केन्द्रीय भूमि जल बोर्ड

जल संसाधन, नदी विकास और गंगा संरक्षण

विभाग, जल शक्ति मंत्रालय

भारत सरकार

Central Ground Water Board

Department of Water Resources, River Development and Ganga Rejuvenation,

Ministry of Jal Shakti

Government of India

AQUIFER MAPPING AND MANAGEMENT OF GROUND WATER RESOURCES

ETAH DISTRICT
UTTAR PRADESH

उत्तरी क्षेत्र, लखनऊ

Northern Region, Lucknow

जल शक्ति मंत्रालय

केंद्रीय भूजल बोर्ड
Central Ground Water Board (CGWB)

जल संसाधन, नदी विकास और गंगा संरक्षण विभाग

Department of Water Resources, River Development and Ganga Rejuvenation

केंद्रीय भूजल बोर्ड
Central Ground Water Board (CGWB)

उत्तरी क्षेत्र , लखनऊ
Northern Region, Lucknow

REPORT OF

AQUIFER MAPPING AND MANAGEMENT PLANS OF

ETAH DISTRICT,

UTTAR PRADESH

AQUIFER MAPPING AND MANAGEMENT PLANS OF BAHRAICH DISTRICT, UTTAR PRADESH STATE

CONTRIBUTORS

Principal Authors	**:**	**Binaya Kumar Behera, Scientist-B (Hydrogeology)**
	:	
Aquifer management Plans	**:**	**Binaya Kumar Behera, Scientist-B (Hydrogeology)**
	:	
Analysis of Geophysical data and interpretation	**:**	**Dr.Shashikant Singh, Scientist-B (Geophysics)** **Anirudh Singh, Asst. Geophysicist**
	:	
	:	
Chemical Analysis	**:**	**K.S.Rana, Scientist-B (Chemist) & O I/c Regional Chemical Laboratory** **K.G.Bhartariya, Scientist-B (Chemist)** **Dr. Supriya Singh, Scientist-B (Chemist)**

ACKNOWLEDGEMENTS

The author is thankful to Dr. Shashi Kant Singh, Scientist-B (Geophysics) and Mr. Anirudh Singh, Asst. Geophysicist for analysis and interpretation of Geophysical data.

The author is also thankful to Mr. Sujatro.R.C, Scientist-B (Hydrogeology) for his help and guidance during the compilation of Groundwater Resource chapter as well as sharing exploratory data.

The author is also thankful to Mr. S.K.Swaroop, Scientist-C (Hydrogeology) and T.S., CGWB-NR for his valuable suggestions that led to overall improvement of NAQUIM report of the allotted study area.

The author is also thankful to Mr. S.G.Bhartariya, Regional Director, CGWB-NR, Lucknow for his supervision and guidance during the course of report completion.

Lastly, the author is thankful to Mr. Chandan Mishra, Dr. Daya Shankar Singh and Dr. Arjun Ram, Young Professionals, CGWB-NR, Lucknow for their help in collating relevant data from R.O.D.C and generation of various thematic maps.

DISTRICT AT A GLANCE

1		**GENERAL INFORMATION**		
	i	**Geographical area (km^2)[1]**	**:**	2651
	ii	**Administrative divisions[1]**	**:**	
	a	No. of Tehsils	**:**	3
	b	No. of Blocks	**:**	8
	c	No. of Towns and urban areas	**:**	5
	d	No. of villages	**:**	892
	iii	**Population (as per 2011 census) [1]**		
	a	No. of Males	**:**	9,47,339
	b	No. of Females	**:**	8,27,141
	c	Population density (People per km^2)	**:**	730
	d	Urban population	**:**	2,68,142
	e	Rural population	**:**	15,06,338
	iv	**Literacy Rate (as per 2011 census) [1]**	**:**	70.8
	v	**Per Capita net income (at current prices)[2018-19] [1]**	**:**	₹ 57,367
	vi	Climate	**:**	Sub – tropical
	a	Normal Annual precipitation (2018)	**:**	787 mm
	b	Minimum temperature (°C)	**:**	-

	c	Maximum temperature (°C)	**:**	-
2		**GEOMORPHOLOGY[2]**		Ganga Yamuna Doab in Central Indo-Gangetic Alluvial Plains
	i	**Major Physiographic units**	**:**	a) Flood Plain b) Younger Alluvial Plain c) Older Alluvial Plain
	ii	**Major Drainage**	**:**	Kali Nadi, Isan, Arind & Bargash Nadi
3		**Land Use [Ha] [1]**		
	i	**Forest Land**	**:**	1,034
	ii	**Fallow Land**	**:**	8,977
	iii	**Gross Area sown**	**:**	3,33,000 Ha.
	iv	**Net Area sown**	**:**	1,98,123 Ha.
	v	**Gross Area irrigated**	**:**	3,09,000 Ha.
	vi	**Net Area irrigated**	**:**	1,98,000 Ha.
4		**Major Soil types**	**:**	a) Dumat or loam b) Matiyar or clay c) Bhur or sand.
5		**Area under Principal crops**		
	i	**Rabi**	**:**	3,12,341
	ii	**Kharif**	**:**	1,70,286

	iii	**Zaid**	**:**	5,071
6		**Sources of irrigation [2016-17]** [1]		
	i	**No. of dug wells**	**:**	0
	ii	**No. of Tube wells**	**:**	1,466 (Government)
			:	1,60,382 (Private)
	iii	**Canals [Ha]**	**:**	10,659
	iv	**Other sources**	**:**	22,820
7		**No. of CGWB GW monitoring stations [2019]**		
	i	**No. of Dug wells**	**:**	2
	ii	**No. of Piezometers**	**:**	4
8		**Groundwater exploration by CGWB**		
	a	**No. of wells drilled**	**:**	EW = 6
	b	**Depth range (mbgl)**	**:**	0 to 427.00
	c	**Discharge (lpm)**	**:**	1533 to 3800
	d	**Storativity (S)**	**:**	$3.1*10^{-4}$ to $1.57*10^{-5}$
	e	**Transmissivity (m^2/day)**	**:**	698 to 5472 lpm
9		**Groundwater quality**		
	a	**Major Hydrochemical facies**	**:**	Mainly Fresh

	b	**Presence of Trace metals**	**:**	None
10		**Dynamic Groundwater Resources [as per GEC-2020] (in Ham)**		
	a	**Net annual Groundwater availability**	**:**	57190.39
	b	**Existing Gross Groundwater draft**	**:**	45599.24
	c	**Net Groundwater availability**	**:**	11177.7
	d	**Stage of Groundwater Development**	**:**	79.73 (Safe)
11		**Groundwater Control and Regulation**		
	a	**No. of over-exploited blocks**	**:**	2
	b	**No. of critical blocks**	**:**	2
	c	**No. of semi-critical blocks**	**:**	4
	d	**No. of notified blocks**	**:**	0

INDEX

Aquifer Mapping And Management of Ground Water Resources Etah District, Uttar Pradesh

1. INTRODUCTION

1.1 Objectives

Aquifer Mapping and Management Program is a fresh project launched by Central Ground Water Board under MoWR, RD & GR in response to the overuse, pollution, and other associated problems with groundwater. The initiative was started as part of the XII plan's Ground Water Management and Regulation Plan Scheme. The following are the project's main goals:

- Delineation and characterization of aquifers in three dimensions,
- Evaluation of aquifers, groundwater regime behavior, hydraulic characteristics, and hydrogeochemistry of aquifer groups on a 1:50,000 scale,
- Identification and quantification of issues,
- Development of management plans to ensure the sustainability of groundwater resources.

As part of the program, management plans are being created for every aquifer system, proposing several actions to optimize groundwater extraction, and recognizing aquifers with potable groundwater for consumption in areas with poorer quality. In addition to demand-side management options such as crop diversification, improving water use efficiency, etc., the management choices also involve recognition of possible areas for artificial recharge to groundwater and water conservation which aid in stopping dropping water levels.

1.2 Scope of the Study

Gathering and compendium of accessible data on aquifer structures, the boundary of their stretches and portrayal, assessment of data gaps, creation of extensive information to complete the recognized data gaps, and eventually preparation of aquifer maps at the preferred magnitude are all part of the systematic mapping of an aquifer. The findings of this research will help strategists, decision-makers, and other stakeholders employ resource management techniques, including long-term aquifer monitoring networks and theoretical and statistical regional ground-

water-flow models. Aquifer mapping at the adequate level can aid in the planning, implementation, and monitoring of numerous managerial treatments focusing on ensuring the long-term viability of our valuable groundwater resources, which will, in turn, aid in the achievement of drinking water security, better irrigation amenities, and overall "water resource development sustainability" in the nation.

1.3 Approach and Methodology

For the creation of aquifer maps and management plans, a multidisciplinary technique utilizing cutting-edge technologies and techniques is being used, involving remote sensing, GIS, geophysical techniques, groundwater modeling, etc.

To guarantee the quality of the deliverables, a multi-tier evaluation procedure has been implemented. The Regional Directors of the different regions of CGWB assess the aquifer maps and management plans created by the team of officers. Subsequently, at the central headquarters level, the updated maps and management plans are provided to the respective CGWB members. "The National Level Expert Committee" (NLEC), which was established for this objective, is then provided with the maps and management plans. The experts' group includes domain experts in the fields of groundwater from JNU, Delhi; IIT, Roorkee; former Chairman of CGWB; agriculture scientists, etc. The ICAR's agricultural experts have also contributed to the formulation of the management plans for every state. "The State Ground Water Coordination Committee" (SGWCC), which is chaired by the principal secretary of the relevant department, has been established in every state and UT in order to facilitate cooperation on different aquifer mapping-related matters between the State and Union Governments. In order for the suggested aquifer-specific groundwater management plans to be adopted by the State Government, the results are exchanged and discussed in the State Ground Water Coordination Committee.

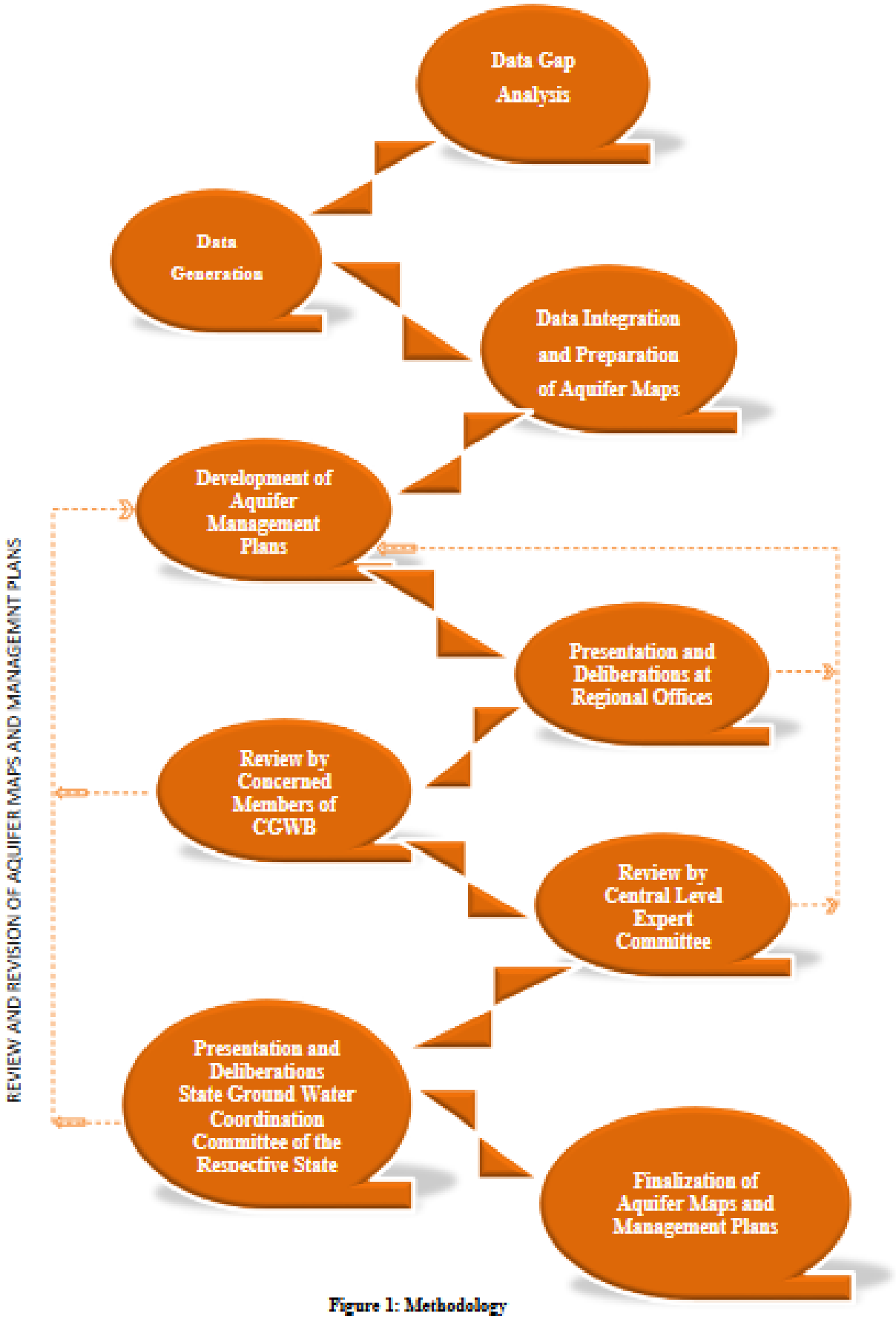


Figure 1: Methodology

1.4 Location of the study area:

Etah district is one of the districts in the Indian state of Uttar Pradesh, and Etah town serves as the district's administrative center. The Aligarh Division includes the Etah District. The Kanpur-Delhi Highway passes through it halfway. It is also well-known historically for serving as the focal point of the Revolt of 1857. Etah was once known as "Aintha," which means "to reply fiercely," since the Yadav community's members are notoriously hostile. In the north, it is bordered by Kasganj, in the south by Mainpuri and Firozabad, in the east by Farrakhabad, and in the west by the districts of Aligarh, Hathras, Mathura, and Agra.

