegetables. Crops are growing in all the four seasons namely Bhadai, Ahgani, Rabi and Garma seasons in a year. The soils in this zone are Sandy loam, Clay loam, red laterite soils , with pH in the range of 6.8 – 8.0. from 37.1 to 7.8˚C.

Ground water resource availability and extraction

The dynamic ground water resource of Adhaura block has been assessed as 81.90 MCM. The gross ground water draft for all uses stands at 6.37 MCM. The stage of Development is 7.78 % depicted in Annuexure I. 1491 STWs are feasible with available ground water resources considering up to 70% SOD.

Water level behaviour

The depth to water level varies from 4 to 7 mbgl during pre-monsoon season. In post monsoon season, the depth to water level varies from 2 to 5 mbgl in most parts.

Aquifer Disposition

Aquifer disposition in the bock is structurally controlled.Water bearing formations are encountered in fracture zones. Prominent fracture zones encountered during the course of exploration ar at depth of 109.7-110 mbgl, 97 mbgl and 128 mbgl.

Ground water resource, extraction, contamination and other issues

The stage of groundwater development in the block is 56.25% and water level trend is not declining. Shallow Tube Well (STW) is the main abstraction structure for irrigation purposes. No contamination is found in ground water of two aquifers.

Ground water resource enhancement

As the stage of groundwater development is within the safe limit and there is no long-term water level decline in the area, the need for artificial recharge through check dams and gabion structures.

Demand side interventions

There is no pumping zone capable of yielding moderate to high discharge, the only possibility indicated is the availability of aquifer capable of yielding low discharge. Artificial recharge structures need to built to augment the demand side intervention.

Annexure I

Dynamic Ground Water Resource Estimation

District	Blocks	Recharge from rainfall Monsoon	Recharge from rainfall Non-Monsoon	Recharge from other sources Monsoon	Recharge from other sources Non-Monsoon	Total ground water recharge	Provision for natural discharge	Net ground water availibility	Existing Gross Ground Water Draft for irrigation	Existing Gross Ground Water Draft for Domestic Uses	Existing Gross Ground Water Draft for Industrial Uses	Existing Gross Ground Water Draft for All Uses	Provision for Domestic and Industrial Requirement for Next 25 years	Net GW Availability for Future Irrigation Development	Stage of Ground Water Development (%)	Category:safe/semi-critical/critical/over-exploited.
		(ham)	(ham)	(ham)	(ham)	(ham)	(ham)	(ham)	(ham)	(ham)	(ham)	(ham)	(ham)	(ham)		
Kaimur	**Adhaura**	8328.89	478.29	109.61	183.70	9100.49	910.05	8190.44	513.09	93.99	30.35	637.43	94.00	7553.00	**7.78**	**Safe**

Annexure II

Chemical Analysis of Ground Water Sample

Location	Block	District	pH	EC	TH	Ca	Mg	Na	K	CO3	HCO3	Cl	NO3	SO4	F
Karar	Adhaura	Kaimur	7.9	126	1.2	14	6	0	3.2	0	61	0	15	0	0
Garka	Adhaura	Kaimur	8	467	3.8	62	9	22	4.7	0	244	4	25	17	0.15

Salient Information
Name of the Block and Area (in km^2)
BHABUA (334.39 sq. km)

District/ State
Kaimur/Bihar

Rainfall

The normal annual rainfall of Bhabua block is 1024 mm of which 95% occurs during the monsoon season. The normal rainfall during monsoon season is 956mm and during non monsoon season is 68 mm.

Agriculture and Irrigation

The block falls in the Agro-climatic Zone III. The cropping sequence followed in this zone is Rice – Wheat, Rice – Maize, Rice – Lentil, Rice – Rai. Principal crops sown are paddy, wheat, sugarcane, potato and vegetables. Crops are growing in all the four seasons namely Bhadai, Ahgani, Rabi and Garma seasons in a year. The soils in this zone are Sandy loam, Clay loam, with pH in the range of 6.8 – 8.0.Temparature ranges from from 37.1 to 7.8˚C.

Ground water resource availability and extraction

The dynamic ground water resource of Bhabua block has been assessed as 101.87 MCM. The gross ground water draft for all uses stands at 57.67 MCM. The stage of Development is 51.61 % depicted in Annexure I. 17909 STWs are feasible with available ground water resources considering up to 70% SOD.

Water level behaviour

The depth to water level varies from 4 to 10 mbgl during pre-monsoon season. In post monsoon season, the depth to water level varies from 2 to 7 mbgl in most parts.

Aquifer Disposition

Aquifer disposition in the bock is structurally controlled. Water bearing formations are encountered in fracture zones. Prominent fracture zones encountered during the course of exploration at depth of 109.7-110 mbgl, 97 mbgl and 128 mbgl.

Ground water resource, extraction, contamination and other issues

The stage of groundwater development in the block is 56.61% and water level trend is not declining. Shallow Tube Well (STW) is the main abstraction structure for irrigation purposes.

Ground water resource enhancement

As the stage of groundwater development is within the safe limit and there is no long-term water level decline in the area. Artificial recharge method should be carried out to enhance ground water resource.

Demand side interventions

There is no pumping zone capable of yielding moderate to high discharge, the only possibility indicated is the availability of aquifer capable of yielding low discharge. Artificial recharge structures need to build to augment the demand side intervention.

Annexure I

Dynamic Ground Water Resource Estimation

District	Blocks	Recharge from rainfall Monsoon	Recharge from rainfall Non-Monsoon	Recharge from other sources Monsoon	Recharge from other sources Non-Monsoon	Total ground water recharge	Provision for natural discharge	Net ground water availibility	Existing Gross Ground Water Draft for irrigation	Existing Gross Ground Water Draft for Domestic Uses	Existing Gross Ground Water Draft for Industrial Uses	Existing Gross Ground Water Draft for All Uses	Provision for Domestic and Industrial Requirement for Next 25 years	Net GW Availability for Future Irrigation Development	Stage of Ground Water Development (%)	Category:safe/semi-critical/critical/over-exploited.
Kaimur	Bhabhua	8483.23	487.15	798.5	1550.04	11318.92	1131.892	10187.03	5074.17	413.61	279.45	5767.23	413.62	4419.79	56.61	Safe

Annexure II

Chemical Analysis of Ground Water Sample

District	Location	Block	District	pH	EC	TH	Ca	Mg	Na	K	CO3	HCO3	Cl	NO3	SO4	F
Kaimur	Nibkhura	Bhabua	Kaimur	8.1	696	4.5	58	19	42	2.3	0	305	18	50	5	0.41
Kaimur	Daraula	Bhabua	Kaimur	7.9	614	5.6	92	12	30	1.4	0	323	11	44	26	0.54
Kaimur	Jadupur	Babhua	Kaimur	7.8	507	4.7	72	13	27	1.9	0	262	14	38	30	0.23
Kaimur	Nirbispur	Bhabua	Kaimur	8	327	3	38	13	2.8	3.4	0	171	4	8	10	0
Kaimur	Silautu	Bhabua	Kaimur	8.1	821	2.5	36	9	147	2.1	0	427	7	49	45	0.25
Kaimur	Samra	Bhabua	Kaimur	8.2	366	2.4	30	11	28	3.6	0	195	4	14	12	0

Salient Information
Name of the Block and Area (in km^2)
BHAGWANPUR (231.5sq. km)

District/ State
Kaimur/Bihar

Rainfall

The normal annual rainfall of Bhagwanpur block is 972.1 mm of which 95% occurs during the monsoon season. The normal rainfall during monsoon season is 910 mm and during non monsoon season is 62 mm.

Agriculture and Irrigation

The block falls in the Agro-climatic Zone III. The cropping sequence followed in this zone is Rice – Wheat, Rice – Maize, Rice – Lentil, Rice – Rai. Principal crops sown are paddy, wheat, sugarcane, potato and vegetables. Crops are growing in all the four seasons namely Bhadai, Ahgani, Rabi and Garma seasons in a year. The numbers of irrigation structures are as follows:

Block	Dug well	Shallow tube well	Medium tube well	Deep tube well
Bhagwanpur	**642**	**444**	**570**	**78**

Ground water resource availability and extraction

The dynamic ground water resource of Bhagwanpur block has been assessed as 74.44 MCM. The gross ground water draft for all uses stands at 15.59 MCM. The stage of Development is 20.94 % depicted in Annexure I. 1323 STWs are feasible with available ground water resources considering up to 70% SOD.

Water level behaviour

The depth to water level varies from 4 to 10 mbgl during pre-monsoon season. In post monsoon season, the depth to water level varies from 2 to 7 mbgl in most parts.

Aquifer Disposition

Exploration carried out at Bhagwanpur reveals that there is thick clay overburden upto the depth of 40 mbgl along with occurrence of boulder bed. No major aquifer zone has been encountered at Bhagwanpur block.

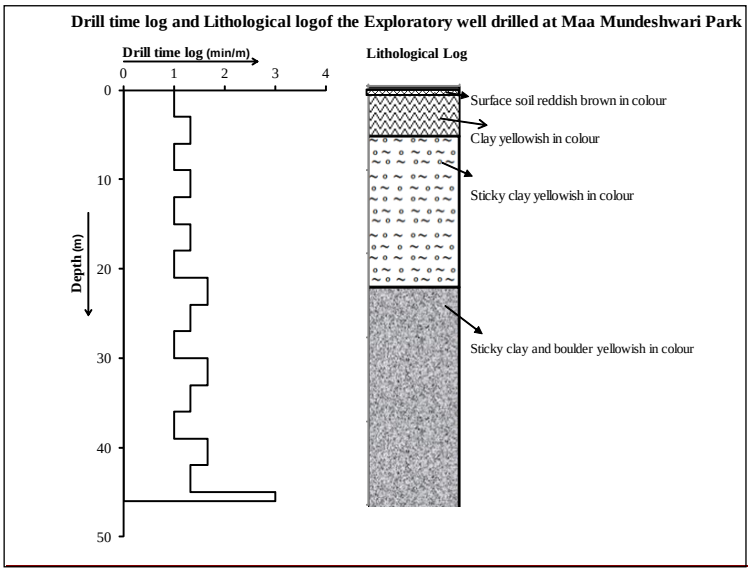

Fig: Lihtological log of exploratory well at Bhagwanpur block

Ground water resource enhancement

As the stage of groundwater development is within the safe limit and there is no long-term water level decline in the area. Artificial recharge method should be carried out to enhance ground water resource.

Demand side interventions

Major aquifer zones has not been encountered till the depth of 40 mbgl, the only possibility indicated is the availability of aquifer capable of yielding low discharge. Artificial recharge structures need to build to augment the demand side intervention.

Annexure I

Dynamic Ground Water Resource Estimation

District	Blocks	Recharge from rainfall Monsoon	Recharge from rainfall Non-Monsoon	Recharge from other sources Monsoon	Recharge from other sources Non-Monsoon	Total ground water recharge	Provision for natural discharge	Net ground water availibility	Existing Gross Ground Water Draft for irrigation	Existing Gross Ground Water Draft for Domestic Uses	Existing Gross Ground Water Draft for Industrial Uses	Existing Gross Ground Water Draft for All Uses	Provision for Domestic and Industrial Requirement for Next 25 years	Net GW Availability for Future Irrigation Development	Stage of Ground Water Development (%)	Category:safe/semi-critical/critical/over-exploited.
Kaimur	Bhagwanpur	1761.54	111.91	2911.67	3192.33	7977.45	532.57	7444.88	1087.01	397.79	74.24	1559.04	397.80	5885.83	20.94	Safe

Annexure II

Chemical Analysis of Ground Water Sample

Block	District	pH	EC	TH	Ca	Mg	Na	K	CO3	HCO3	Cl	NO3	SO4	F
Bhagwanpur	Kaimur	7.9	815	6.7	110	15	46	3.5	0	397	11	65	42	0.23

Salient Information
Name of the Block and Area (in km^2)
CHAINPUR (454.64 sq. km)

District/ State
Kaimur/Bihar
Population (as per 2011 census): 227101

Normal Annual Rainfall : 901.7 mm

Agriculture and Irrigation

The block falls in the Agro-climatic Zone III. The cropping sequence followed in this zone is Rice – Wheat, Rice – Maize, Rice – Lentil, Rice – Rai. Principal crops sown are paddy, wheat, sugarcane, potato and vegetables. Crops are growing in all the four seasons namely Bhadai, Ahgani, Rabi and Garma seasons in a year. The numbers of irrigation structures are as follows:

Block	Dug well	Shallow tube well	Medium tube well	Deep tube well
Chainpur	670	511	732	112

Ground water resource availability and extraction

The dynamic ground water resource of Chainpur block has been assessed as 140.22 MCM. The gross ground water draft for all uses stands at 22.37 MCM. The stage of Development is 15.96 % depicted in Annexure I. 2521STWs are feasible with available ground water resources considering up to 70% SOD.

Water level behaviour

The depth to water level varies from 5to 8 mbgl during pre-monsoon season. In post monsoon season, the depth to water level varies from 3 to 7 mbgl in most parts.

Aquifer Disposition

Exploration carried out at Chainpur block down to depth of 80 mbgl reveals that there is aquifer zone is encountered at depth range of 39 to 48 mbgl. Transmissivity of the aquifer is 4094 m^2/day .

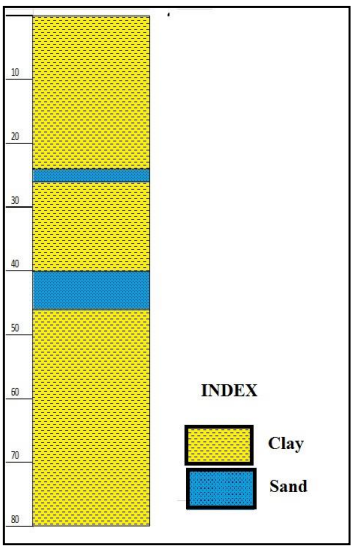

Fig: Lihtological log of exploratory well at Chainpur block.

Ground water resource enhancement

As the stage of groundwater development is within the safe limit and there is no long-term water level decline in the area. Artificial recharge method should be carried out to enhance ground water resource.

Annexure I

Dynamic Ground Water Resource Estimation

Blocks	Recharge from rainfall Monsoon	Recharge from rainfall Non-Monsoon	Recharge from other sources Monsoon	Recharge from other sources Non-Monsoon	Total ground water recharge	Provision for natural discharge	Net ground water availibility	Existing Gross Ground Water Draft for irrigation	Ground Water Draft for Domestic Uses	Ground Water Draft for Industrial Uses	Existing Gross Ground Water Draft for All Uses	Industrial Requirement for Next 25 years	Net GW Availability for Future Irrigation Development	Stage of Ground Water Development (%)	Category safe/semi-critical/critical/over exploited
Chainpur	10403.89	597.45	2149.84	2429.36	15580.54	1558.05	14022.49	1822.45	308.97	106.57	2237.99	308.97	11784.50	15.96	Safe

Annexure II

Chemical Analysis of Ground Water Sample

Location	Block	District	pH	EC	TH	Ca	Mg	Na	K	CO3	HCO3	Cl	NO3	SO4	F
Madurna	**Chainpur**	**Kaimur**	7.8	1365	5	42	35	185	3.2	0	610	28	70	55	0.82
Khoradih	**Chainpur**	**Kaimur**	7.8	347	3.2	56	5	6.82	1.9	0	177	4	23	8	0.15

Salient Information
Name of the Block and Area (in km^2)
CHAND (206.70 sq. km)

District/ State
Kaimur/Bihar
Population (as per 2011 census): 161147.
Normal Annual Rainfall : 875.6 mm

Agriculture and Irrigation

The block falls in the Agro-climatic Zone III. The cropping sequence followed in this zone is Rice – Wheat, Rice – Maize, Rice – Lentil, Rice – Rai. Principal crops sown are paddy, wheat, sugarcane, potato and vegetables. Crops are growing in all the four seasons namely Bhadai, Ahgani, Rabi and Garma seasons in a year. The number of irrigation structures is as follows:

Dug Well	**15**
Shallow Tube well	1715
Medium Tube Well	13
Deep Tube wells	0

Ground water resource availability and extraction

The dynamic ground water resource of Chand block has been assessed as 65.63 MCM. The gross ground water draft for all uses stands at 34.21 MCM. The stage of Development is 52.12 % depicted in Annuexure I. 1163 STWs are feasible with available ground water resources considering up to 70% SOD.

Water level behaviour

The depth to water level varies from 4.2 to 10.8 mbgl during pre-monsoon season. In post monsoon season, the depth to water level varies from 2.7 to 7.3 mbgl in most parts.

Aquifer Disposition

Exploration carried out at Chainpur block down to depth of 80 mbgl reveals that there is aquifer zone is encountered at depth range of 39 to 48 mbgl. Transmissivity of the aquifer is 4094 m^2/day.