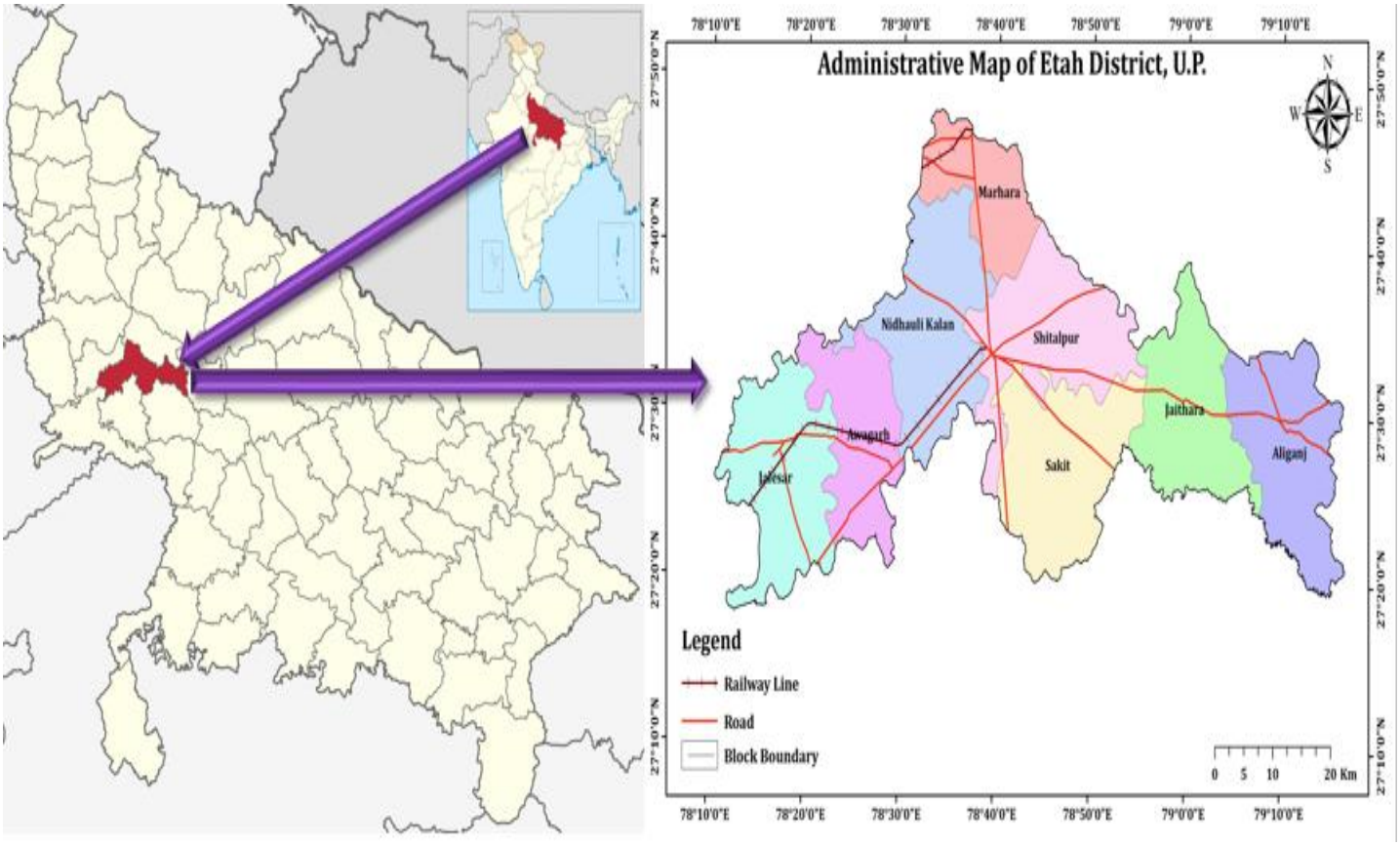


Figure 1: Location Map of Etah District, U.P

1.4 Data Availability

Data on the numerous characteristics of groundwater were gathered from publications of the "Central Ground Water Board," state departments, and other organizations. The collected data were displayed on a map on a scale of 1:50,000, and a data gap analysis was done to determine the need for future hydrological, hydrogeological, hydrochemical, and geophysical research. The following table lists the key facts:

Table 1: Status of Data availability, data gap, and data generation

Sl. No.	Parameter (s)	Data Required	Data Available	Data Gap	Data Generation
1.	Rainfall Data	IMD Meteorological station in the study area	No. Data obtained from European Space Agency.	No.	No.
2.	Soil	Soil Map and Soil infiltration test data.	Soil shape file available from U.P.R.S.A.C	Soil infiltration test data.	Soil infiltration across the study area.
3.	Land Use/ Land cover	Land Use/Land cover pattern	Land Use/ Land cover shape file available from U.P.R.S.A.C	No.	No.
4.	Geomorphology	Digitized Geomorphological map	District Resource Map available from G.S.I	No.	Map generated on GIS platform.
5.	Geology	Digitized Geological map	District Resource Map available from G.S.I	No.	Map generated on GIS platform.
6.	Exploration Data	EW in each quadrant	Available from old CGWB & UPGWD records	Yes	Carried out in 3 blocks.
7.	Aquifer Parameters	Aquifer parameters in all the quadrants	From 3 exploratory wells under NAQUIM	Yes	Data to be generated.

1.5 Climate

The yearly rainfall average is 722.4 mm. The sub-humid climate is marked by a comfortable cold season and sweltering summer days. From June through September, there is an average of 88 percent of the annual rainfall. Surplus water is available during the monsoon for deep percolation to groundwater. At Mainpuri, there is a meteorological observatory whose data may be used to determine realistic meteorological conditions. After February, the temperature continues to rise steadily. The warmest month of the year is often May. In May, the average daily high temperature is about 41 °C, the average daily low temperature is around 27 °C, and the average daily high temperature is around 46 °C. The daytime temperature rapidly drops as soon as the monsoon arrives. The coldest month is January, with an average daily high temperature of around 22 °C and an average daily minimum temperature of 8 °C. The average maximum temperature for a month is 32.8°C, while the average lowest temperature is 16.5°C.

Except for the monsoon, the seasons have high humidity levels and dry air. The average monthly relative humidity in the morning is 67 percent, while in the evening, it is 50 percent. The summer and early monsoon months see a minor increase in the normally low winds. The average wind speed is 3.5 km/h. There might be 1431.7 mm of evapotranspiration.

1.6 Geomorphology and Geology

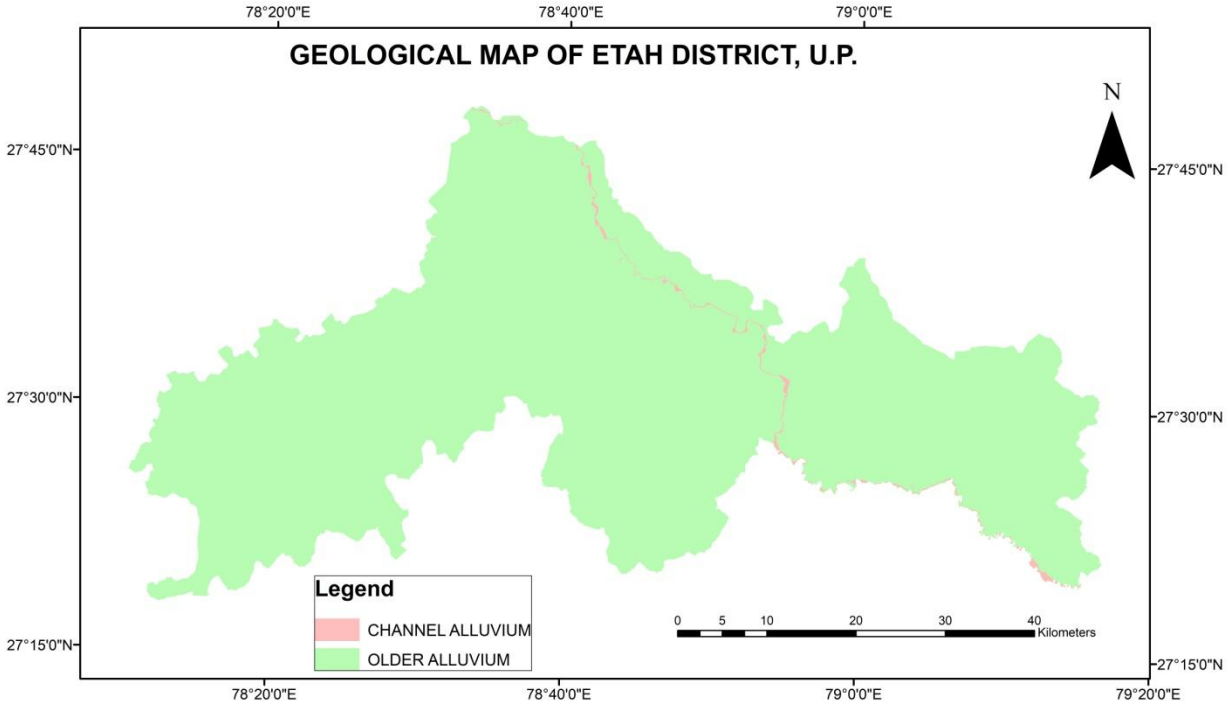
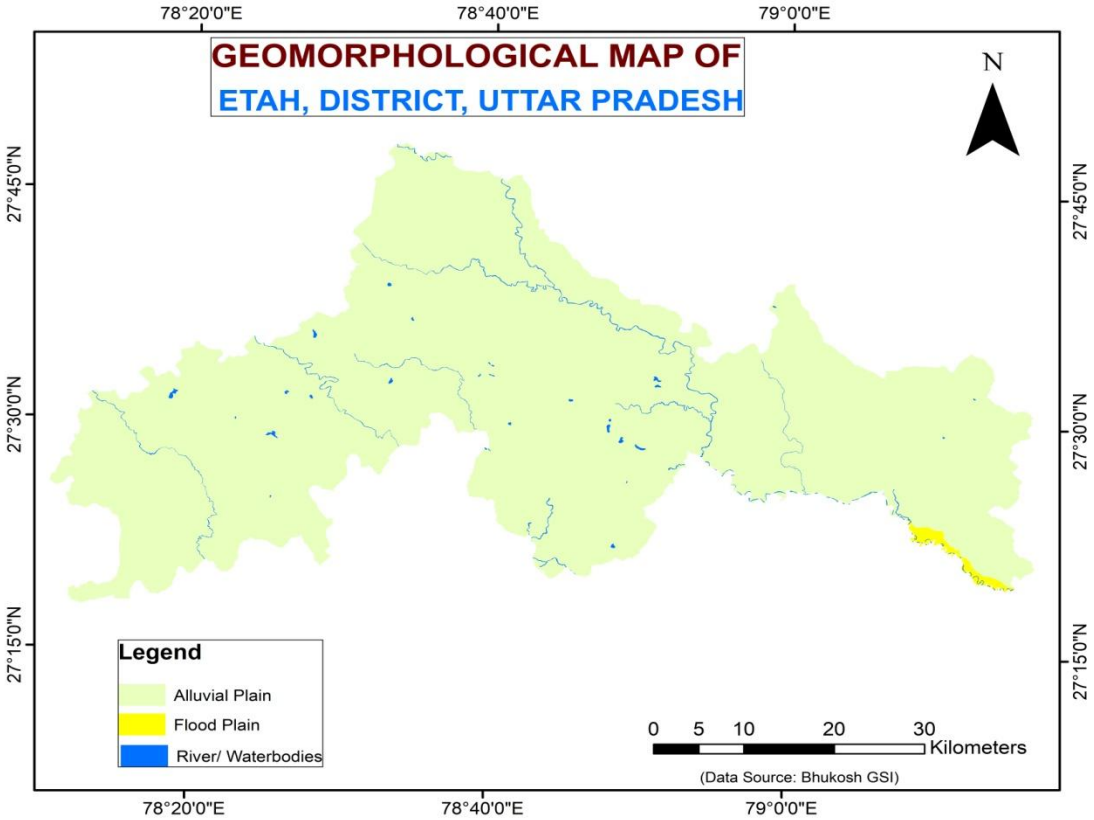


Figure 2: Geological Map of Etah District



The district's geography is mostly flat, with a few minor undulations. The region has not reached complete geomorphological maturity. The following geomorphic units may be used to categorize the district.

(i) Active Alluvial Plain

Floods from the Ganges and its tributaries regularly cover the region between the river and the terraced plain of recent alluvium or active alluvial plain. Old channels and other cutting and depositional fluvial characteristics define the AAP. Sandbars, ox-bows, river meanders, and degraded levees. Frequent floods, siltation, and waterlogging have a significant negative impact on farming activities. The soil was poorly developed in the younger alluvium, which is characteristic of the flood plain and has coarser soil layers. Salts have accumulated and been distributed differently in sites like Bhaura, Labher, Yaqutganj, and Kadarwadi as a result of the unique hydrological circumstances.

(ii) Younger Alluvial Plain

The Younger Alluvial Plain (YAP) is younger than the Older Alluvial Plain (OAP), which is older than the Active Alluvial Plain (AAP) and is situated between the two plains (Active Alluvial Plain). However, the boundary between the YAP and AAP is clearly defined by high relief in the form of badly eroded terraces running parallel to Budhi Ganga through the cities of Soran, Ganjdudwara, and Patiali. The YAP combines with the OAP with extremely gentle slopes. Although the SAS (salt-affected soils) distribution in YAP is less widespread than in OAP, Sidhpura, Jaithra, and Aliganj have particular topographical configurations that have resulted in significant SAS expansion.

(iii)Older Alluvial Plain

Flat or very gently sloping plains define the OAP (Older Alluvial Plain). The oxbow lakes are connected by a variety of paleo-channels that allow water to flow both above and below the surface. Significant soil growth in the form of illuviation, structural development, and calcification stabilizes the landform. Large-scale salinization and alkalization have occurred in areas like Jalesar, Awagarh, Sakit, and Nidhauli Kalan as a result of the rising water table caused by obstructions in natural drainage and seepage from canals in lower topographical

circumstances. Na-silicate surface accumulation is particularly frequent in the hamlet of Lakhimpur and the nearby areas, and it is utilized in the city of Firozabad to make glass.

1.7 Drainage

The drainage system of the district is controlled by the river Ganga and its tributaries, namely Kali, Isan, Arind & Bargash Nadi and their tributaries. The Kali nadi is perennial, and the remaining tributaries are ephemeral. Etah district falls under the category of the agricultural-dominated district, occupying mainly the area between the Ganga and Kali rivers.

The Lower Ganga Canal makes its way through the proposed site area, which forms the main drainage system of the area. The Lower Ganga Canal is 3.19 KM West of the proposed site. The drainage system shall be designed accordingly to connect through underground drains after sewage treatment has been planned.

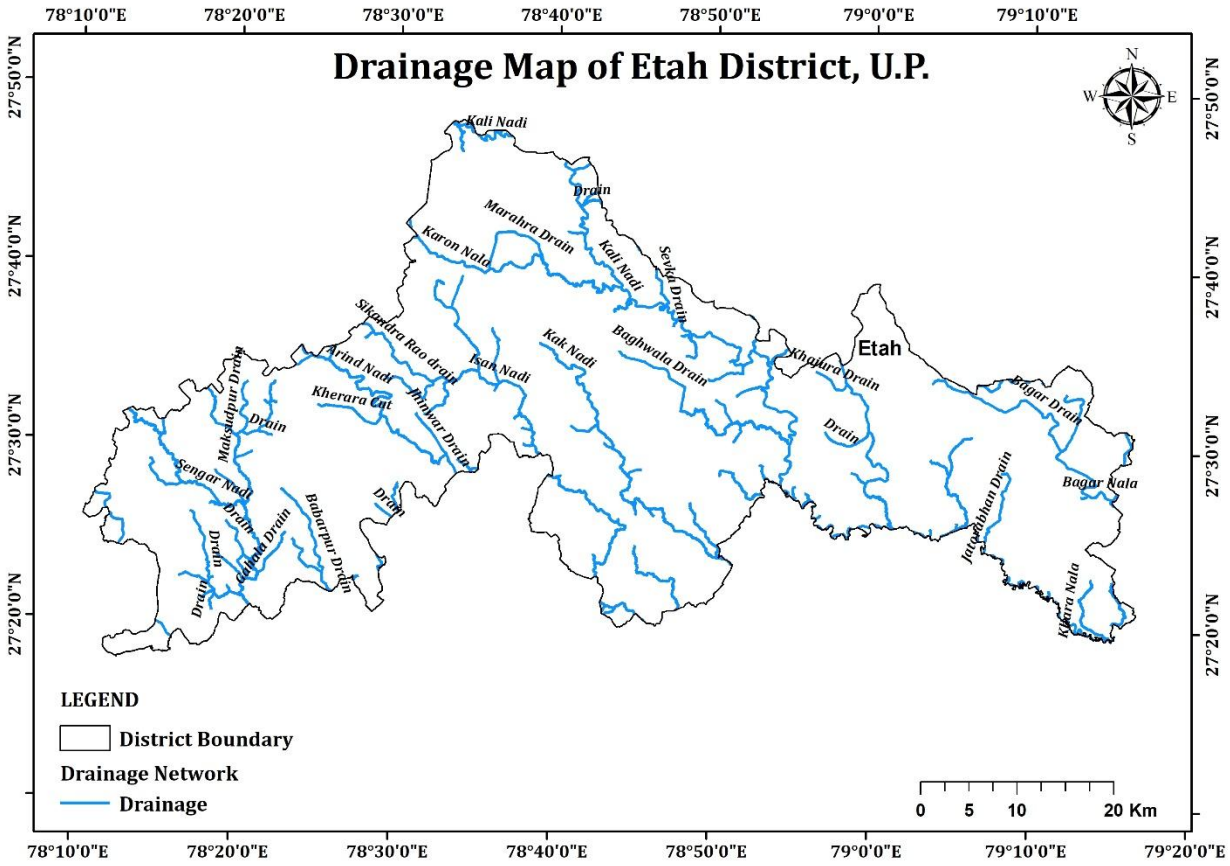


Figure 3: Drainage Map of Etah district

1.8 Soil

Depending on their textural and compositional characteristics, the soils in the district can be divided into the three main traditional groups listed below:

- Dumat or Loam: When powdered, fertile soil feels velvety to the touch.
- Matiyar Clay: Clay that is stiff while wet and dries to be as hard as a baked brick.
- Bhur or Sand: Sandy soil and less fertile.

The district's soils are mostly "Matiyar," or clay, and "Domat," or loam. The Matiyar (hard clay soil) is suited for rice production and is quite fruitful. The Domat, also known as loam, is fertile soil that is good for growing a variety of crops. This is the explanation for the district's excellent agricultural production. The principal soil types present in the district are "bhur (sand and loam)," "domat (a combination of sand and clay in different amounts)," and "matiyar (clay)." The type of soil present in the Doab region of Etah between River Yamuna and River

Ganga is alluvial soil. This type of alluvial soil has high fertility for the cultivation of various types of crops.