Annexure I

Dynamic Ground Water Resource Estimation

Blocks	Recharge from rainfall Monsoon	Recharge from rainfall Non-Monsoon	Recharge from other sources Monsoon	Recharge from other sources Non-Monsoon	Total ground water recharge	Provision for natural discharge	Net ground water availibility	Existing Gross Ground Water Draft for irrigation	Ground Water Draft for Domestic Uses	Ground Water Draft for Industrial Uses	Existing Gross Ground Water Draft for All Uses	Industrial Requirement for Next 25 years	Net GW Availability for Future Irrigation Development	Stage of Ground Water Development (%)	Category safe/semi-critical/critical/over exploited
Chand	5242.26	301.04	799.04	950.49	7292.83	729.28	6563.55	3038.14	220.06	162.91	3421.11	220.06	3142.44	52.12	Safe

Annexure II

Chemical Analysis of Ground Water Sample

Location	Block	pH	EC	TH	Ca	Mg	Na	K	CO3	HCO3	Cl	NO3	SO4	F
Baradhi	Chand	7.6	541	1.9	38	0	66	1.9	0	238	7	30	14	0.21
Biuri	Chand	7.8	1217	10	200	0	40	2.4	0	531	18	73	62	0.85
Mahdaich	Chand	7.9	1325	9	140	24	101	2.5	0	622	36	65	54	0.8
Kukra	Chand	7.6	509	2.9	30	17	49	1.7	0	232	18	32	12	0.35

Salient Information
Name of the Block and Area (in km^2)
DURGAWATI (167.64 sq. Km)

District/ State
Kaimur/Bihar
Population (as per 2011 census): 162765

Normal Annual Rainfall : 957.76 mm

Agriculture and Irrigation

The block falls in the Agro-climatic Zone III. The cropping sequence followed in this zone is Rice – Wheat, Rice – Maize, Rice – Lentil, Rice – Rai. Principal crops sown are paddy, wheat, sugarcane, potato and vegetables. Crops are growing in all the four seasons namely Bhadai, Ahgani, Rabi and Garma seasons in a year. The number of irrigation structures are as follows:

Dug Well	**92**
Shallow Tube well	839
Medium Tube Well	4
Deep Tube wells	2

Kharif and rabi crop coverage during 2017-2018 (in hectares)

	Kharif (in hectares)				**Rabi (in hectares)**			
Block	**Paddy**	**Maize**	**Pulses**	**Oilseeds**	**Wheat**	**Barley**	**Pulses**	**Oilseeds**
Durgawati	8270	20	145	0	5915	40	1660	395
Source: District Agriculture Office, Kaimur,								

Ground water resource availability and extraction

The dynamic ground water resource of Durgawati block has been assessed as 50.81 MCM. The gross ground water draft for all uses stands at 18.60 MCM. The stage of Development is 36.61 % depicted in Annexure I. 889 STWs are feasible with available ground water resources considering up to 70% SOD.

Water level behaviour

The depth to water level varies from 6.4 to 11.4 mbgl during pre-monsoon season. In post monsoon season, the depth to water level varies from 3.2 to 8.7 mbgl in most parts.

Aquifer Disposition

Exploration carried out at Durgawati block down to depth of 87.89 mbgl reveals that the thickness of aquifer zone is encountered 26.20 metre consisting .Transmissivity of the aquifer is 2200 m^2/day .

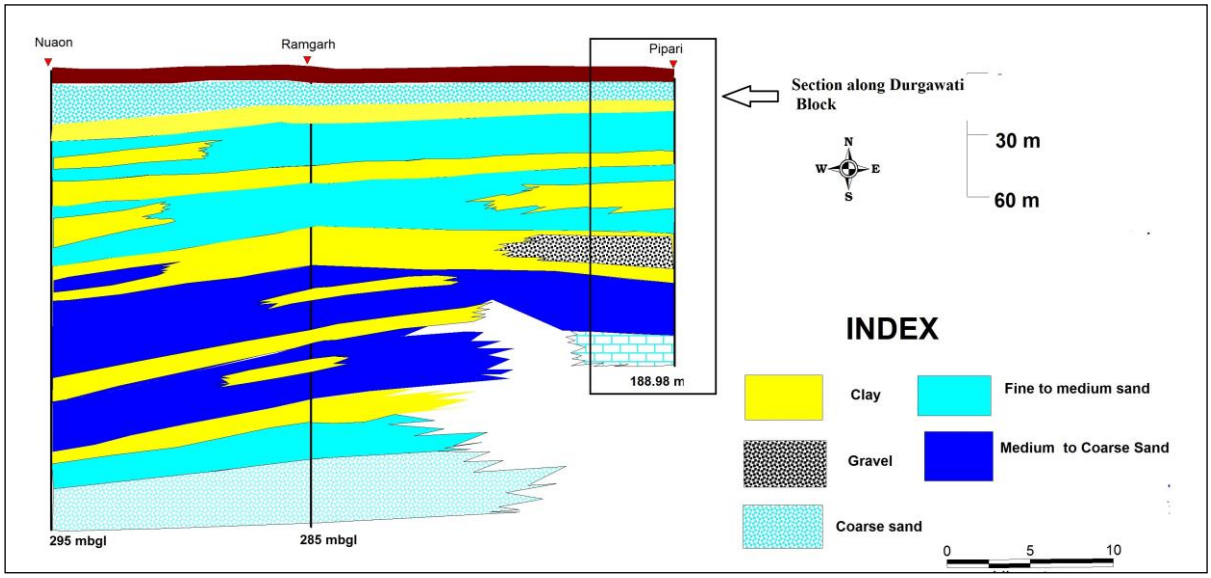

Fig: Lihtological log of exploratory well at Durgawati block

Annexure I

Dynamic Ground Water Resource Estimation

Blocks	Recharge from rainfall Monsoon	Recharge from rainfall Non-Monsoon	Recharge from other sources Monsoon	Recharge from other sources Non-Monsoon	Total ground water recharge	Provision for natural discharge	Net ground water availibility	Existing Gross Ground Water Draft for irrigation	Ground Water Draft for Domestic Uses	Ground Water Draft for Industrial Uses	Existing Gross Ground Water Draft for All Uses	Industrial Requirement for Next 25 years	Net GW Availability for Future Irrigation Development	Stage of Ground Water Development (%)	Category safe/semi-critical/critical/over exploited
Durgawati	2834.42	244.15	1547.86	1019.78	5646.21	564.62	5081.59	1546.56	225.46	88.60	1860.62	225.46	3220.97	36.61	Safe

Annexure II

Chemical Analysis of Ground Water Sample

Location	Block	pH	EC	TH	Ca	Mg	Na	K	CO3	HCO3	Cl	NO3	SO4	F
Kabilaspur	**Durgawati**	**7.8**	**377**	**4.2**	**70**	**9**	**8.75**	**3.9**	**0**	**153**	**18**	**34**	**54**	**0.19**
Gora	**Durgawati**	**8.2**	**403**	**3**	**56**	**2**	**25**	**1.5**	**0**	**189**	**7**	**32**	**15**	**0.15**

Salient Information
Name of the Block and Area (in km^2)
KUDRA : (210.54 sq. Km)

District/ State
Kaimur/Bihar
Population (as per 2011 census): 198312.

Normal Annual Rainfall: 755.51 mm

Agriculture and Irrigation

The block falls in the Agro-climatic Zone III. The cropping sequence followed in this zone is Rice – Wheat, Rice – Maize, Rice – Lentil, Rice – Rai. Principal crops sown are paddy, wheat, sugarcane, potato and vegetables. Crops are growing in all the four seasons namely Bhadai, Ahgani, Rabi and Garma seasons in a year. The number of irrigation structures are as follows:

Dug Well	**367**
Shallow Tube well	1524
Medium Tube Well	995
Deep Tube wells	493

Kharif and rabi crop coverage during 2017-2018 (in hectares)

	Kharif (in hectares)				Rabi (in hectares)			
Block	**Paddy**	**Maize**	**Pulses**	**Oilseeds**	**Wheat**	**Barley**	**Pulses**	**Oilseeds**
Kudra	**15714**	**15**	**130**	**5**	**9210**	**85**	**1540**	**345**
Source: District Agriculture Office, Kaimur,								

Ground water resource availability and extraction

The dynamic ground water resource of **Kudra** block has been assessed as 141.53 MCM. The gross ground water draft for all uses stands at 33.33 MCM. The stage of Development is 23.55 % depicted in Annexure I. 2553 STWs are feasible with available ground water resources considering up to 70% SOD.

Water level behaviour

The depth to water level varies from 4.9 to 7.4 mbgl during pre-monsoon season. In post monsoon season, the depth to water level varies from 3.1 to 5.7 mbgl in most parts.

Aquifer Disposition

Granular zones delineated from exploration data reveals that aquifer zones are encountered at:

Shallow aquifer zone: 10-30 mbgl , average thickness is 20 m.

Deeper aquifer zone I: 95-125 mbgl, average thickness of 30 m.

Deeper aquifer zone II: 130-165 mbgl, average thickness of 35 m.

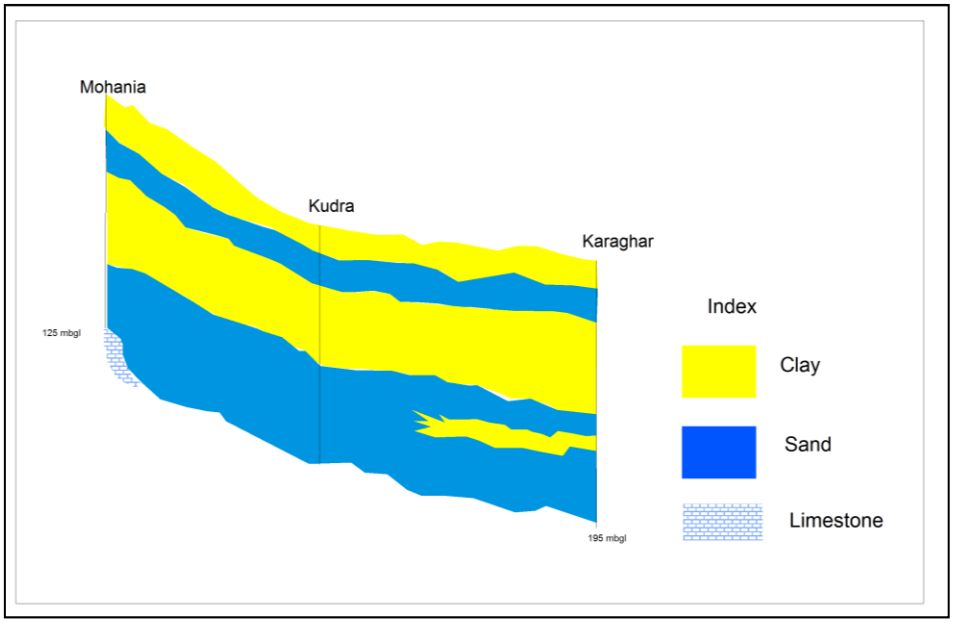

Fig: Aquifer disposition along Kudra block

Annexure I

Dynamic Ground Water Resource Estimation

Blocks	Recharge from rainfall Monsoon	Recharge from rainfall Non-Monsoon	Recharge from other sources Monsoon	Recharge from other sources Non-Monsoon	Total ground water recharge	Provision for natural discharge	Net ground water availibility	Existing Gross Ground Water Draft for irrigation	Ground Water Draft for Domestic Uses	Ground Water Draft for Industrial Uses	Existing Gross Ground Water Draft for All Uses	Industrial Requirement for Next 25 years	Net GW Availability for Future Irrigation Development	Stage of Ground Water Development (%)	Category safe/semi-critical/critical/over exploited
Kudra	**5339.65**	306.63	3916.54	6163.65	15726.47	1572.65	14153.82	2902.57	271.85	158.72	3333.14	271.86	10820.67	23.55	Safe

Annexure II

Chemical Analysis of Ground Water Sample

Location	Block	pH	EC	TH	Ca	Mg	Na	K	CO3	HCO3	Cl	NO3	SO4	F
Mokaran	**Kudra**	7.9	597	4.7	70	15	40	2.4	0	317	7	35	22	0.17
Asraulia	**Kudra**	7.1	357	3.1	48	9	30	6.4	0	214	4	50	10	0
Bhadaura	**Kudra**	7.9	392	2	30	6	32	1.8	0	153	4	12	30	0
Chtrabhuji sthan	**Kudra**	7.8	1132	7.3	100	28	91	1.7	0	494	25	69	65	0.94

Salient Information
Name of the Block and Area (in km^2)
MOHANIA : (285.52 sq. Km)

District/ State
Kaimur/Bihar
Population (as per 2011 census): 269088

Normal Annual Rainfall: 929.1 mm

Agriculture and Irrigation

The block falls in the Agro-climatic Zone III. The cropping sequence followed in this zone is Rice – Wheat, Rice – Maize, Rice – Lentil, Rice – Rai. Principal crops sown are paddy, wheat, sugarcane, potato and vegetables. Crops are growing in all the four seasons namely Bhadai, Ahgani, Rabi and Garma seasons in a year. The number of irrigation structures are as follows:

Dug Well	**88**
Shallow Tube well	1548
Medium Tube Well	883
Deep Tube wells	220

Kharif and Rabi crop coverage during 2017-2018 (in hectares)

	Kharif (in hectares)				Rabi (in hectares)			
Block	**Paddy**	**Maize**	**Pulses**	**Oilseeds**	**Wheat**	**Barley**	**Pulses**	**Oilseeds**
Mohania	13033	65	115	7	14700	200	2160	410
Source: District Agriculture Office, Kaimur,								

Ground water resource availability and extraction

The dynamic ground water resource of Mohania block has been assessed as 85.96 MCM. The gross ground water draft for all uses stands at 48.84 MCM. The stage of Development is 56.82 % depicted in Annuexure I. 1506 STWs are feasible with available ground water resources considering up to 70% SOD.

Water level behaviour

The depth to water level varies from 4.9 to 11.5 m bgl during pre-monsoon season. In post monsoon season, the depth to water level varies from 3.02 to 4.78 m bgl in most parts.

Aquifer Disposition

Granular zones delineated from exploration data reveals that aquifer zones are encountered at:

Shallow aquifer zone: 10-30 mbgl , average thickness is 20 m.

Deeper aquifer zone I: 95-125 mbgl, average thickness of 30 m.

Deeper aquifer zone II: 130-165 mbgl, average thickness of 35 m.

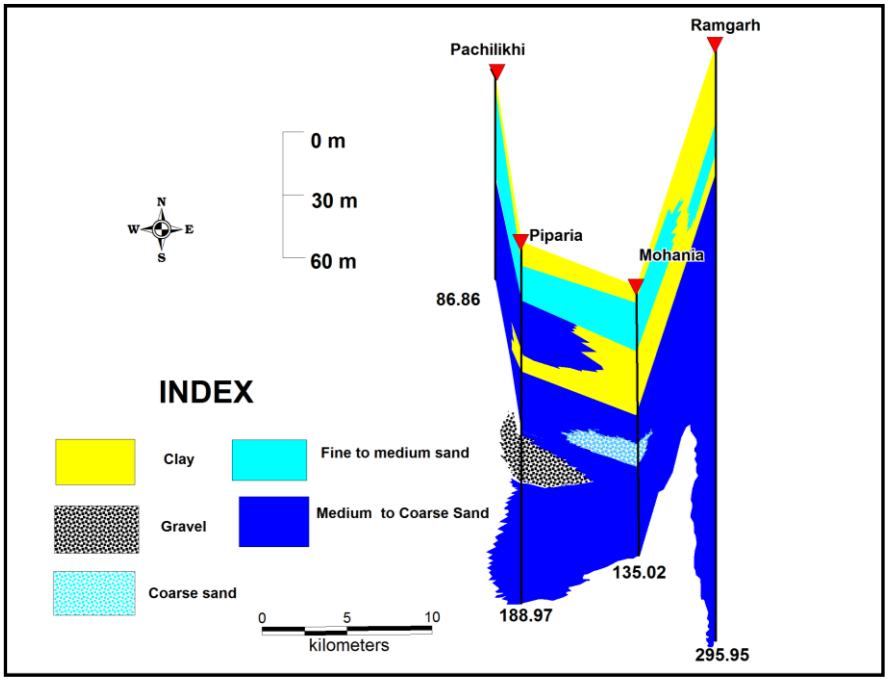

Fig: Aquifer disposition along Mohania block

Annexure I

Dynamic Ground Water Resource Estimation

Blocks	Recharge from rainfall Monsoon	Recharge from rainfall Non-Monsoon	Recharge from other sources Monsoon	Recharge from other sources Non-Monsoon	Total ground water recharge	Provision for natural discharge	Net ground water availability	Existing Gross Ground Water Draft for irrigation	Ground Water Draft for Domestic Uses	Ground Water Draft for Industrial Uses	Existing Gross Ground Water Draft for All Uses	Industrial Requirement for Next 25 years	Net GW Availability for Future Irrigation Development	Stage of Ground Water Development (%)	Category safe/semi-critical/critical/over exploited
Mohania	6302.19	415.83	792.54	1538.20	9048.76	452.44	8596.32	4256.91	392.74	234.60	4884.25	392.75	3712.06	56.82	Safe