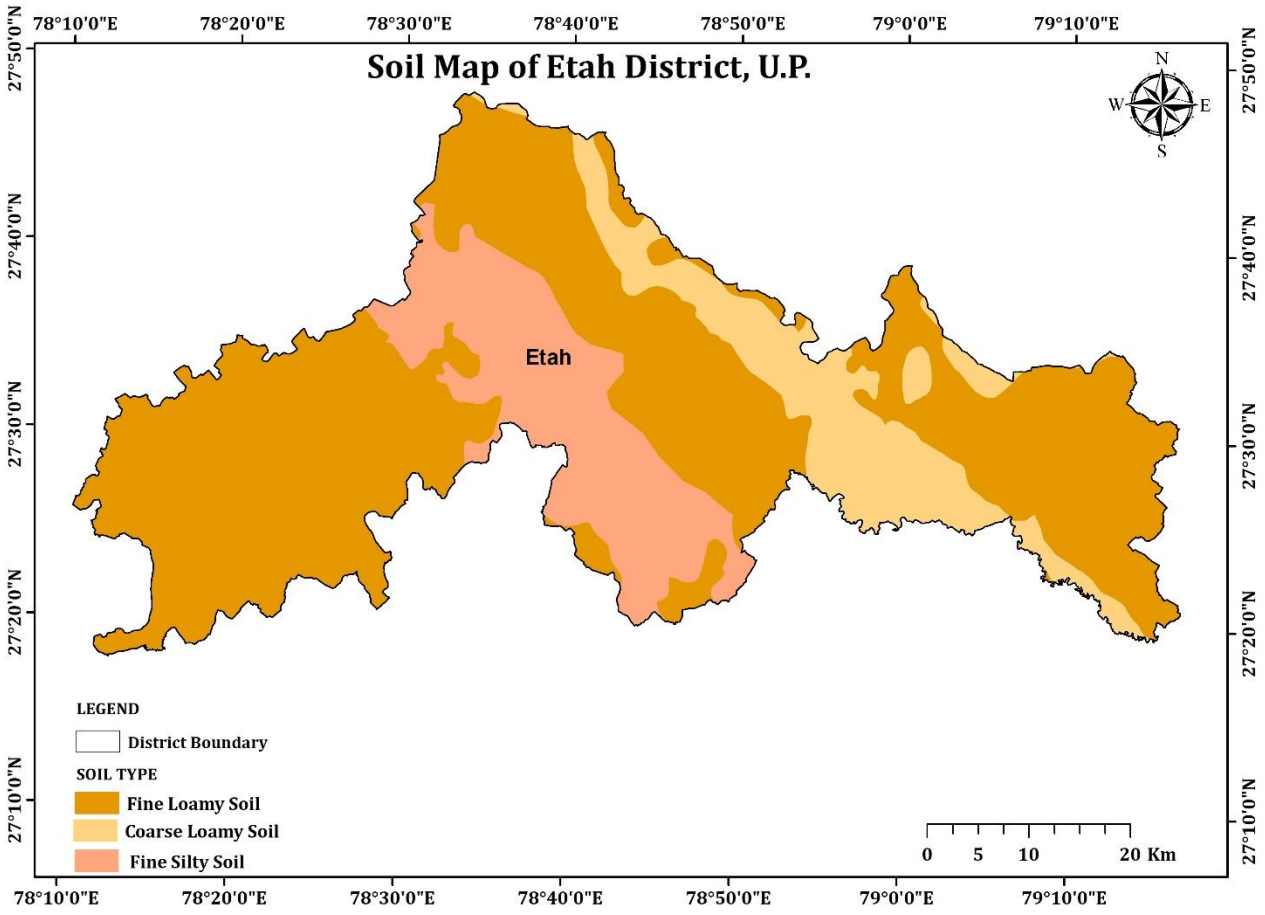


Figure 4: Soils Map Etah District (U.P.)

Table 2: Soils of Etah District (U.P.)

Legend	Plains	Description
1	**Alluvial plain (0-1% slope)**	Deep, slightly eroded and loamy soils.
2		Silty soils are often deep, loamy, and somewhat eroded.
3		Fine, deep soils somewhat eroded, slightly saline, and sodic, connected to loamy soils
4		Deep, fine soils are somewhat degraded and paired with loamy soils that are moderately sodic and mildly salty.

5		Connected with loamy soils are deep, fine, and somewhat eroded soils.
6		Loamy soils with moderate salinity and sodicity, together with deep, silty soils, are connected to waterlogging.
7		Deep loamy soils with high sodicity and mild salinity are related to loamy soils with moderate salinity.
8		Connected with silty soils that are somewhat eroded, deep loamy soils with mild salinity and moderate sodicity
9	**Old Alluvial plain with river left out channels/Oxbows/point bars (1-3%slope)**	Along with stratified loamy soils that are somewhat eroded, there are deep, loamy soils.
10	**Recent Alluvial Plain (1-3% slope)**	Deep, layered loamy soils that are mildly eroded, somewhat salinized, and moderately sodic.
11		Heavy floods, deep, loamy soils, and a little saltiness or sodicity.
12		Scandalized soils with mild waterlogging are connected with deep, loamy soils.
13	**Active Flood Plain (1-3% slope)**	Layered loamy soils with minimal flooding in association with deep, sandy soils.

1.9 Land use/ Landcover

Table 3 depicts the district's land use pattern. The geographical area accounts for 244.1 ha of the total reported land, the Cultivable area accounts for 218.9 ha, the Forest area accounts for 1.0 ha, Land under nonagricultural use 21.9 ha, Permanent pastures 0.2 ha, Cultivable wasteland 10.5 ha, Land under Misc. tree crops and groves 0.5 ha, Barren and uncultivable land 2.9 ha, Current fallows 6.9 ha, and Other fallows 5.2 ha. As a result, there is an urgent necessity for afforestation in the region. There is no livestock usage of land in the region. It would be important to improve land grazing in the district.

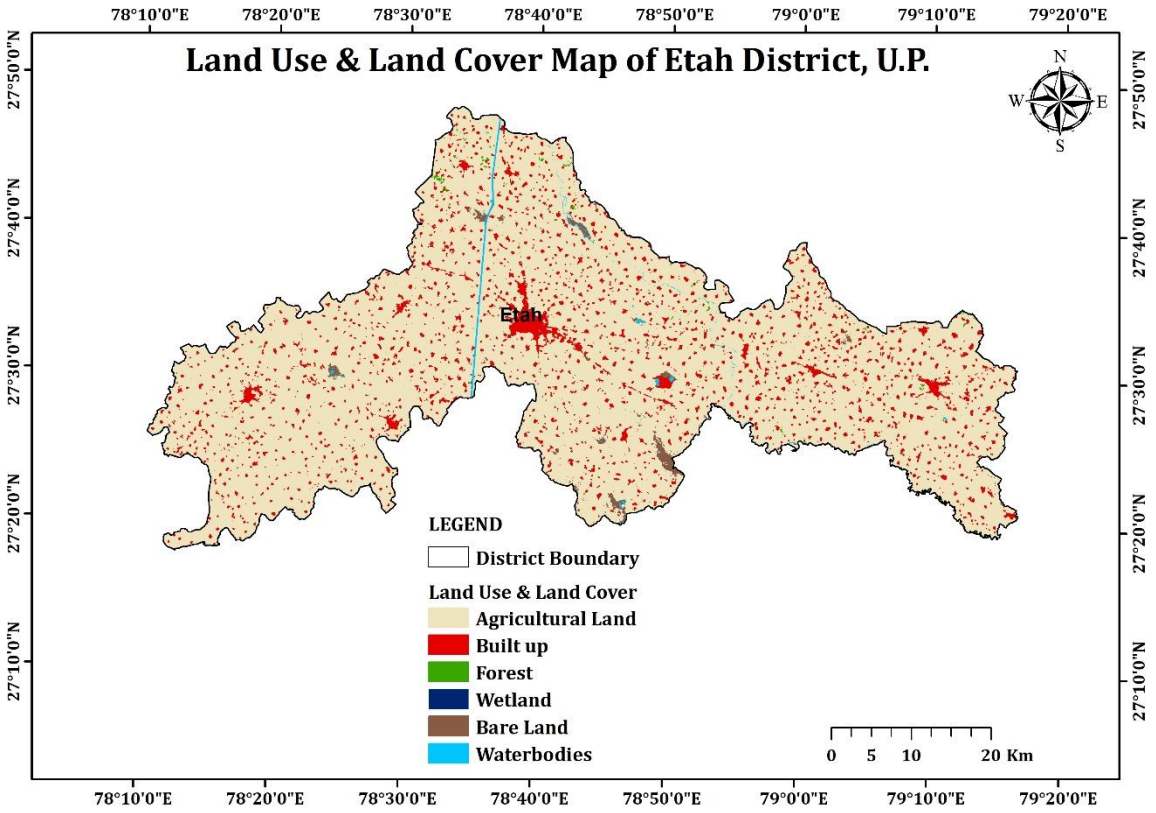


Figure 5: Land use/ Landcover map of Etah district

Table 3: Land Use Pattern of the Etah District (2011 -12)

Land use pattern of the district (Latest statistics)	Area in (000 ha)
Geographical area	244.1
Cultivable area	218.9
Forest area	1.0
Land under nonagricultural use	21.9
Permanent pastures	0.2
Cultivable wasteland	10.5
Land under Misc. tree crops and groves	0.5
Barren and uncultivable land	2.9
Current fallows	6.9
Other fallows	5.2
Total	512.1

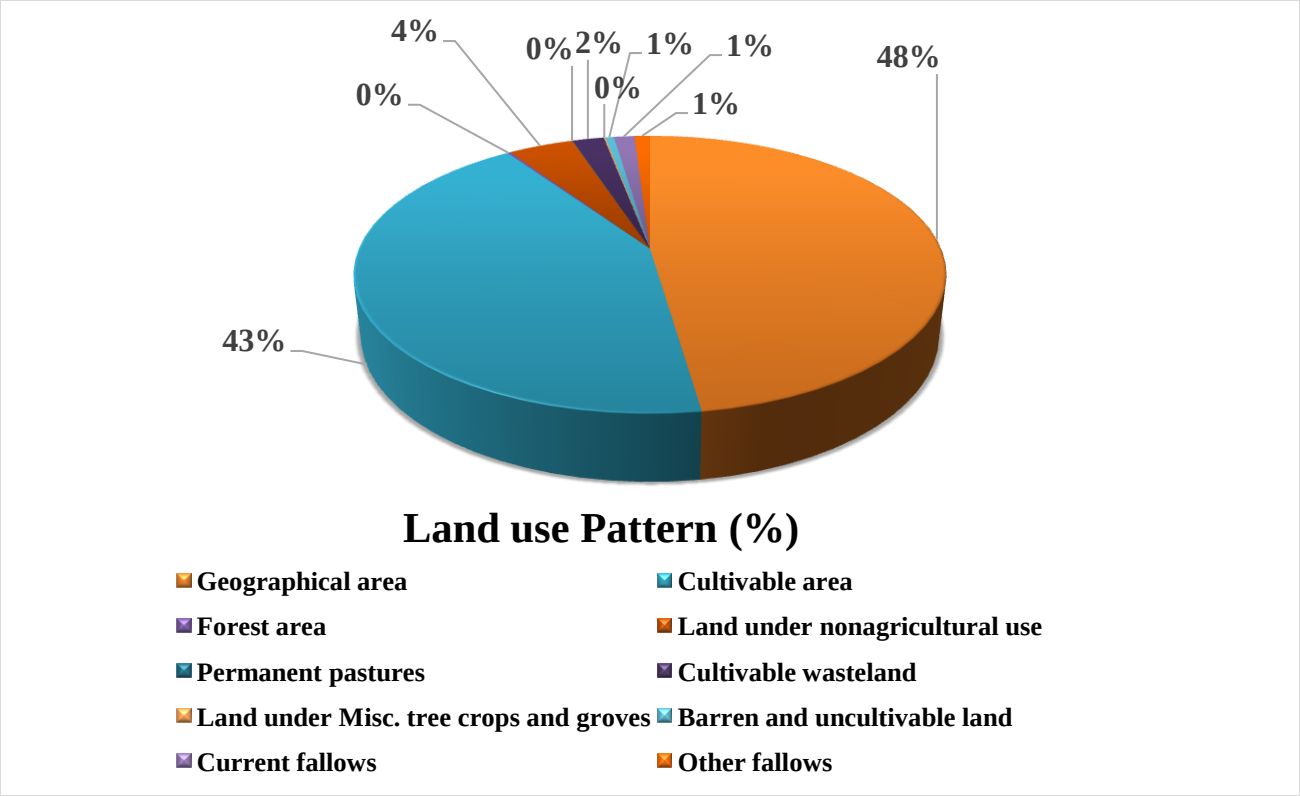


Figure 6: Land Use Pattern of the Etah District (in 000 ha)

1.10 Agriculture and Cropping Pattern

Etah is a historically significant city. Another feature of this territory is its ever-flowing rivers. The land is extremely rich, and farming is the primary source of income for the majority of the population. The climate is also ideal for agriculture. Etah was a major marketplace for paddy and wheat. The area is also notable for bajra, Maize-Kharif, Chickpea, Lentil, Moong (Kharif) etc. Over 10% of the population of Etah depends on agriculture for a living.

Table 4: Area under major field crops & horticulture (as per latest figures of 2008-09)

S. No.	Major field crops cultivated	Area ('000 ha)							
		Kharif			Rabi				
		Irrigated	Rainfed	Total	Irrigated	Rainfed	Total	Summer	Total
1	Wheat	0	0	0	135.228	0	135.228	-	135.228
2	Pearl millet	24.190	21.831	46.021	-	-	-	-	46.021

3	**Maize**	22.508	2.690	25.198	-	-	-	-	25.198
4	**Rice**	17.788	0.721	18.509	0	0	0	0	18.509
5	**Rapeseed Mustard**	-	-	-	10.834	0	10.834	0	10.834
6	**Barley**	-	-	-	8.879	0	8.879	-	8.879
7	**Sorghum**	Not Available	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
8	**Urd**	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.

	Horticulture crops - Fruits	**Area ('000 ha)**		
		Total	**Irrigated**	**Rainfed**
1	Mango	0.128	0.128	-
2	Guava	0.164	0.164	-
	Horticulture crops - Vegetables			
1	Potato	10.168	10.168	-
2	Onion	0.373	0.373	-
3	Pea	6.933	6.933	-
	Medicinal and Aromatic crops			
1	Mentha	0.154	0.154	-

Source: https://agricoop.nic.in/sites/default/files/UP56-Etah-28.07.14_0.pdf

1.11 Irrigation

Farming is the most common employment in the entire area. Massive surface and underground water improvements are being carried out to ensure irrigation. The irrigation region in the Etah region is presented by many sources in (Annexure-3). The entire area irrigated by various sources is 2204 square kilometers.

A comprehensive "Strategic Plan for District Irrigation" has been prepared through a geospatial approach. As of 31.3.2011, the extent of the principal canal in the area was 166 kilometers. State irrigation works include state tube-wells and canals, whereas private irrigation works include canal-based (Govt. and Pvt.) and tube-wells (Govt. and Pvt.). The district's net

area seeded is 2294 square kilometers; however, only 2189 square kilometers of that land is irrigated.

1.12 Prevailing Water Conservation and Recharge Practices

Data not available

2. DATA COLLECTION, INTEGRATION, AND AQUIFER MAPPING

2.1 Aquifer Geometry

To understand the lithological framework and sub-surface disposition of aquifers in the study area, the lithological data of wells drilled by CGWB and UPGWD was first compiled and redefined as per ROCK WORKS software format and then plotted for visualization of aquifer disposition.

The major lithology is Quaternary alluvium, underlain by the Vindhyan basement. Quaternary alluvium is divided into Older and Newer alluvium. Older alluvium consists of oxidized sediments of the polycyclic sequence of silt, clay with calcareous concretions (kankar), and micaceous beds. Newer alluvium was deposited by the annual flooding of the Ghaghara River and has non-oxidized sediments made of alternate clay and sand layers.

Three aquifer groups were identified visually upon generation of 2-D and 3-D models and fence diagrams. The quality of formation water is good, barring the occurrence of Iron at a few places in the unconfined aquifer.