Annexure II

ical Analysis of Ground Water SampleChem

Location	Block	pH	EC	TH	Ca	Mg	Na	K	CO3	HCO3	Cl	NO3	SO4	F
Usri	Mohania	8	759	5.7	84	18	38	5.2	0	354	14	25	40	0.81
Karmhara	Mohania	8	842	7.3	124	13	27	3.2	0	397	11	39	52	0.61
Muijan	Mohania	8.1	143	1.1	16	4	0	1.7	0	61	0	8	0	0
Bomhar khas	Mohania	7.8	444	2.2	44	0	56	2.5	0	189	7	25	45	0
Bokhari	Mohania	8	467	3.2	20	27	26	3.1	0	201	4	35	20	0

Salient Information
Name of the Block and Area (in km^2)
NUAON : 189 sq. Km

District/ State
Kaimur/Bihar
Population (as per 2011 census): 127433

Normal Annual Rainfall: 723.7 mm

Agriculture and Irrigation

The block falls in the Agro-climatic Zone III. The cropping sequence followed in this zone is Rice – Wheat, Rice – Maize, Rice – Lentil, Rice – Rai. Principal crops sown are paddy, wheat, sugarcane, potato and vegetables. Crops are growing in all the four seasons namely Bhadai, Ahgani, Rabi and Garma seasons in a year. The number of irrigation structures are as follows:

Dug Well	**11**
Shallow Tube well	**1418**
Medium Tube Well	**318**
Deep Tube wells	**33**

Kharif and Rabi crop coverage during 2017-2018 (in hectares)

	Kharif (in hectares)				Rabi (in hectares)			
Block	**Paddy**	**Maize**	**Pulses**	**Oilseeds**	**Wheat**	**Barley**	**Pulses**	**Oilseeds**
Nuaon	7784	21	114	2	6960	30	1130	350
Source: District Agriculture Office, Kaimur,								

Ground water resource availability and extraction

The dynamic ground water resource of Nuaon block has been assessed as 54.47 MCM. The gross ground water draft for all uses stands at 30.43 MCM. The stage of Development is 52.49 % depicted in Annexure I. 1022 STWs are feasible with available ground water resources considering up to 70% SOD.

Water level behaviour

The depth to water level varies from 4 to 6.8 mbgl during pre-monsoon season. In post monsoon season, the depth to water level varies from 2.42 to 4.78 mbgl in most parts.

Aquifer Disposition

Aquifer disposition and characteristics can be ascertained through bore hole data at the block. Aquifer zones are delineated in the block based on exploration data down to depth of 295 mbgl. Aquifer zones are of different grades of sand, silt and clay.

Shallow aquifer zone: 10-30 mbgl , average thickness is 20 m.

Deeper aquifer zone I: 95-125 mbgl, average thickness of 30 m.

Deeper aquifer zone II: 130-165 mbgl, average thickness of 35 m.

Deeper aquifer zone II: 210-250 mbgl, average thickness of 40m.

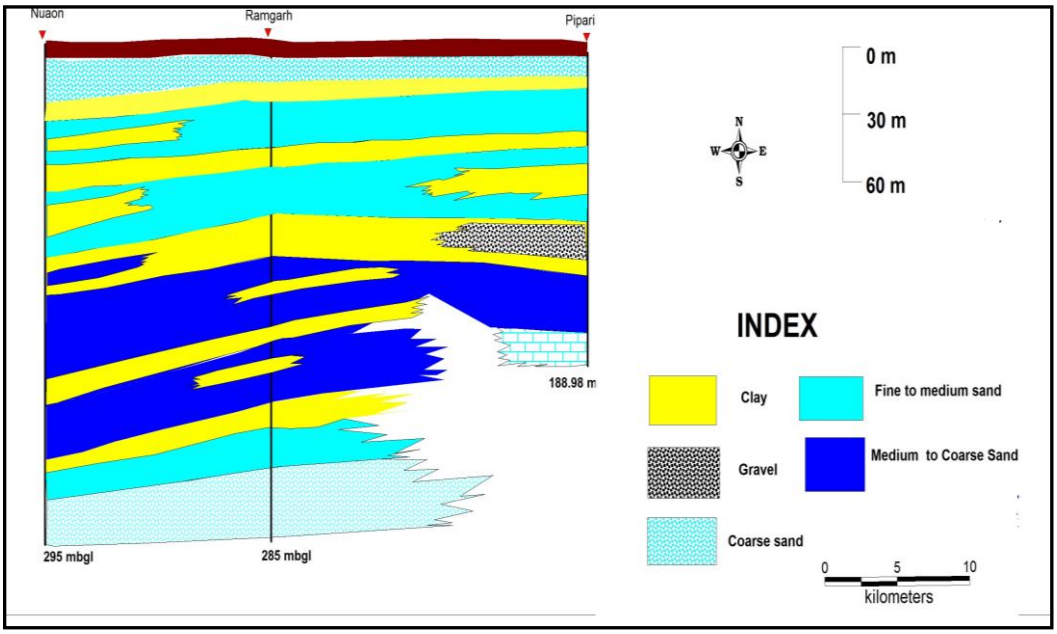

Fig: Aquifer disposition along Nuaon block

Annexure I

Dynamic Ground Water Resource Estimation

Blocks	Recharge from rainfall Monsoon	Recharge from rainfall Non-Monsoon	Recharge from other sources Monsoon	Recharge from other sources Non-Monsoon	Total ground water recharge	Provision for natural discharge	Net ground water availibility	Existing Gross Ground Water Draft for irrigation	Ground Water Draft for Domestic Uses	Ground Water Draft for Industrial Uses	Existing Gross Ground Water Draft for All Uses	Industrial Requirement for Next 25 years	Net GW Availability for Future Irrigation Development	Stage of Ground Water Development (%)	Category safe/semi-critical/critical/over exploited
Nuaon	3872.97	275.26	647.14	1255.07	6050.44	302.52	5747.92	2722.78	175.36	144.91	3043.05	175.37	2704.86	52.94	Safe

Annexure II

Chemical Analysis of Ground Water Sample

Location	Block	pH	EC	TH	Ca	Mg	Na	K	CO3	HCO3	Cl	NO3	SO4	F
Jaitpur	Nuon	7.6	388	2.2	40	2	42	2.6	0	177	4	35	25	0.13
Etwa english	Nuon	7.9	768	6.5	96	21	23	5.2	0	366	11	52	22	0.65
Mukhraon	Nuon	7.7	861	7	68	44	35	6.8	0	403	14	55	36	0.94
Kuchilliana	Nuon	7.9	932	5.2	98	4	88	2.1	0	415	18	60	36	0.85

Salient Information
Name of the Block and Area (in km^2)
RAMGARH : 168.52 sq. Km

District/ State
Kaimur/Bihar
Population (as per 2011 census): 157369

Normal Annual Rainfall: 552.6 mm

Agriculture and Irrigation

The block falls in the Agro-climatic Zone III. The cropping sequence followed in this zone is Rice – Wheat, Rice – Maize, Rice – Lentil, Rice – Rai. Principal crops sown are paddy, wheat, sugarcane, potato and vegetables. Crops are growing in all the four seasons namely Bhadai, Ahgani, Rabi and Garma seasons in a year. The number of irrigation structures are as follows:

Dug Well	**1140**
Shallow Tube well	227
Medium Tube Well	82
Deep Tube wells	44

Kharif and Rabi crop coverage during 2017-2018 (in hectares)

	Kharif (in hectares)				Rabi (in hectares)			
Block	**Paddy**	**Maize**	**Pulses**	**Oilseeds**	**Wheat**	**Barley**	**Pulses**	**Oilseeds**
Ramgarh	10605	85	250	6	7935	65	1360	400
Source: District Agriculture Office, Kaimur,								

Ground water resource availability and extraction

The dynamic ground water resource of Ramgarh block has been assessed as 36.51 MCM. The gross ground water draft for all uses stands at 14.54 MCM. The stage of Development is 39.85 % depicted in Annuexure I. 626 STWs are feasible with available ground water resources considering up to 70% SOD.

Water level behaviour

The depth to water level varies from 5.1 to 7.1 mbgl during pre-monsoon season. In post monsoon season, the depth to water level varies from 1.82 to 2.43 mbgl in most parts.

Aquifer Disposition

Aquifer disposition and characteristics can be ascertained through bore hole data at the block. Aquifer zones are delineated in the block based on exploration data down to depth of 295 mbgl. Aquifer zones are of different grades of sand, silt and clay.

Shallow aquifer zone: 10-30 mbgl , average thickness is 20 m.

Deeper aquifer zone I: 95-125 mbgl, average thickness of 30 m.

Deeper aquifer zone II: 130-165 mbgl, average thickness of 35 m.

Deeper aquifer zone II: 210-250 mbgl, average thickness of 40m.