2.2 Groundwater scenario

The groundwater arises in the aperture spaces of unconsolidated alluvial sediments in the sedimentation zone. The top silty/sandy clay beds mixed with kankar support the dug-wells where groundwater occurs under water table conditions. The groundwater in the deeper aquifers occurs in semi-confined to confined conditions.

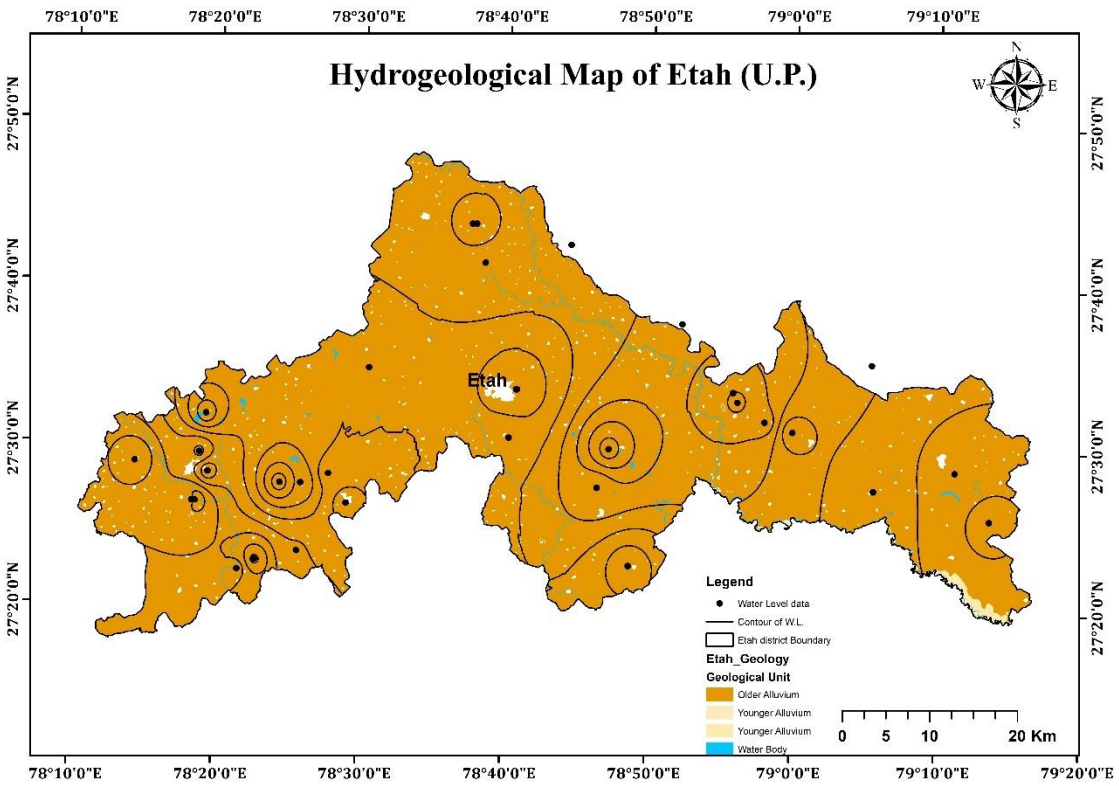


Figure 7: Hydrogeological map of the study area

2.3 Depth To Water Level

Pre-monsoon and post-monsoon water level data were collected from the key wells and piezometers in the district for 2021. The depth to water level data and fluctuation data has been attached in Table 6. Depth to water level maps prepared for the pre-monsoon and post-monsoon periods have been below, as shown in Figures 9 and 10.

Pre-monsoon depth to water level varies between 3.26 mbgl to 23.54 mbgl, and post-monsoon depth to water level varies between 2.35 mbgl to 23.65 mbgl.

Table 6: Water Level and Fluctuation Data of Water Level Monitoring Stations

S.NO.	Block Name	Location Names	Long	Lat	Type of well	PRM_21	PTM_21	FLU_21
1	ALIGANJ	PANCHYAT BHAWAN, AGONAPUR	79.187500	27.48	P	14.82	14.95	-0.13
2	ALIGANJ	P.S. ABHAGPUR BHATAN	79.228056	27.43	D	16.78	16.80	-0.02
3	AWAGARH	PUNHERA	78.407177	27.46	W	6.88	2.43	4.45
4	AWAGARH	AWAGARH B.D. O. OFFICE	78.484167	27.44	D	17.15	15.66	1.49
5	AWAGARH	P.S. SIKRARI	78.428056	27.39	P	16.10	15.75	0.35
6	AWAGARH	P.S. ISAULI	78.379444	27.38	D	22.37	22.19	0.18
7	AWAGARH	P.S. BARAI KALYANPUR	78.463333	27.47	P	15.00	11.05	3.95
8	AWAGARH	P.S. GADESARA	78.431389	27.46	P	10.02	8.30	1.72
9	JAITHARA	JAITHARA BDO OFFICE	78.999167	27.52	P	13.33	11.55	1.78
10	JAITHARA	P.S. DHUMARI	78.935000	27.55	P	5.66	4.45	1.21
11	JAITHARA	PMV. PARAULI SUHAGPUR	78.966667	27.53	P	7.10	4.55	2.55
12	JAITHARA	SARAUNTH	79.093611	27.46	D	13.38	13.52	-0.14
13	MAREHRA	MIRHACHI B.D.O. OFFICE	78.625278	27.73	P	9.84	8.70	1.14
14	MAREHRA	P.S. SIRSA TIPPU	78.640984	27.69	P	10.06	8.55	1.51
15	NIDHOLIKALAN	NIDHOLI KALAN BDO OFFICE	78.508333	27.58	D	14.00	13.10	0.90
16	SAKEET	SAKIT B.D.O. OFFICE	78.773889	27.46	P	9.16	7.07	2.09
17	SAKEET	NIDHOLI KHURD	78.671111	27.51	D	12.68	10.16	2.52
18	SAKEET	PMV. LALDUNDWARA	78.786944	27.50	P	3.26	1.00	2.26
19	SAKEET	P.S. ISHARA WEST	78.811389	27.38	P	15.07	14.40	0.67
20	SHEETALPUR	SITALPUR BDO OFFICE	78.678889	27.56	D	15.94	15.31	0.63
21	JALESAR	JALESAR B.D.O. OFFICE	78.305833	27.44	D	17.34	16.23	1.11
22	JALESAR	PMV. PATNA	78.321111	27.53	P	8.83	5.22	3.61
23	JALESAR	PMV. GUDAUN	78.309167	27.44	P	23.45	23.65	-0.20
24	JALESAR	SHALWAHANPUR	78.239444	27.48	D	21.95	21.81	0.14

25	JALESAR	KRASHHIKARYALAY, JALESAR	78.323889	27.47	P	12.65	11.45	1.20
26	JALESAR	CANAL OFFICE, JALESAR	78.313829	27.49	D	18.41	18.60	-0.19
27	JALESAR	PMV. SHERGANJ	78.239444	27.48	D	23.54	23.49	0.05
28	JALESAR	PMV. RAMGARHI	78.359444	27.37	P	17.31	15.60	1.71
29	AMANPUR	AMANPUR PZ-GWD	78.74	27.71	P	5.07	3.6	1.47
30	MAREHRA	MARAHCHI PZ-GWD	78.63	27.73	P	9.75	8.65	1.10
31	PATIYALI	DARYAGANJ	79.09	27.59	W	10.43	10.23	0.20
32	SHITALPUR	ETAH PZ-GWD	78.68	27.56	P	14.9	14.1	0.80
33	SIDHPURA	DHUMRI1	78.93	27.56	W	3.49	2.35	1.14
34	SIDHPURA	SIDHPURA PZ-GWD	78.87	27.63	P	6.39	5.25	1.14

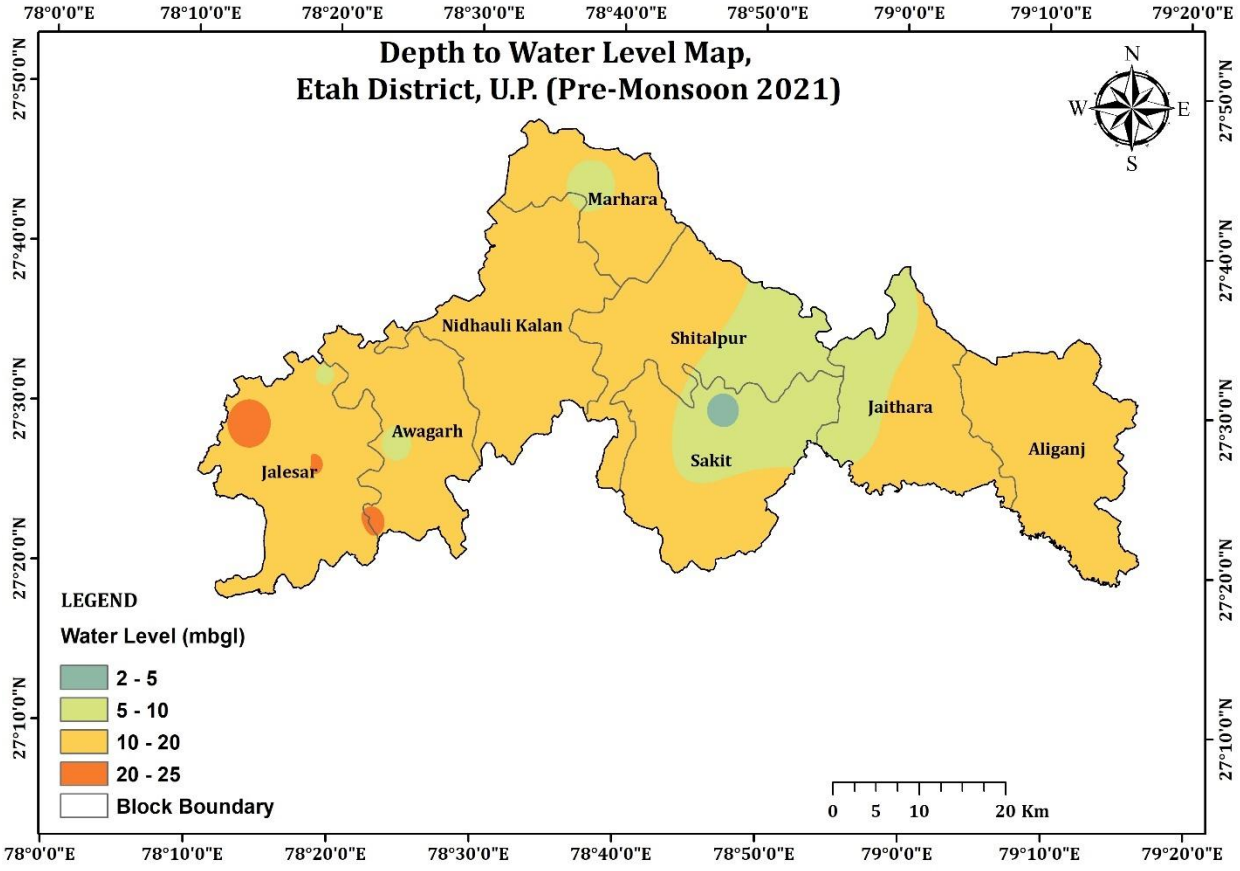


Figure 8: Depth of Water Level Map of Etah District (Pre-Monsoon)

A perusal of the depth to water level contour map for the period of May 2021 reveals that the water level that most of the district displays are water levels in the range of 5 – 19 mbgl.

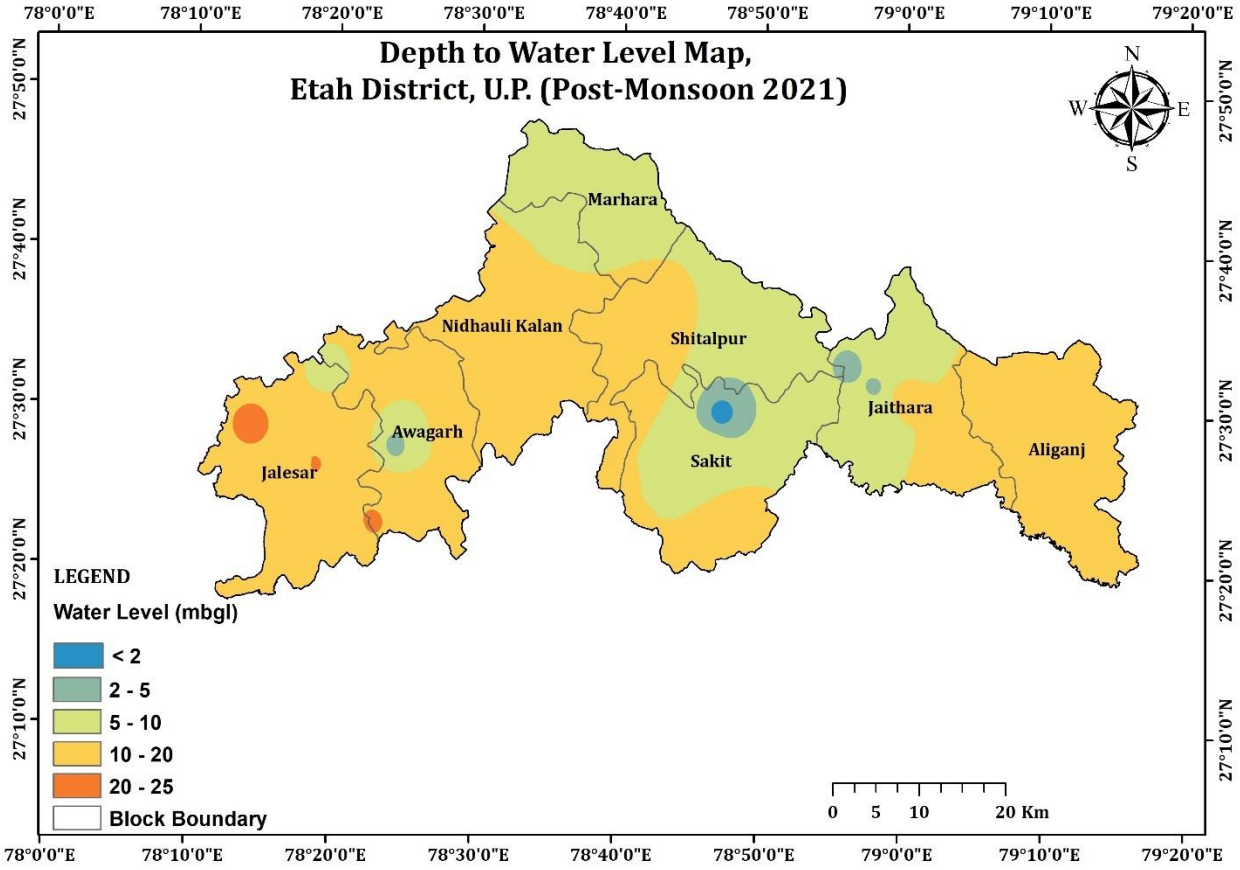


Figure 9: Depth of Water Level Map of Etah District (Post-Monsoon)

A perusal of the depth to water level contour map for the period November 2021 reveals water level becomes shallower owing to recharge of the aquifer from rainfall, and the majority of the area has water levels of 5 - 19 mbgl.

2.3.1 Water Level Fluctuation

According to water level statistics from Etah district wells for the year 2021, the district's water level is increasing. The majority of the district's water level variation is between 0.0 and 2.0 mbgl, with an increasing tendency. Figure 11 depicts the fluctuation in water level.