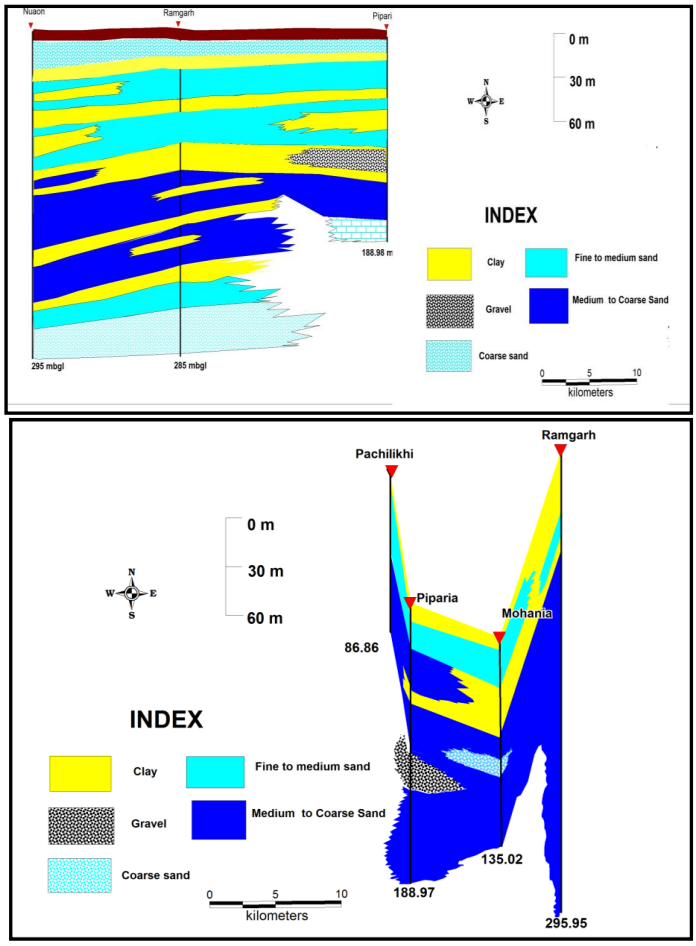

Fig: Aquifer disposition along Ramgarh block

Annexure I

Dynamic Ground Water Resource Estimation

Blocks	Recharge from rainfall Monsoon	Recharge from rainfall Non-Monsoon	Recharge from other sources Monsoon	Recharge from other sources Non-Monsoon	Total ground water recharge	Provision for natural discharge	Net ground water availibility	Existing Gross Ground Water Draft for irrigation	Ground Water Draft for Domestic Uses	Ground Water Draft for Industrial Uses	Existing Gross Ground Water Draft for All Uses	Industrial Requirement for Next 25 years	Net GW Availability for Future Irrigation Development	Stage of Ground Water Development (%)	Category safe/semi-critical/critical/over exploited
Ramgarh	2849.30	245.43	327.27	634.76	4056.76	405.68	3651.08	1136.15	246.99	71.83	1454.97	247.00	2196.10	39.85	Safe

Annexure II

Chemical Analysis of Ground Water Sample

Location	Block	pH	EC	TH	Ca	Mg	Na	K	CO3	HCO3	Cl	NO3	SO4	F
Bhairgawan	Ramgarh	7.9	591	3.2	60	2	70	2.1	0	244	7	50	62	0.88
Bharauli	Ramgarh	7.5	408	3	56	2	26	1.2	0	153	11	30	43	0.37
Rashidpur	Ramgarh	8.1	500	3.5	60	6	35	3.1	0	189	7	42	54	0.14

Salient Information
Name of the Block and Area (in km^2)
RAMPUR : 190.09 sq. Km

District/ State
Kaimur/Bihar
Population (as per 2011 census): 107019

Normal Annual Rainfall: 771.18 mm

Agriculture and Irrigation

The block falls in the Agro-climatic Zone III. The cropping sequence followed in this zone is Rice – Wheat, Rice – Maize, Rice – Lentil, Rice – Rai. Principal crops sown are paddy, wheat, sugarcane, potato and vegetables. Crops are growing in all the four seasons namely Bhadai, Ahgani, Rabi and Garma seasons in a year. The number of irrigation structures are as follows:

Dug Well	**183**
Shallow Tube well	738
Medium Tube Well	265
Deep Tube wells	209

Kharif and Rabi crop coverage during 2017-2018 (in hectares)

	Kharif (in hectares)				Rabi (in hectares)			
Block	**Paddy**	**Maize**	**Pulses**	**Oilseeds**	**Wheat**	**Barley**	**Pulses**	**Oilseeds**
Rampur	9730	125	235	0	4290	65	1195	260
Source: District Agriculture Office, Kaimur,								

Ground water resource availability and extraction

The dynamic ground water resource of Ramgarh block has been assessed as 62.62 MCM. The gross ground water draft for all uses stands at 16.37 MCM. The stage of Development is 26.15 % depicted in Annexure I. 1124 STWs are feasible with available ground water resources considering up to 70% SOD.

Water level behaviour

The depth to water level varies from 4.4 to 4.8 mbgl during pre-monsoon season. In post monsoon season, the depth to water level varies from 1.78 to 3.57 mbgl in most parts.

Aquifer Disposition

Aquifer disposition and characteristics can be ascertained through bore hole data at the block. Water bearing formation mainly consists of fractured sandstone. Two fracture zone has been encountered at the depth range of 33-33.4 mbgl and 75-75.7 mbgl.

Annexure I

Dynamic Ground Water Resource Estimation

Blocks	Recharge from rainfall Monsoon	Recharge from rainfall Non-Monsoon	Recharge from other sources Monsoon	Recharge from other sources Non-Monsoon	Total ground water recharge	Provision for natural discharge	Net ground water availibility	Existing Gross Ground Water Draft for irrigation	Ground Water Draft for Domestic Uses	Ground Water Draft for Industrial Uses	Existing Gross Ground Water Draft for All Uses	Industrial Requirement for Next 25 years	Net GW Availability for Future Irrigation Development	Stage of Ground Water Development (%)	Category safe/semi-critical/critical/over exploited
Rampur	3815.57	219.11	993.93	1929.41	6958.02	695.80	6262.22	1413.37	146.30	77.98	1637.65	146.31	4624.56	26.15	Safe

Annexure II

Chemical Analysis of Ground Water Sample

Location	Block	pH	EC	TH	Ca	Mg	Na	K	CO3	HCO3	Cl	NO3	SO4	F
Gangapur	Rampur	8.2	929	7	122	11	51	1.7	0	458	7	36	45	0.87
Pali	Rampur	8.1	429	4.1	78	2	15	1.3	0	250	4	13	15	0.13

Annexure I

NAQUIM KEY WELL DETAILS

Sl no.	District	Block	Location	Longitude	Latitude	M.P	Depth(mbmp)	Dia	Elevation m amsl	Pre-monsoon water level(mbg)	Post-monsoon water level(mbg)
1	Kaimur	Bhabua	Nibkhurd	83.599	25.145	0.20	6.10	1.50	79.00	5.6	3.34
2	Kaimur	bhabua	Dharaula	83.550	25.108	0.90	12.10	1.50	78.70	10.2	7.73
3	Kaimur	Bhabua	Jadupur	83.685	25.017	0.20	7.50	1.85	89.10	5.4	3.17
4	Kaimur	Bhabua	Siu	83.602	25.018	0.10	9.40	1.50	86.20	8.6	5.77
5	Kaimur	Bhabua	Khorasan	83.576	25.042	0.10	9.10	2.00	84.60	8.7	5.35
6	Kaimur	Bhabua	Silauthu	83.682	25.098	0.25	4.50	1.50	81.00	3.6	1.85
7	Kaimur	Bhabua	Samra	83.736	25.058	1.20	7.65	1.85	85.30	4.5	2.02
8	Kaimur	Bhagwanpur	Gobarcha	83.655	24.961	1.20	9.60	1.85	90.50	7.5	5.93
9	Kaimur	Bhagwanpur	Saraiya	83.596	24.987	0.85	13.20	1.84	88.80	12.4	7.65
10	Kaimur	Chainpur	madurna	83.478	25.042	0.45	11.60	1.85	87.90	10.6	5.35
11	Kaimur	chainpur	khoradih	83.547	25.003	0.20	7.80	1.60	89.00	5.3	3.05
12	Kaimur	Chand	Baradhi	83.462	25.172	0.85	12.10	2.00	75.30	10.8	7.27
13	Kaimur	Chand	Biuri	83.367	25.194	1.40	9.80	1.20	77.20	7.5	9.23
14	Kaimur	Chand	mahdaich	83.349	25.058	0.45	6.40	2.15	84.50	4.0	5.72
15	Kaimur	Chand	Kukra	83.450	25.093	0.20	9.60	1.85	79.70	8.3	2.7
16	Kaimur	Chand	Chand in p.s.	83.400	25.113	0.30	5.50	1.00	81.00	5.2	7.66
17	Kaimur	Durgawati	Karmansa	83.433	25.236	0.40	13.20	2.10	77.00	11.4	3.2
18	Kaimur	Durgawati	Kabilashpur	83.545	25.289	0.64	11.40	2.27	72.20	10.1	8.72
19	Kaimur	Durgawati	Gora	83.490	25.196	0.85	8.50	2.10	75.50	6.4	7.48
20	Kaimur	Durgawati	Kabilashpur p.O	83.548	25.289	0.5	12.1	1.8	72.23	11.3	5.49