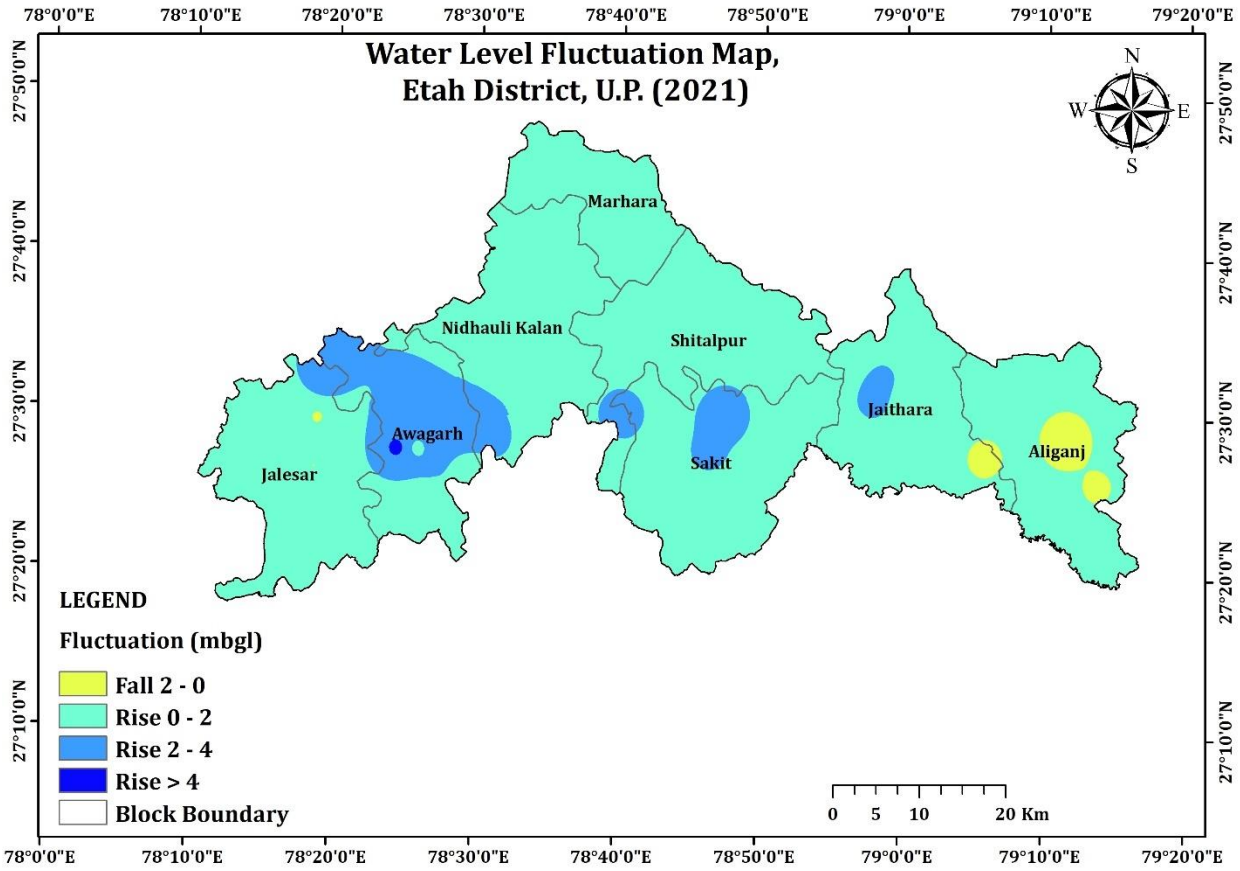


Figure 10: Water Level Fluctuation Map of Etah District

A perusal of the map reveals that the water level is mainly rising between 0 mbgl to > 4 mbgl across the district. A small part of the Aliganj and Jaithara block display falls at a water level between 2-0 mbgl. Parts of Jalesar, Nidhauli Kalam, Marhara, Shitalpur, Sakit, Jaithara, Aliganj and some parts of Awagarh blocks display a rise in water level between 0-2 mbgl. Parts of Awagarh and a little part of Sakit, Shitalpur, and Jaithara blocks show water level rise between 2-4 mbgl. A little part of the Awagarh block displays a water level rise > 4 mbgl.

2.3.2 Water Level Trend

Long-term water level trends are depicted in water level hydrographs, which show how groundwater storage in the phreatic zone has changed over time. Variations in storage are caused by variations in atmospheric pressure, as well as variances in refill and outflow rates throughout time. A long-term water level trend for the pre-and post-monsoon phase has been calculated and reported using 9-year water level data (Table-7):

Table 7: Water Level Trend of Etah District (from 2012 to 2021)

S. No.	Location	Pre-Monsoon			Post-Monsoon			Annual		
		Data Points	Rise (m/year)	Fall (m/year)	Data Points	Rise (m/year)	Fall (m/year)	Data Points	Rise (m/year)	Fall (m/year)
1	Jalesar Pz- GWD	6		0.6057	7		0.0295	28		0.0615
2	Awagarh Pz-GWD	1			1			4		
3	Nidhauli Pz-GWD	1			1			4		
4	Shitalpur Pz-GWD	1			1			4		
5	Sakit Pz-GWD	6		0.6973	7		0.4181	26		
6	Etah Pz-GWD	7		0.7398	8		0.6266	30		
7	Jaithra Pz-GWD	6		0.5559	8		0.7108	29		
8	Marahchi Pz-GWD	7		0.3863	8		0.2695	30		
9	Kasganj Pz-GWD	3			2			10		
10	Soron Pz-GWD	1			0			3		
11	Sahawar Pz-GWD	1			1			4		
12	Ganjdundwara Pz-GWD	3			2			8		0.1050
13	Patiali Pz-GWD	1			1			3		0.0084
14	Sidhpura Pz-GWD	7		0.2399	8		0.1394	29		0.0041
15	Amanpur Pz-GWD	7		0.2932	8		0.1217	30		
16	Bhagwala1	5			4			17		0.0117
17	Daryaganj	9		0.4150	9		0.3926	34		
18	Jaisukhpur	2			4			13		
19	Sakit (new)	4			4			15		
20	Dhumri1	7		0.0966	9		0.0492	34		
21	Locha	8		0.4625	8		0.5335	34		

According to the hydrograph trend, there has been a modest drop in water level in the majority of the district both in the “pre-monsoon and post-monsoon periods,” which might be attributed to

over-exploitation of groundwater and reduced recharge (figures 12-16). Throughout the "pre-monsoon season" as well as "post-monsoon period," the graph shows no increase in water levels.

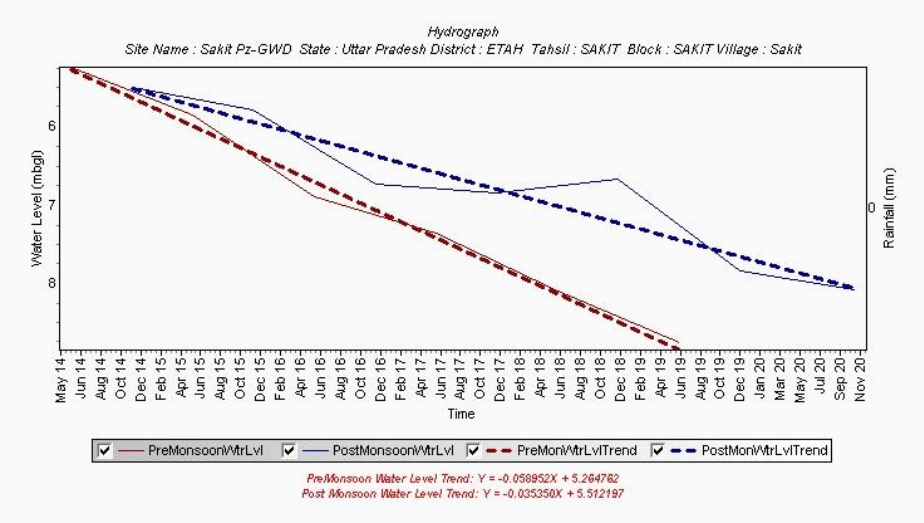


Figure 11: Long-Term Water Level Trend of Sakit, Etah District

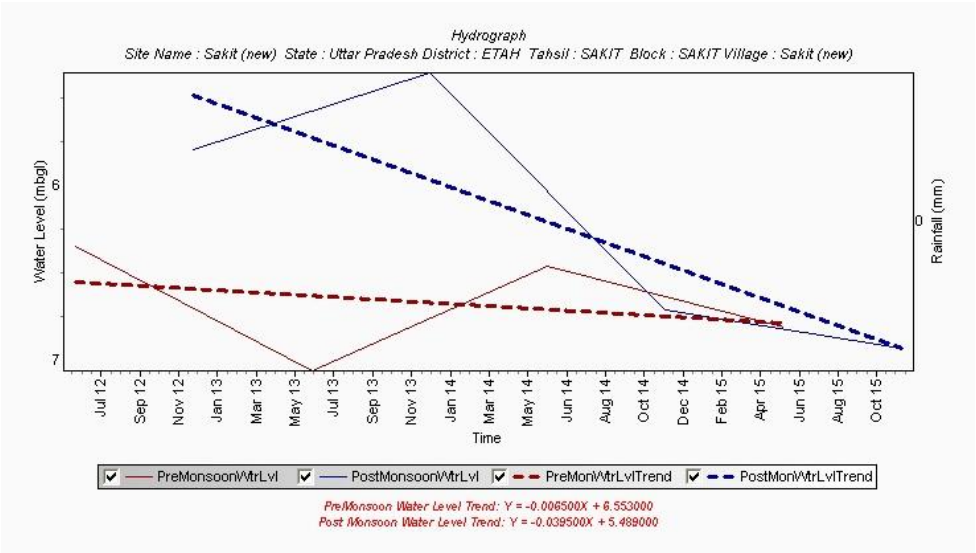


Figure 12: Long Term Water Level Trend of Sakit (new), Etah District

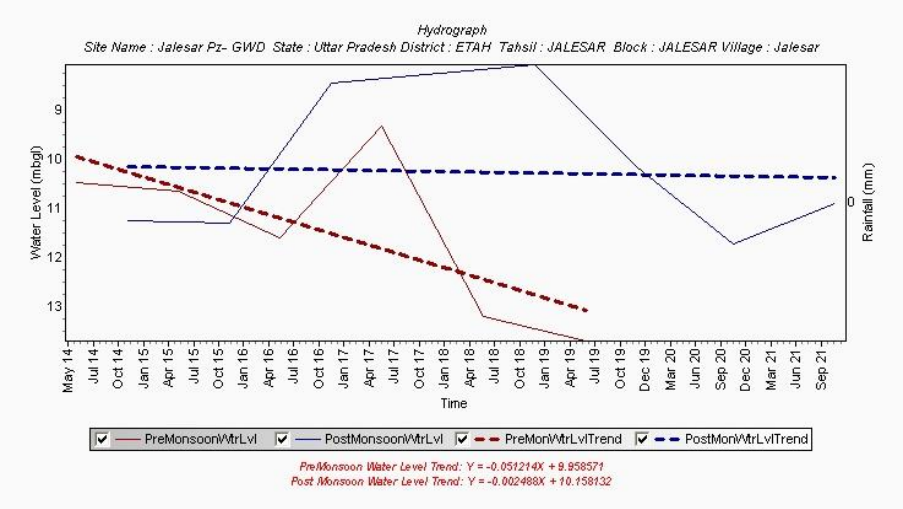


Figure 13: Long-Term Water Level Trend of Jalesar, Etah District

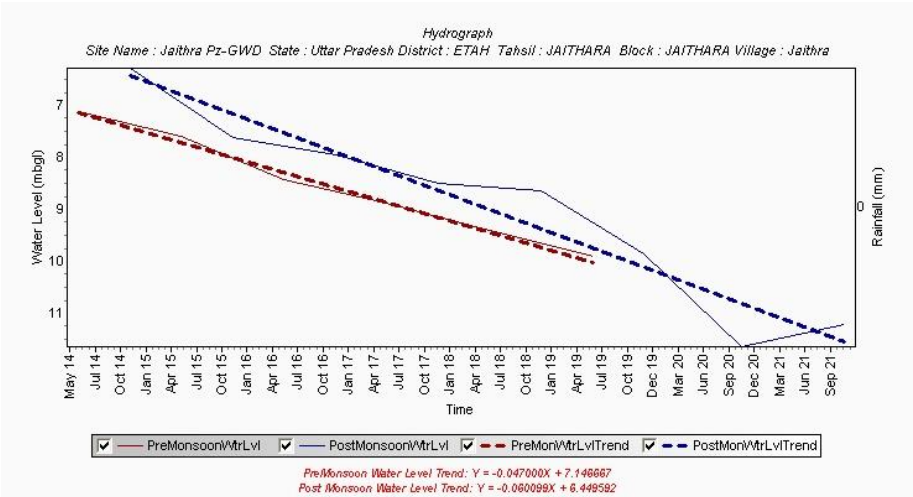


Figure 14: Long-Term Water Level Trend of Jaithara, Etah District

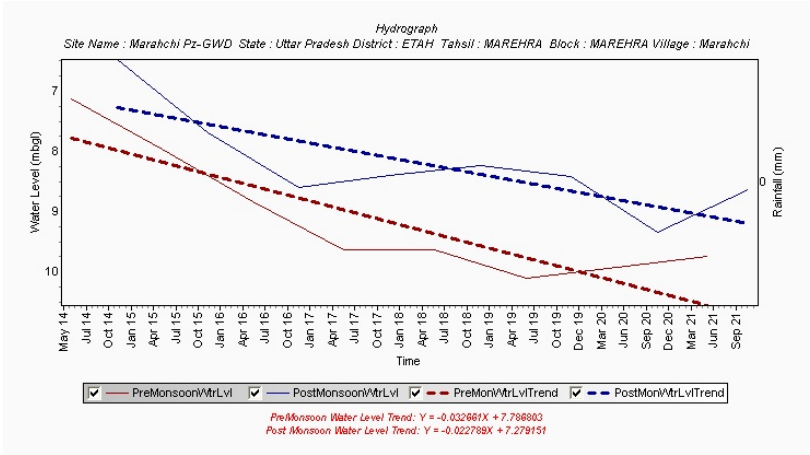


Figure 15: Long-Term Water Level Trend of Marehra, Etah District

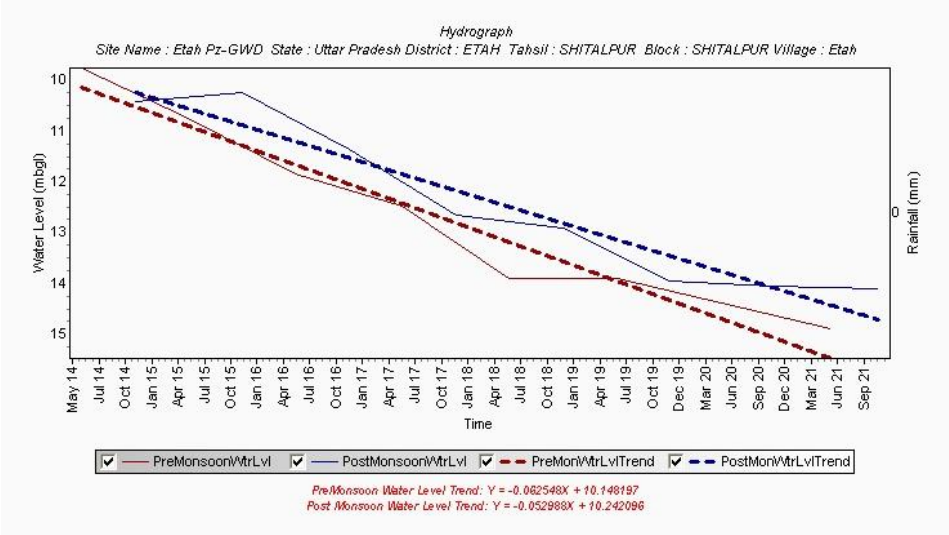


Figure 16:Long Term Water Level Trend of Shitalpur, Etah District

2.4 Groundwater Quality

The concentration of elements in groundwater is governed by many factors. i.e.

- Nature of formation,
- Minerals present in the rock,
- Characteristics of soil,
- Anthropogenic activities like Irrigation run-off, Discharge of effluents, Industrial and domestic activities, etc.

In order to have a clear picture and to study the hydrochemistry of groundwater, the analytical data of monitored wells and hand pumps were analyzed by the NABL accredited Regional Chemical Laboratory at Lucknow.

2.4.1 Groundwater sampling

In June 2021, pre-monsoon monitoring was done to identify locations with poor water quality by determining basic metrics and trace metal concentrations.

2.4.2 General Aspects of the unconfined aquifer

8 groundwater samples were collected during the pre-monsoon season in 2021 for analysis of basic parameters and trace metals. The analyzed data has been attached as Annexures 1 and 2.