21	Kaimur	Kudra	Mokaran	83.811	24.999	0.20	6.85	1.20	95.20	4.9	9.1
22	Kaimur	Kudra	Bhadaura	83.758	25.096	0.10	8.20	1.25	84.30	7.4	10.2
23	Kaimur	Kudra	Dumari	83.801	25.171	0.30	7.20	2.15	78.80	6.0	9.5
24	Kaimur	Mohania	Usri	83.574	25.174	0.21	7.30	1.50	79.20	5.9	10.06
25	Kaimur	Mohania	Mujan	83.718	25.212	0.35	6.50	1.85	76.00	4.9	3.02
26	Kaimur	Mohania	Bomhar khas	83.599	25.242	0.40	12.20	2.50	75.00	11.5	5.06
27	Kaimur	Mohania	Bokhari	83.669	25.187	0.45	7.20	1.65	76.00	6.4	4.82
28	Kaimur	Mohania	Chotki kulharia	83.711	25.254	0.25	7.60	1.50	72.60	6.2	4.92
29	Kaimur	Nuon	Rashidpur	83.714	25.339	1.05	13.72	1.80	71.20	5.4	2.91
30	Kaimur	Nuon	Jaitpur	83.737	25.395	0.85	9.80	2.15	69.70	5.9	8.72
31	Kaimur	Nuon	Mukhraon	83.844	25.311	0.77	8.10	1.80	73.00	6.8	2.42
32	Kaimur	Nuon	Kuchillana	83.865	25.254	0.20	5.30	1.50	75.90	4.0	2.42
33	Kaimur	Ramgarh	Bhairgawan	83.628	25.304	0.10	9.18	1.85	70.10	7.1	1.82
34	Kaimur	ramgarh	Bharauki	83.656	25.337	0.85	6.85	1.64	69.10	5.2	2.25
35	Kaimur	ramgarh	Tenuyan	83.759	25.284	1.40	7.50	1.80	71.40	5.2	2.43
36	Kaimur	Rampur	Chamariawan	83.694	24.971	0.35	6.50	1.80	95.80	4.8	1.78
37	Kaimur	Rampur	Gangapur	83.743	24.959	0.85	8.35	2.00	99.00	4.4	3.57

Annexure II

VES Survey Details of Kaimur District

Block	Dist	Block	Village	Longitude	Latitude	r1	r2	r3	r4	r5	r6	h1	h2	h3	h4	h5
Bhabhua	Kaimur	Bhabhua	Posauli	83.72	25.10	17.23	8.1	40	5.7	60		3.25	3.85	13.6	42.3	
Kudra	Kaimur	Kudra	Kudra	83.77	25.05	14.1	6.81	24.3	4.24	55.6		2.7	3.3	24.2	37.1	
Mohania	Kaimur	Mohania	Mohammadpur	83.64	25.24	9	7	42	7	91		1	16	33	42	
Ramgarh	Kaimur	Ramgarh	Akorhi Mauja	83.68	25.31	4	15	7	28			1	7	21		
Ramgarh	Kaimur	Ramgarh	Ramgarh	83.65	25.27	16	28	15	29	5		4	7	46	122	
Ramgarh	Kaimur	Ramgarh	Sisauda	83.70	25.32	5	2	17	5	20	57	1	1	8	11	165
Noan	Kaimur	Noan	Kanhua	83.72	25.34	10	26	VH				20	33			
Mohania	Kaimur	Mohania	Usari	83.57	25.18	21	6	21	3			1	6	393		
Mohania	Kaimur	Mohania	Bomhour Khas	83.60	25.23	13	11	25	61			2	30	199		
Durgauti	Kaimur	Durgauti	Chahria (Tola- Shemra)	83.52	25.23	86	39	13	156	VH		1	15	24	59	
Bhabhua	Kaimur	Bhabhua	Nibi Kalan	83.60	25.14	8	41	3	130			11	12	24		
Bhabhua	Kaimur	Bhabhua	Marichawan	83.58	25.14	8	7	24	5	20	VH	1	8	12	21	159
Bhabhua	Kaimur	Bhabhua	Asrarhi	83.66	25.10	12	5	14	5	12	7	1	1	3	5	15
Mohania	Kaimur	Mohania	Dasoti	83.63	25.20	9	6	16				1	42			
Ramgarh	Kaimur	Ramgarh	Devhalia	83.58	25.26	18	157	14	31	182		1	1	10	193	
Ramgarh	Kaimur	Ramgarh	Piparia	83.64	25.31	9	VH					44				
Ramgarh	Kaimur	Ramgarh	Sahuka	83.61	25.28	24	8	34				3	21			

Annexure III

Exploratory Well Details of Kaimur District

Location	Longitude	Latitude	Drilled depth (mbgl)	Zones taped (mbgl)	Fracture zone (mbgl)	Discharge (m3/day)	Transmissivity(m2/day)	Storativity
Barahuli	83.70	25.11	125.05	80-89;92-101;109-115		883	269.3	
Jagaria	83.51	25.04	93	39-48		1902	4094	2.2×10^{-6}
Nuon	83.74	25.35	310.44	156-162;168-174;190-196;211-217;250-256		3957	2069	
Dahrak			259.69	118-124;131-137;143-146;170-176;196-205		2987	6074	3.4×10^{-4}
Adhaura	83.61	24.68	154		97 &128	1121.47		
Nauhatta	84.22	25.57	102		36-37; 75-76	1192.32	121.32	

Annexure IV

Dynamic Ground Water Resources (2017)

District	Block	Formation	Net Annual Ground Water Availability	Existing Gross Ground Water Draft for irrigation	Existing Gross Ground Water Draft for Domestic Uses	Existing Gross Ground Water Draft for Industrial Uses	Existing Gross Ground Water Draft for All Uses	Provision for Domestic and Industrial Requirement for Next 25 years	Net GW Availability for Future Irrigation Development	Stage of Ground Water Development
			(ham)	(ham)	(ham)	(ham)	(ham)	(ham)	(ham)	(%)
Kaimur	Adhaura	Hard Rock	8190.441	513.09	93.9948	30.35	637.4348	33.29	7644.061	7.78
Kaimur	Bhabhua	Alluvium	10187.028	5074.17	413.61216	279.45088	5767.23304	146.47	4966.388	56.61
Kaimur	Bhagwanpur	Alluvium	5038.2965	516.66	114.0698	31.54	662.2698	23.62	4498.0165	13.14
Kaimur	Bhagwanpur	Hard Rock	2406.582	570.35	283.72326	42.7	896.77326	58.75	1777.482	37.26
Kaimur	Chainpur	Alluvium	13524.057	1705.8	304.78814	100.53	2111.11814	107.93	11710.327	15.61
Kaimur	Chainpur	Hard Rock	498.429	116.65	4.17998	6.04	126.86998	1.48	380.299	25.45
Kaimur	Chand	Alluvium	6563.547	3038.14	220.05996	162.91	3421.10996	77.93	3447.477	52.12
Kaimur	Durgawati	Alluvium	5081.589	1546.56	225.45904	88.6	1860.61904	79.84	3455.189	36.61
Kaimur	Kudra	Alluvium	14153.823	2902.57	271.852	158.72	3333.142	96.27	11154.983	23.55
Kaimur	Mohania	Alluvium	8596.322	4256.91	392.74292	234.6016	4884.25452	131.27	4208.142	56.82
Kaimur	Nuaon	Alluvium	5747.918	2722.78	175.36352	144.91	3043.05352	62.1	2963.038	52.94
Kaimur	Ramgarh	Alluvium	3651.084	1136.15	246.99258	71.8324	1454.97498	77.34	2437.594	39.85
Kaimur	Rampur	Alluvium	5035.626	985.91	112.73244	54.93	1153.57244	39.92	4009.796	22.91
Kaimur	Rampur	Hard Rock	1226.592	427.46	33.56978	23.05	484.07978	11.89	787.242	39.47

Annexure V

Minor Irrigation Census Data of Kaimur District

Block	Dug well	Shallow tube well	Medium tube well	Deep tube well
Adhaura	30	3	277	0
Bhabua	35	2857	92	119
Bhagwanpur	642	444	570	78
Chainpur	670	511	732	112
Chand	15	1715	13	
Durgawati	92	839	4	2
Kudra	367	1524	995	493
Mohania	88	1548	883	220
Nuaon	11	1418	318	33
Ramgarh	1140	227	82	44
Rampur	183	738	265	209

(MI Census data 2013-14)

Annexure VI

Blockwise Land Use Land Cover Details Of Kaimur District

Block wise land use data of Kaimur district (in acres)														
Sl No.	**Name of Block**	**Geographical area (acres)**	**Forest (acres)**	**Barren and unculurable land (acres)**	**Land not available for cultivation**			**Culturable Waste land (acres)**	**Permanent pasture and grazing land (acres)**	**Land under misc. Tree, crops and Gross net including net area**				**(3 - 14)**
					Land Area	**Water Area**					**Other fallow land**	**Current fallow land**	**Total (4 to 13)**	
						Perennial	**Temporary**							
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1	**Bhabhua**	82462.39	0	612.2	17715.85	3096.65	127.15	0	9.14	1119.35	260.1	170.1	23110.54	59351.85
2	**Bhagwanpur**	58864.35	23460.49	4185.63	5964.01	2556.03	712.51	3.61	186.34	544.8	190.8	280.2	38084.42	20779.93
3	**Rampur**	40968.67	15612.25	1678.12	3499.55	1156.63	2.39	0	0	380.85	99.16	80.16	22509.11	18459.56
4	**Chainpur**	113201.00	27232.81	3072.28	7700.02	2580.2	28.43	455.25	131.87	428.46	7561.23	18140.3	67330.89	45870.11
5	**Chand**	50805.00	0	3215.21	6420.65	2235.34	227.9	0	0	510.18	2169.52	4219.83	18998.63	31806.37
6	**Adhaura**	228978.46	160418.9	3314.64	4682.7	1750.1	143.38	3812.66	0	842.76	18736.1	32541.9	226243.14	2735.32
7	**Mohania**	71787.00	0	1183.48	6643.34	2445.4	154.37	1642.33	0	574.32	510.19	986.15	14139.58	57647.42
8	**Durgawati**	43454.37	0	3245.87	6303.27	4192.36	184.25	843.54	0	976.1	508.13	288.35	16541.87	26912.5

9	**Kudra**	53400.00	0	1031.81	5814.48	983.12	234.41	1008.73	141.36	781.64	316.76	316.26	10628.57	42771.43
10	**Ramgadh**	42446.73	0	846.58	6754.69	698.48	224.84	0	0	156.32	91.01	89.46	8861.38	33585.35
11	**Nuwau**	48459.27	10.08	3494.89	8193.11	3185.34	816.4	187.58	115.38	836.74	31078	310.91	17461.21	30998.06
12	**Total**	**834827.24**	**226734.5**	**25880.71**	**79691.67**	**24879.65**	**2856.03**	**7953.7**	**584.09**	**7151.52**	**30753.8**	**57423.66**	**463909.34**	**370917.9**

(Source: District Statistical Office , Kaimur)

Annexure VII

Chemical data of pre-monsoon water samples ,Kaimur

Sl no.	Location	Block	District	Longitude	Latitude	pH	EC (µs/cm) 25C	TH (as CaCO3)	Ca+2	Mg+2	Na	K	CO3-2	HCO3-	Cl-	NO3-1	SO4-2	F-
1	Usri	Mohania	Kaimur	83.574	25.174	8	759	285	84	18	38	5.2	0	354	14	25	40	0.81
2	Kabilaspur	Durgawati	Kaimur	83.545	25.289	7.8	377	210	70	9	8.75	3.9	0	153	18	34	54	0.19
3	Bhairgawan	Ramgarh	Kaimur	83.490	25.196	7.9	591	160	60	2	70	2.1	0	244	7	50	62	0.88
4	Bharauli	Ramgarh	Kaimur	83.656	25.337	7.5	408	150	56	2	26	1.2	0	153	11	30	43	0.37
5	Rashidpur	Ramgarh	Kaimur	83.644	25.300	8.1	500	175	60	6	35	3.1	0	189	7	42	54	0.14
6	Jaitpur	Nuon	Kaimur	83.733	25.391	7.6	388	110	40	2	42	2.6	0	177	4	35	25	0.13
7	Etwa english	Nuon	Kaimur	83.757	25.347	7.9	768	325	96	21	23	5.2	0	366	11	52	22	0.65
8	Mukhraon	Nuon	Kaimur	83.844	25.311	7.7	861	350	68	44	35	6.8	0	403	14	55	36	0.94
9	Kuchilliana	Nuon	Kaimur	83.865	25.254	7.9	932	260	98	4	88	2.1	0	415	18	60	36	0.85
10	Gora	Durgawati	Kaimur	83.490	25.196	8.2	403	150	56	2	25	1.5	0	189	7	32	15	0.15
11	Baradhi	Chand	Kaimur	83.462	25.172	7.6	541	95	38	0	66	1.9	0	238	7	30	14	0.21
12	Biuri	Chand	Kaimur	83.367	25.194	7.8	1217	500	200	0	40	2.4	0	531	18	73	62	0.85
13	Mahdaich	Chand	Kaimur	83.450	25.093	7.9	1325	450	140	24	101	2.5	0	622	36	65	54	0.8
14	Madurna	Chainpur	Kaimur	83.478	25.042	7.8	1365	250	42	35	185	3.2	0	610	28	70	55	0.82
15	Kukra	Chand	Kaimur	83.547	25.003	7.6	509	145	30	17	49	1.7	0	232	18	32	12	0.35
16	Khoradih	Chainpur	Kaimur	83.547	25.003	7.8	347	160	56	5	6.82	1.9	0	177	4	23	8	0.15
17	Nibkhura	Bhabua	Kaimur	83.599	25.145	8.1	696	225	58	19	42	2.3	0	305	18	50	5	0.41
18	Daraula	Bhabua	Kaimur	83.550	25.108	7.9	614	280	92	12	30	1.4	0	323	11	44	26	0.54
19	Jadupur	Babhua	Kaimur	83.685	25.017	7.8	507	235	72	13	27	1.9	0	262	14	38	30	0.23
20	Nirbispur	Bhabua	Kaimur	83.602	25.018	8	327	150	38	13	2.8	3.4	0	171	4	8	10	0
21	Gangapur	Rampur	Kaimur	83.743	24.959	8.2	929	350	122	11	51	1.7	0	458	7	36	45	0.87
22	Pali	Rampur	Kaimur	83.774	24.934	8.1	429	205	78	2	15	1.3	0	250	4	13	15	0.13
23	Mokaran	Kudra	Kaimur	83.811	24.999	7.9	597	235	70	15	40	2.4	0	317	7	35	22	0.17

24	Asraulia	Kudra	Kaimur	83.758	25.096	7.1	357	155	48	9	30	6.4	0	214	4	50	10	0
25	Bhadaura	Kudra	Kaimur	83.801	25.171	7.9	392	100	30	6	32	1.8	0	153	4	12	30	0
26	Chtrabhuji sthan	Kudra	Kaimur	83.8	25.123	7.8	1132	365	100	28	91	1.7	0	494	25	69	65	0.94
27	Karmhara	Mohania	Kaimur	83.711	25.254	8	842	365	124	13	27	3.2	0	397	11	39	52	0.61
28	Muijan	Mohania	Kaimur	83.718	25.212	8.1	143	55	16	4	0	1.7	0	61	0	8	0	0
29	Karar	Adhaura	Kaimur	83.540	24.848	7.9	126	60	14	6	0	3.2	0	61	0	15	0	0
30	Garka	Adhaura	Kaimur	83.595	24.711	8	467	190	62	9	22	4.7	0	244	4	25	17	0.15
31	Mohanpur	Bhagwanpur	Kaimur	83.655	24.961	7.9	815	335	110	15	46	3.5	0	397	11	65	42	0.23
32	Silautu	Bhabua	Kaimur	83.682	25.098	8.1	821	125	36	9	147	2.1	0	427	7	49	45	0.25
33	Samra	Bhabua	Kaimur	83.736	25.058	8.2	366	120	30	11	28	3.6	0	195	4	14	12	0
34	Bomhar khas	Mohania	Kaimur	83.599	25.242	7.8	444	110	44	0	56	2.5	0	189	7	25	45	0
35	Bokhari	Mohania	Kaimur	83.669	25.187	8	467	160	20	27	26	3.1	0	201	4	35	20	0