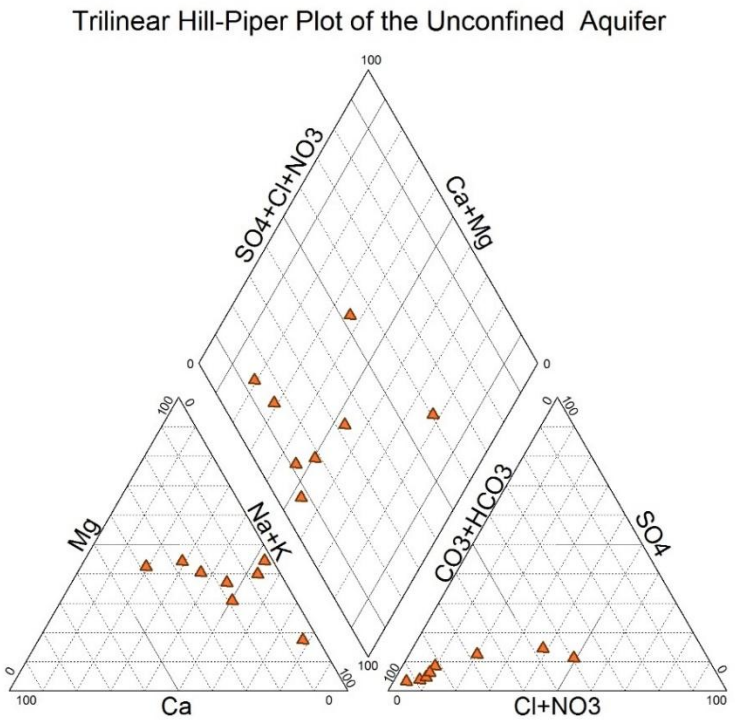


Figure 17: Trilinear Hill-Piper plot of the unconfined aquifer

2.4.3 Classification with respect to agricultural use

The unconfined aquifer's water quality has been categorized according to agricultural criteria as required by IS 11624-1986.

- **Total salt concentration –** It is represented as Electrical Conductivity (EC), and Table 8 below lists the categorization in regard to the danger it poses to soils.

Table 8: Summarized table of GW samples w.r.t EC

Sl. No.	Class	Range of EC (µS/cm)	No. of samples
1.	Low	0 – 1,500	6
2.	Medium	1,500 – 3,000	2
3.	High	3,000 – 6,000	-
4.	Very High	>6,000	-

All the samples lie within the ambit of the 'Low' class with reference to EC and pose no problem for irrigation except 2 samples (max. part of Jalesar and a little part of Awagarh).

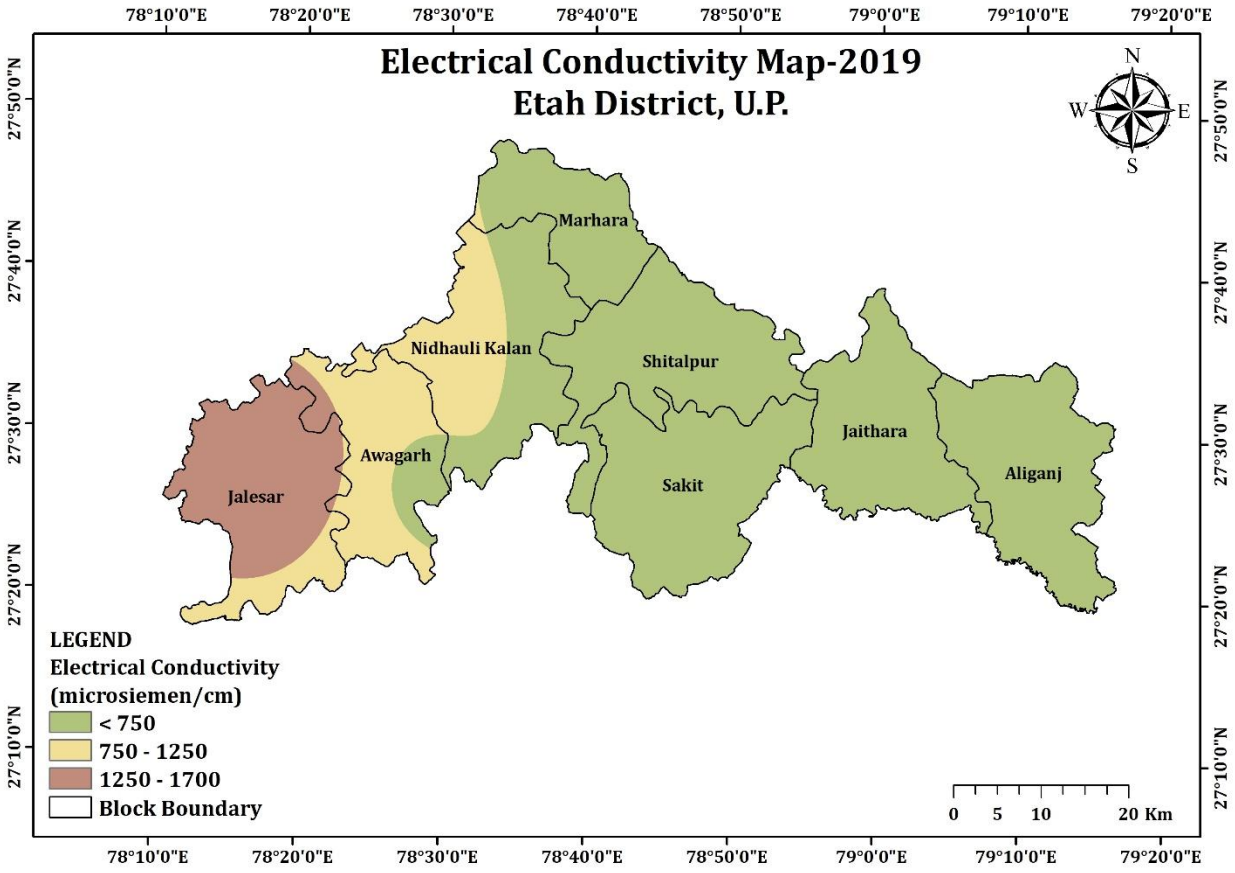


Figure 18: Electrical Conductivity Map-2019 Etah District, U.P.

- **Residual Sodium Carbonate –** It is computed using the below formula, where all constituents are expressed in meq/l, and is characterized in terms of the potentially harmful consequences of bicarbonate ion concentration on soil:

$$RSC = (CO_3^{2-} + HCO_3^{-}) - (Ca^{2+} + Mg^{2+})$$

Table 9: Summarized table of GW samples w.r.t RSC

Sl. No.	Class	Range of RSC (meq/l)	No. of samples
1.	Low	< 1.5	3
2.	Medium	1.5 – 3.0	5
3.	High	3.0 – 6.0	-
4.	Very High	> 6.0	-

Three samples (37.5% of total samples) lie within the ambit of the 'Low' class with reference to RSC and pose no problem for irrigation. Five samples (62.5% of total samples) lie within the

ambit of the 'Medium' class, and the soil requires some treatment prior to the application of groundwater for irrigation.

- **Sodium Adsorption Ratio –** It is a measure of the quality of irrigation water that is utilized to manage soils that have been impacted by salt. The amount of the principal alkaline and alkaline earth cations found in groundwater serves as a sign of the water's appropriateness for irrigation of agricultural land. It may also be used as a diagnostic measure for a soil's sodicity risk based on an investigation of soil pore water.

It is computed from the formula given below:

$$SAR = \frac{Na}{\sqrt{(Ca + Mg)/2}}$$

Table 10: Summarized table of GW samples w.r.t SAR

Sl. No.	Class	Range of SAR (meq/l)	No. of samples
1	Low	<10	8
2	Medium	10 - 18	-
3	High	18 - 26	-
4	Very High	> 26	-

All Eight samples (100% samples) lie within the ambit of the 'Low' class with reference to SAR and pose no problem for irrigation.

2.4.4 Note on Trace elements

- **Chromium as Cr:** Only two samples (25% of total samples), namely Awagarh, Jaithara display values of Cr greater than the acceptable limit as per BIS 10500:2012-2nd Revision.
- **Copper:** No Copper was found in any sample.
- **Iron:** Only two samples (25% of total samples), namely Jaithara and Nidholi Kalan, display values of Iron not greater than 0.3 mg/l, which is an acceptable limit as per BIS 10500:2012-2nd Revision.
- **Manganese:** Six samples (12.5% of total samples), namely Aliganj, Awagarh, Jaithara, Jalesar, Nidholi Kalan, Sakit, and Shitalpur, display values of Mn not greater than 0.3 mg/l, which is an acceptable limit as per BIS 10500:2012-2nd Revision.
- **Zinc:** Six samples (75% of total samples), namely Aliganj, Jaithara, Jalesar, Nidholi Kalan, Marhara and Shitalpur, display values of Zn not greater than 0.5 mg/l, which is an acceptable limit as per BIS 10500:2012-2nd Revision.

- **Arsenic as As** Only three samples (37.5% of total samples), namely Awagarh, Jaithara and Sakit block, displays Arsenic higher than the limit as per BIS 10500:2012-2nd Revision.
- **Lead:** Only one sample (12.5% of total samples), namely Jaithara, has Lead content higher than the acceptable limit as per BIS 10500:2012-2nd Revision.

2.4.5 General hydrochemistry of deeper aquifers

8 groundwater samples were collected in May 2019 when pumping tests were carried out to determine aquifer parameters. 3 samples were earmarked for the determination of basic parameters, namely pH, EC, Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}, HCO_3^{-}, CO_3^{2-}, SO_4^{2-}, Cl^{-}, F^{-} and PO_4^{3-}. 3 samples were earmarked for analysis of trace metals, namely Fe, Mn, Cu, Cr, Zn, Pb, As, and U by ICP-MS. After obtaining the results of chemical analyses, the samples were plotted on a trilinear Hill-Piper plot, and the samples were classified into different hydrochemical facies based on dominant cations and anions.

Table 11: Deep Aquifer Quality of Etah

	Aquifer -1	Aquifer-2	Aquifer-3	Aquifer-4
EC range	360-856	312-743	308-752	350-785
Fluoride	0-0.23 mg/l	0-0.73 mg/l	0-0.63 mg/l	0-0.45 mg/l
Other Problem	No Quality Problem	No Quality Problem	No Quality Problem	No Quality Problem

2.5 Aquifer Characteristics

The research area's main aquifers were identified by grouping sand, clay, loam, bhur, sandy-loam, and domat as aquifers separated by restricting clay layers called aquicludes. The electrical resistivity (64 inches Normal) and gamma radioactivity records of the boreholes drilled in the region were merged to identify granular zones (the aquifers) with varying resistivity. The lithological character, hydraulic parameters, and quality, as determined by exploratory drilling and geophysical logging, have been used to demarcate various aquifer groupings. "Aquifer group I, Aquifer group II, Aquifer group III and Aquifer group IV" are the three aquifer systems in the research region.

- **Aquifer Group- I**

The top clay layer lies slightly below the first aquifer group, which is widespread geographically and has a maximum thickness of 80 meters. The ten granular materials in this category are mostly fine to medium sand, with some kankar and sandy clay thrown in for variety.

- **Aquifer Group- II**

The second aquifer group, which typically occurs between 110 and 160 mbgl in-depth, is made up of fine to coarse sand that has been combined with kankar and gravels. In a large portion of the region, clay lenses are a regular occurrence within this aquifer category.

- **Aquifer Group- III**

The third aquifer group is made up of fine to coarse sand that is sometimes combined with kankar and gravels, and it typically ranges in depth from 240 (20) m to 290 (20). According to the lithological logs of the 4 deep boreholes, the presence of clay lenses at depths in this aquifer is also reducing its regional extent.

- **Aquifer Group- IV**

The fourth aquifer group, occurring generally below Conceptual Plan for Development of Proposed Government Medical College at Gata No-1206 &1093 Village-Siraon, Pargana, Tehsil & District- Etah, Uttar Pradesh 340 m, (±20 m), consists of fine to coarse sand with occasional gravels. Due to the low drilling depth, it is difficult to determine the exact thickness of this set of aquifers, although it appears to range between 20 and 50 m, with clay lenses of 10 to 20 m thickness in between. As you move west, the aquifer group's thickness declines.

The data are available from exploratory drilling summarizing the depth of aquifer groups, feasible extraction structure, discharge, and other details that have been summarized below:

Table 12: Summarized details of Aquifer groups in the district

Aquifer	Group – 1 [AL03]	Group – 2 [AL03]	Group – 3 [AL03]	Group – 4 [AL03]
Formation	Sand, clay, and loam.	Gravel and pebbles, mostly sand and bhur.	Sand, silt & thick clay.	Coarse sand with occasional gravel.
Abstraction Structure	Tube wells and public wells.	Exploratory wells	Tube-well	Not available
Depth Range (mbgl)	150	160-240	250 and below	340
Discharge (lpm)	50 – 100	1,517	1,1119 – 1,173	Not available
Transmissivity	-	837 to 3083	318 to 1766	Not available

		m2/day	m2/day	
SY / S	0.10	1.3710-04 to 6.7810-05	1.9810-04 to 6.1810-04	Not available
Groundwater suitability	occasional occurrences of arsenic and Iron. Suitable for irrigation and domestic purposes.	Suitable for irrigation and domestic purposes.	Suitable for irrigation and domestic purposes.	Suitable for irrigation and domestic purposes.

2.6 Lithological Disposition and Aquifer Disposition

To better comprehend the lithological and aquifer disposition in the study area, a 3-D model, sections, and stratigraphy diagrams based on lithological information gathered through exploratory drilling and geophysical investigations carried out by CGWB and private drillers in the district have been created. Borehole data is used to create the lithological strata. Aquifer/Lithological sections, Stratigraphy diagrams, and 3D Aquifer/ Lithological dispositions diagrams are all prepared using the same color codes. The existence of a substantial pile of various grades of sand with an alternating sequence of clay is shown in the research region by lithology and geophysical logging. The models were used to evaluate the lithological and aquifer dispositions; stratigraphic sections were created using Rockworks software. The vertical and horizontal scales in meters are used on the sections created for subsurface formations and aquifers.

- **Principal Aquifer System in the study area**

The research area's main aquifers were identified by grouping sand, clay, loam, bhur, sandy-loam, and domat as aquifers separated by restricting clay layers called aquicludes. The electrical resistivity (64 inches Normal) and gamma radioactivity records of the boreholes drilled in the region were merged to identify granular zones (the aquifers) with varying resistivity. The lithological character, hydraulic parameters, and quality, as determined by exploratory drilling and geophysical logging, have been used to demarcate various aquifer groupings. "Aquifer group I, Aquifer group II, Aquifer group III and Aquifer group IV" are the three aquifer systems that exist in the research region.

Table 13: Deep Aquifer Quality of Etah

	Aquifer -1	Aquifer-2	Aquifer-3	Aquifer-4
EC range	360-856	312-743	308-752	350-785
Fluoride	0-0.23 mg/l	0-0.73 mg/l	0-0.63 mg/l	0-0.45 mg/l
Other Problem	No Quality Problem	No Qaulity Problem.	Salinity Problem	Salinity Problem

Exploratory Well Details of Etah district

S.No	District	Village	Type of Well	Latitude	Longitude	Depth Drilled (mbgl)	Lithology	Aquifer Zones tapped	S.W.L (mbgl)	Discharge	Drawdown (m)	Specific Capacity	T_m2per day	S_Sy	EC	Chloride
1	Etah	Amanpur	SH			393	Alluvium									
2	Etah	Dhumri	SH	27° 31'12''	78° 55'12''	428	Alluvium									
3	Etah	Nagla Bhajua	EW	27° 33'00''	78° 40'12''	237.74	Alluvium	25-27, 29-34,38-46,50-57	2.77	1533	2.65	578.49	698		1087	34
4	Etah	Pasia Begumpur	EW	27° 29'54''	78° 16'12''	358	Alluvium	46-58,68-74,91-97	13.97	1263	7.71	163.81	668	0.0003	1530	113
5	Etah	Pilua	EW	27° 36'15''	78° 55'12''	427	Alluvium	40-55	6.33	3800	8.82	430.84	5742	0.0000157	530	21

➢ 3-D lithological and Aquifer Model

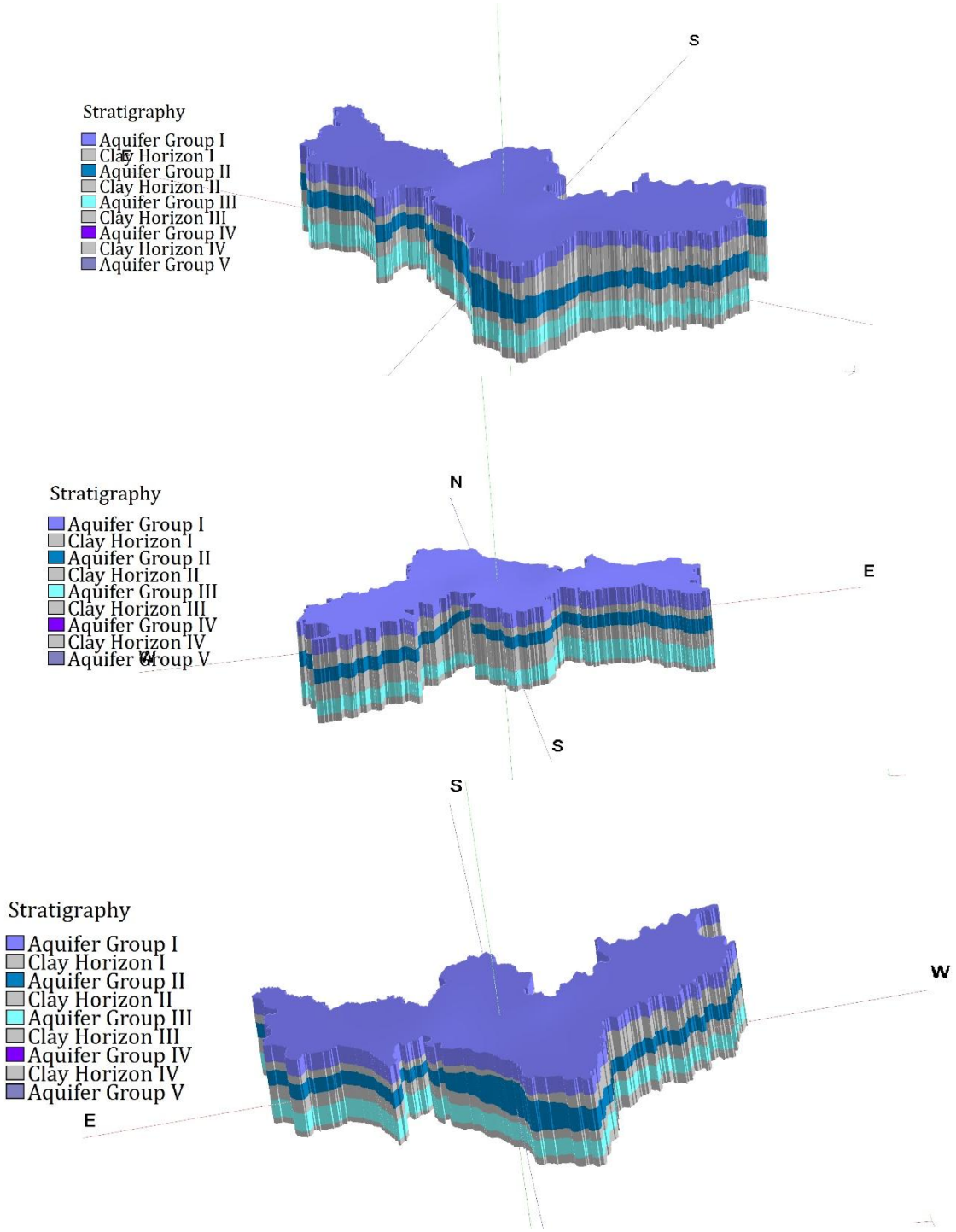


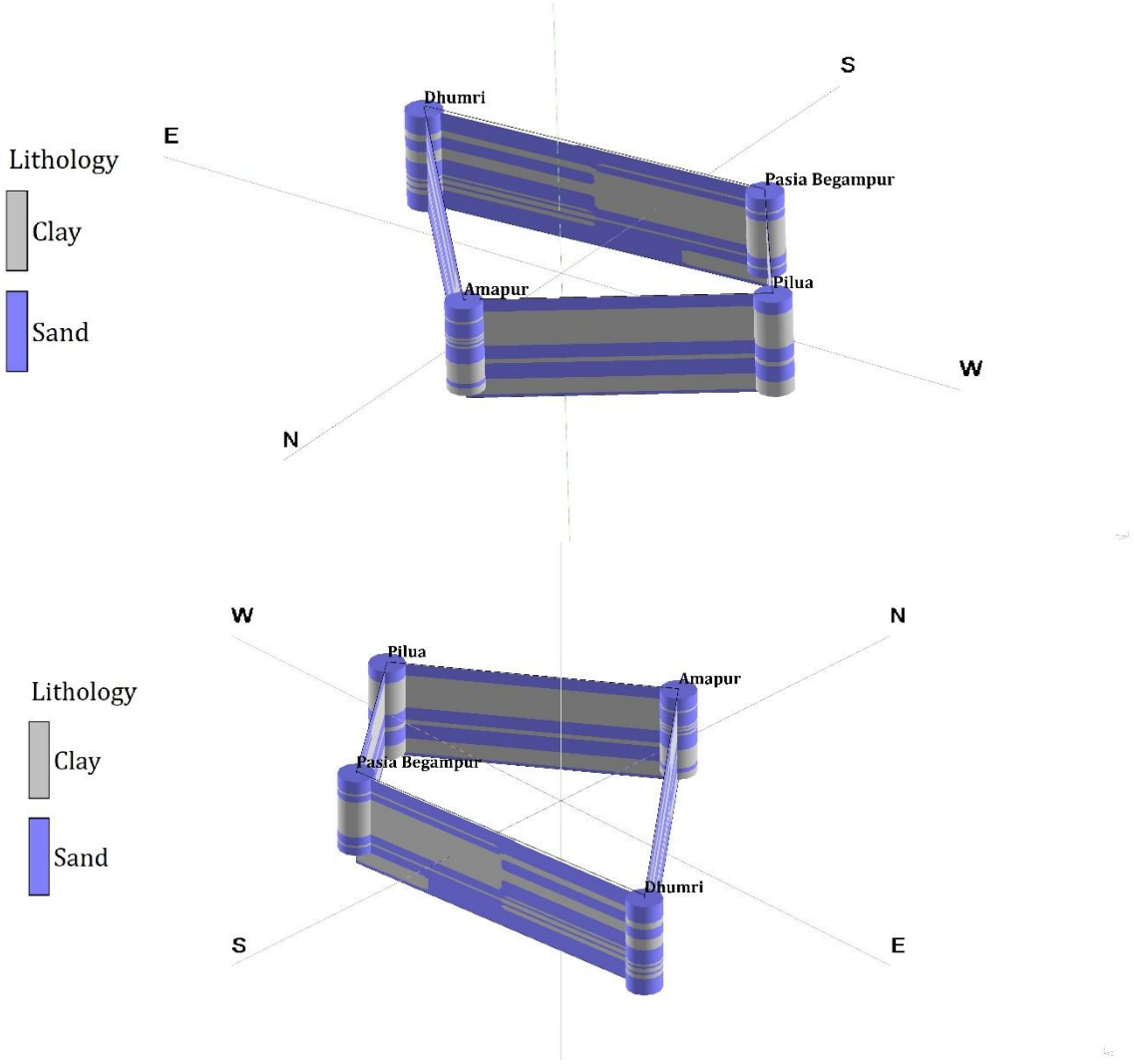
Figure 19: 3D model of Etah district

The thickness of Aquifer Group – 1 extends down to 80 mbgl (meters below ground level) from the ground surface. It is separated from the Aquifer Group – 2 by a clay layer. Aquifer Group – 2

is observed between 110 to 160 mbgl (meters below ground level). It is further separated from Aquifer Group - 3 by thick clay with thickness greater than the one separating Aquifers 1 and 2. Aquifer group – 3 is observed between the depths of 240 (±20) m to 290 (±20), and Aquifer group – 4 is observed between the depths of 340 m (±20 m).

- **Fence diagram**

Figure 22 displays fence diagrams built in the research area that delineate the lithology on a regional scale.



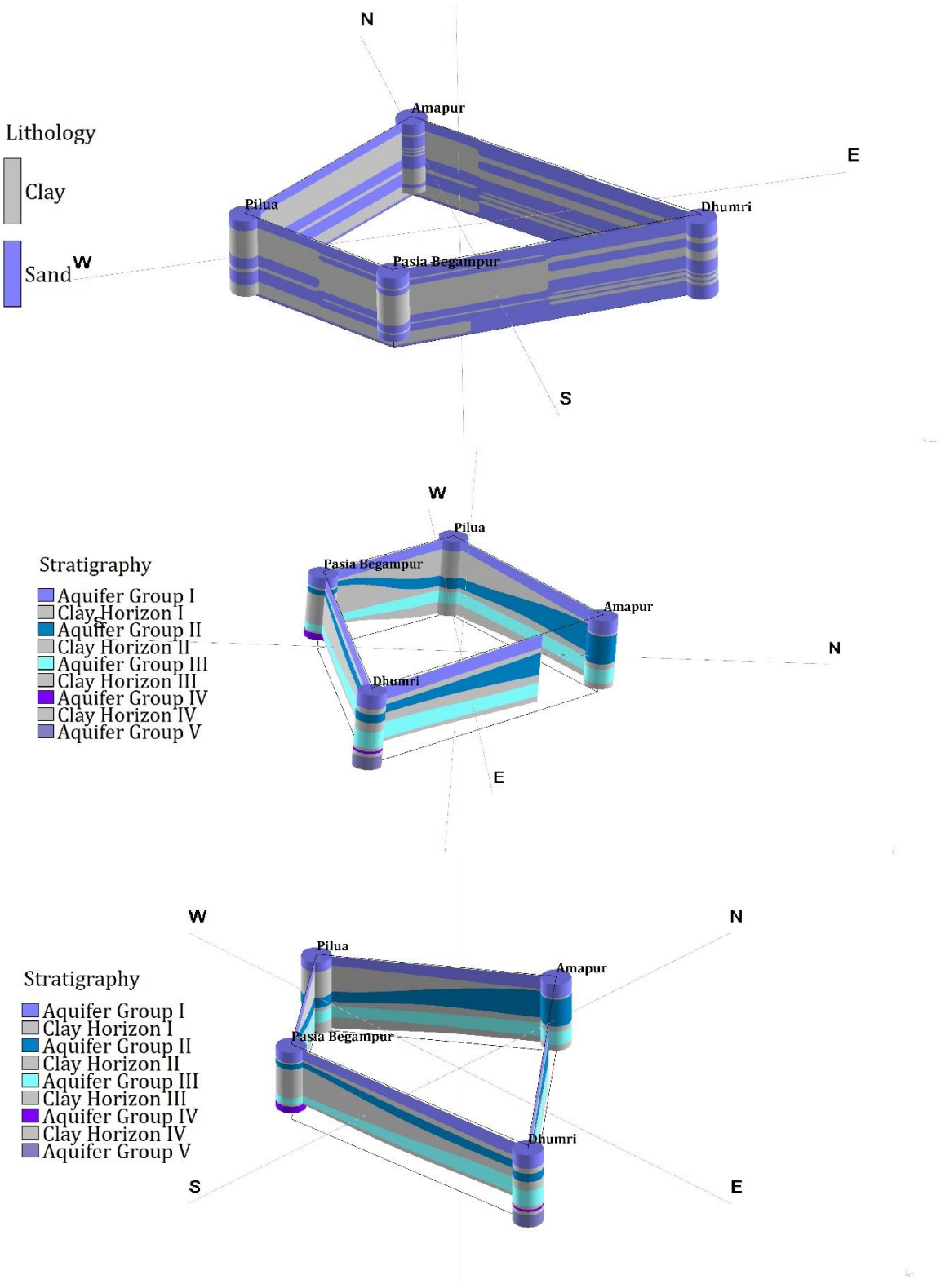


Figure 20: 3D diagram showing lithological variation in Etah district.

3. GROUNDWATER RESOURCE POTENTIAL

- **Stage of Groundwater Development:**

The current stage of Groundwater Development in the Etah district has been pegged at 79.73% as per GWRE 2021, which is categorized as Safe. 2 blocks of the district, namely Aliganj and Jalesar, have been categorized as "Critical" as their Stage of GW Development is 90.02% and 97.37% respectively. 2 blocks of the district, namely Awagarh and Marhara have been categorized as "Safe" as their Stage of GW Development is 68.32% and 61.11% respectively. 4 blocks of the district, namely Jaithara, Nidhauli Kalan, Sakit and Shitalpur have been categorized as "Semi-critical" as their Stage of GW Development is 77.35%, 80.63%, 70.48 and 87.24% respectively. Awagarh block lies at the lower end of the scale displaying 68.32% Stage of GW Development, whereas the Jalesar block lies at the extreme end of the scale with 97.37% of GW Development. Jalesar block has the lowest groundwater availability, whereas the Awagarh block has the highest groundwater availability.

The groundwater resource potential of the district (block-wise) has been calculated on the methodology given in Groundwater Estimation Committee (GEC) Report 2020.

Table 14: Dynamic Groundwater Resources of Etah district

S. No	Assessment Unit Name	Net Annual Ground Water Availability (in ham)	Existing Gross Ground Water Draft for all Uses (in ham)	Existing Gross Ground Water Draft for all Uses (in ham)	Net Ground Water Availability for future use	Stage of Ground Water Development	Categorization (OE/Critical/Semi critical/Safe)
1	**ALIGANJ**	7928.96	7137.76	6435.14	717.64	90.02%	Critical
2	**AWAGARH**	8717.07	5955.88	5542.16	2718.59	68.32%	Safe
3	**JAITHARA**	5738.64	4438.61	3914.5	1246.1	77.35%	Semi-critical
4	**JALESAR**	5127.73	4992.94	4520.82	87.57	97.37%	Critical
5	**MARHARA**	3817.37	2332.93	1916.4	1446.44	61.11%	Safe

6	**NIDHAULI KALAN**	8821.07	7112.19	6605.24	1660.02	80.63%	Semi-critical
7	**SAKIT**	7380.93	5202.36	4686.96	2136.45	70.48%	Semi-critical
8	**SHITALPUR**	9658.62	8426.57	7551.35	1164.89	87.24%	Semi-critical
Total		57190.39	45599.24	41172.5	11177.7	79.73%	

Map displaying the block-wise categorization as well as Stage of Groundwater Development has been attached below as Figure 23.

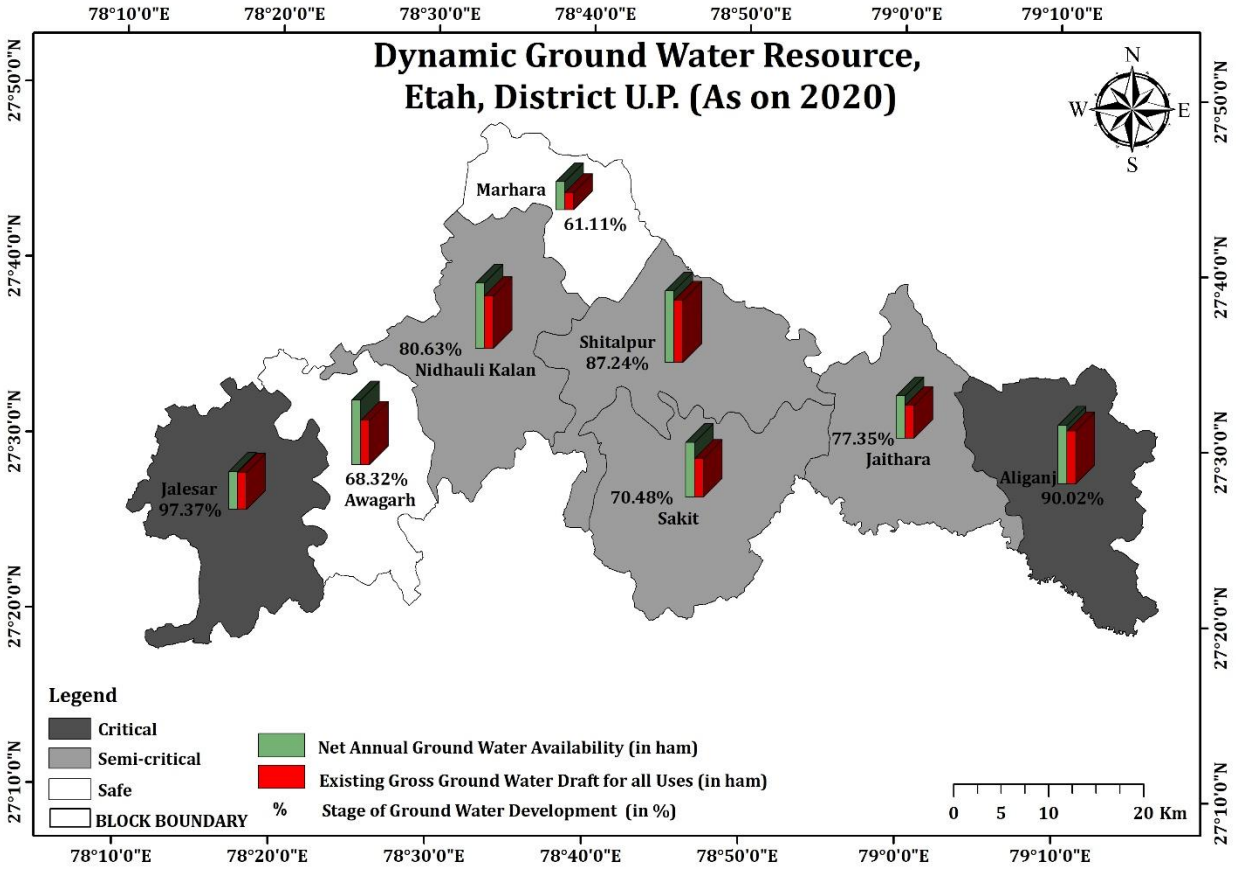
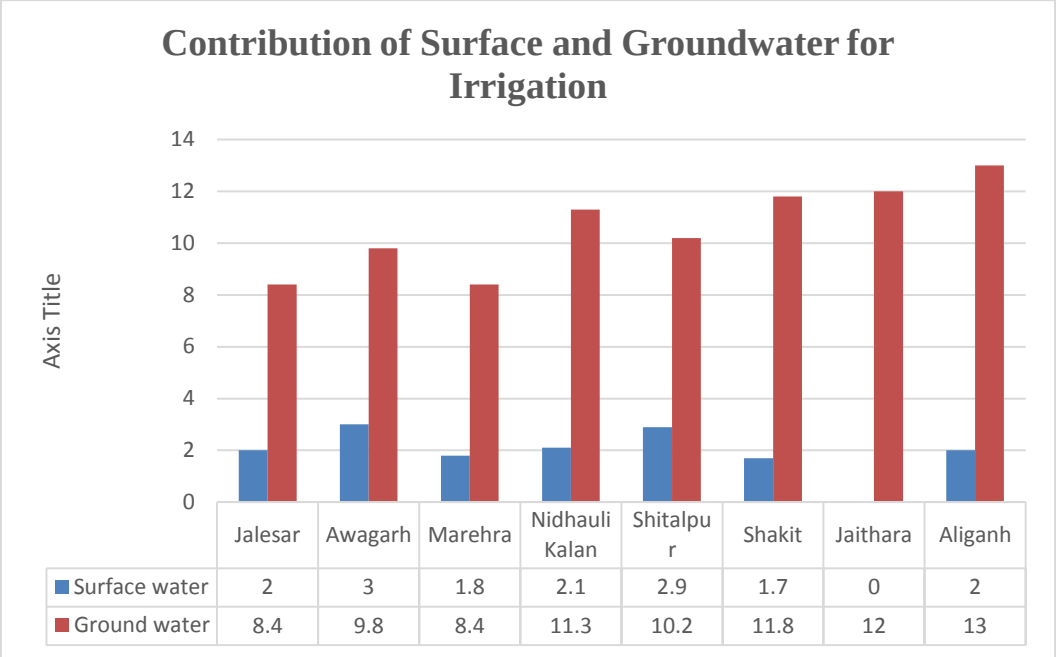


Figure 21:Dynamic Ground Water Resources Map of Etah district

4. GROUND WATER-RELATED ISSUES

4.1 Over Exploitation and Quality:

- Further groundwater development in Marhara, the overexploited block, has to be carefully monitored.
- At locations in Jalesar and Awagarh. Jaithra inhibits the EC, TDS, and Total Hardness, which are determined to be over acceptable thresholds. In certain regions, the deeper aquifer's quality is unfit for drinking.



	Jalesar	Awagarh	Marehra	Nidhauli Kalan	Shitalpur	Shakit	Jaithara	Aliganh
Surface water	2	3	1.8	2.1	2.9	1.7	0	2
Ground water	8.4	9.8	8.4	11.3	10.2	11.8	12	13

Figure 22: Graph displaying contribution of surface and groundwater for irrigation for each block

4.2 Identification of issues

- The high contribution of groundwater towards irrigation: The contribution of surface water from the existing canal network towards irrigation ranges from 2.9% in the Shitalpur block to a paltry 1.8% in the Marehra block. The balance is made up by harnessing groundwater. Only Jaithara block are entirely reliant on groundwater for irrigation.
- Data on rainfall through 2021-2022 show a tendency toward decline, which will only lead to less rainfall recharging subsurface aquifers.

4.3 Groundwater quality issues and contamination

- Sporadic occurrence of Iron, Manganese, and Arsenic in the unconfined aquifer.

5. MANAGEMENT STRATEGIES

In order to reduce the demand for groundwater resources and enhance their accessibility, management measures must be quickly established and put into action by the responsible agencies. The following table summarizes management techniques by demand- and supply-side actions for implementation:

Table 15: Proposed Supply-side and Demand-side interventions

SUPPLY-SIDE INTERVENTIONS	DEMAND-SIDE INTERVENTIONS
1. Increasing storage by de-silting surface water catchments, such as streams, ponds, tanks, and surface water.	1. Instead of using conventional flood irrigation techniques, drip, sprinkler, and pressured irrigation are encouraged to increase irrigation efficiency.
2. Construction of Rainwater harvesting structures at suitable locations.	2. Promoting cultivation of pulses with high per hectare yield along with incentives.
3. Construction of check dams at suitable locations to increase the quantum of groundwater recharge	3. Promoting oilseed cultivation with subsidies and incentives.

5.1 Supply Side Interventions

In order to raise the amount of available water by expanding storage, encouraging community involvement in the reemergence and recovery of conventional water bodies like tanks, ponds, etc., and adequate rainwater harvesting frameworks at urban locations, it has been suggested to embrace that kind initiatives only in groundwater stressed blocks. The following is a description of the various interventions:

5.1.1 Construction of Rainwater harvesting structures at suitable locations

Rooftop rainwater harvesting is a process where rainwater from roofs of homes, buildings, schools, and other businesses is redirected to a storage tank or used to rehydrate an underground aquifer via a network of pipes and filter media (by Manager Aquifer Recharge techniques). Additionally, it takes far less upkeep to operate.

If not held in a tank, it reduces excess rainfall pouring into sewers that cause urban floods, stops soil erosion, and raises groundwater levels. It can assist get through the summer's peak water demand if kept in a tank or sump.

The amount of rainfall harvested depends on 3 factors:

- Quantum of Annual Rainfall (mm)
- Rooftop area (m2)
- Runoff factor (0.2 to 0.8 depending on roofing material)

Formula to calculate harvested rainfall = Quantum of Annual Rainfall (mm)* Rooftop area (m2)* Runoff factor

5.1.2 Construction of check dams at suitable locations to increase the quantum of groundwater recharge.

5.2 Demand-side interventions:

Agriculture is the main user of groundwater, followed by domestic and industrial needs. There is increased interest in promoting the use of micro-irrigation techniques like spray and drip watering as the traditional form of irrigation via canals provides decreased efficiency. The several approaches are described below:

5.2.1 Promoting drip and sprinkler irrigation to enhance crop production.

- The amount of groundwater used for irrigation will be reduced, and the farmer's revenue will increase since they will be able to plant one or two extra crops.
- As little as 20–25 percent of water is lost with drip irrigation and 30–40 percent with sprinkler irrigation.
- Drip irrigation can also be used to water wheat, cotton, pulses, and oil seeds crops that are spread out. Sprinkler irrigation works well for crops that are close to each other, like sugarcane, spices, vegetables, flowers, fruits, and so on.
- The department in charge (Revenue, Agriculture, Land Holding, etc.) should do a rigorous survey to find out how much land small and marginal farmers own since most micro-irrigation practices are run on a large scale, and most land holdings are small, usually less than 1 hectare.

5.2.2 Introduction of water-tolerant rice crops

- Popularization of rice varieties like Madhukar for water-prone areas and Jal Priya & Jal Lahari varieties for waterlogged conditions by Krishi Vigyan Kendra among the farmers.

- These problematic areas have been identified by KVK under KVK and It is recommended to Adaptaion of agricultural contingency plan prepared by KVK which has been attached in Annexure-4.

5.2.3 Promoting the cultivation of pulses

- Pulses not only give you the protein you need, but the nitrogen-fixing bacteria in their roots also add about 40 kg/Ha of nitrogen to the soil. It also helps the succeeding crop grow by making the soil's microenvironment, quality, and yield better.
- By combining the farming of pulses with other government programs already in place, such as the "Integrated Scheme of Oilseeds, Pulses, Oil Palm and Maize" (ISOPOM) program, Accelerated Pules Production program, and Pulses Development Program under "Rashtriya Krishi Vikas Yojana," the cultivation of pulses can be given a boost.
- Via seminars and other events, the state agricultural department may educate farmers on the advantages of growing pulses as intercrops and including short-duration pulse types as cash crops.
- Promoting cultivation of pulses has been identified by KVK and It is recommended to Adaptaion of agricultural contingency plan prepared by KVK which has been attached in Annedure-3..

5.2.4 Promoting oilseed cultivation with subsidies and incentives

- Since the output of oil seeds is inadequate to meet the demands of the population and involves a 40 percent import charge, India is the second biggest importer of oil seeds and the third-largest consumer of oil seeds, spending a total of 74,996 crores on imports in 2017–18.
- In the long-term, it will be advantageous for the nation to double the import duty in addition to providing bonuses for domestic oilseed cultivation by integrating the "Minimum Support Price" (MSP) with the "Minimum Remunerative Price" (MRP) and assent the oil seed sector special prestige under the "National Food Security Mission" (NFSM).
- The "Integrated Scheme of Oilseeds, Pulses, Oil Palm and Maize" (ISOPOM) is a federal program whereby every State develops a five-year seed plan outlining the needs of every farmer and designates ICAR as the nodal organization. In moreover to securing infrastructure support, technical training for farmers, and demonstrations of the most recent agricultural inputs to increase yield, ICAR is responsible for the purchasing and dispersion of seeds,

weedicides/bio-pesticides, distribution of Gypsum/Pyrite/Liming/Dolomite for lining soils, and sprinkler sets.

- These oilseeds may be grown on appropriate soils, as determined by State Agricultural Universities: Linseed, Mustard, Rap seed, Sunflower, Castor Soybean, Safflower, Niger, Sesamum, and Groundnuts.
- Promoting cultivation of oilseeds has been identified by KVK and It is recommended to Adaptaion of agricultural contingency plan prepared by KVK which has been attached in Annexure-3.

5.3 Miscellaneous interventions

5.3.1 Formulation of village water security and safety plan under the ambit of the National Rural Drinking Water Program (NRDWP).

With the primary goal of institutionalizing community participation and involvement in "Panchayat Raj Institution (PRI)" for water quality monitoring & surveillance of all drinking water sources, the "National Rural Drinking Water Quality Monitoring & Surveillance Program (NDWQM&S)" was introduced in February 2006. The following are the main components of NDWQM&S:

- To establish district- and sub-district-level drinking water quality testing labs (or enhance the current ones) for routine and ongoing evaluation of the water quality of rural drinking water sources.
- To provide "Field Test Kits (FTKs)" and bacteriological vials to GPs for on-the-field testing of essential general parameters (including Arsenic).
- Raising public awareness of problems with water quality and health.
- Developing the capacity of five local staff members in every GP to test water sources under their control utilizing straightforward FTKs and receiving verification from the closest water testing laboratory for samples that test positively.
- Perform a sanitary survey with certified Panchayat staff to check for potential bacterial contamination.

Underneath the program, all states receive full funding for Information, Education, and Communication (IEC) initiatives, human resource development initiatives, bolstering district-level drinking water quality testing laboratories, purchasing FTK for drinking water testing,

travel and transportation costs, data reporting costs, stationery costs, honoraria for district-level surveillance coordinators, water testing, documentation, and data entry costs. Since 2009, the WQMS Program has been included in the NRDWP.

The NRDWP offers grants to all the states for the development of rural water supply schemes, with a concentration on areas that are water-stressed and have poor water quality, as well as for initiatives to collect rainwater and recharge the groundwater, as well as for operation, and maintenance, including minor repairs. Every year, the states get their assigned cash in three installments (40 percent, 40 percent, and 30 percent, correspondingly). The NRDWP gives the states the authority to develop, authorize, and carry out water supply plans, including, among other things, the choice of acceptable treatment technology.

5.3.2 Implementation agricultural contingency plan for Etah by KVK.

The same has been attached in the Annexure-IV.

5.3.3 Carrying out de-siltation of streams, ponds, tanks, and surface water catchments to increase storage.

- Conventional water features like tanks, ponds, and can be desalted to expand storage space by catching extra rainwater, which can then be used for home and irrigation needs.

5.3.4 Construction of deeper tub-wells tapping 2nd Aquifer group at locations where quality issues plague the confined aquifer.

Deeper tube-wells tapping the 2nd Aquifer group between 70 – 152 mbgl can be constructed at suitable locations where the confined aquifer is affected by quality issues like high Salinity.

5.3.5 Providing impetus to horticulture and orchards under Rashtriya Krishi Vikas Yojana

National Agriculture Development Scheme is being operated by the Department of Horticulture & Food Processing, Government of Uttar Pradesh, that covers districts left out of the ambit of the National Horticulture Mission (N.H.M). 60% of the budgetary allocation is covered by the Central government, whereas 40% of budgetary allocation is covered by the State government's budget.

BLOCK-WISE, GROUNDWATER MANAGEMENT PLANS

5.4 Groundwater Management Plan of Aliganj block

Block: *ALIGANJ* **District:** *Etah*

1. General Information

State	Uttar Pradesh
District name	Etah
Block Name	ALIGANJ
Location	
Geographical area	327.83Sq.Km.
Basin/Sub-basin	Central Ganga Plain
Principal Aquifer System	Alluvium
Major Aquifer System	Older Alluvium(AL03)
Normal Annual Rainfall	787 mm

2. Aquifer Disposition

Aquifer Disposition	• Aquifer Disposition: One aquifer group with 3 Aquifer layers exist.
	  ○ Aquifer 1 (mbgl): From Surface to 60mbgl.
	  ○ Aquifer 2 (mbgl): 90 to 210 mbgl.
	  ○ Aquifer 3 (mbgl): 230 to 300 mbgl.
	• Fresh Aquifer Depth: Upto 300 mbgl.
	• Transmissivity (m2/day):
	• Sp. Yield:

Groundwater Monitoring Status	• Ground Water Monitoring Wells: 2
Ground Water Quality	• For Aquifer Group I: No Quality Problem In Shallow aquifer but There is Salinity Problem in deeper aquifer.
Aquifer Potential	• Aquifer Group I: lpm
Groundwater	• Annual Extractable GW Recharge: 79.28 MCM

Resource	• GW Draft: 71.37 MCM • Stage of GW Development: 0.90 % • Total in-storage resource of the block (fresh) is 7.17 MCM
Existing and Future Water Demand	• Present demand for All Usage: 79.28 MCM • Future Demand for Domestic and Industrial Use: 71.37 MCM

3. Aquifer Management Plan

Groundwater Management issues	• Location of feasible sites for successful wells. • Decline in water levels in some parts. • • Decline in water levels in some parts. • GW quality No Quality Problem in Shallow aquifers whereas depper aquifers have Salinity problem.
AR & Conservation Possibilities	Construction of Recharge Structures mainly ponds and adoption of water use efficiency practices.
Groundwater Management Plan	• SUPPLY SIDE MANAGEMENT: Water conservation and Artificial Recharge to ground water and on Farm Activities. • DEMAND SIDE MANAGEMENT: Promoting Cultivation of Sugarcane ,rice crops ,pulses,oilseed and horticultural Crop.
Status of GW Exploration	Exploratory Wells: Observation Wells: Piezometers: 1
Aquifer Characteristics	Aquifer Group I: o Transmissivity: m2/day o Storativity:

- **Water Level Behaviour**

In Aliganj, there is no rise in water level in Pre-monsoon and post-monsoon.

- **Issues**

Groundwater contribution to agriculture is 97.90%.

- **Groundwater Management Plan**

The proposed groundwater management plan for the block has been tabulated below. Upon implementation, 14.97 MCM of groundwater is expected to be available for additional utilization, and Stage of Groundwater Development is expected to decrease by 14.30 %.

Table 16(a): Summarized details of interventions proposed

Block	Check Dams (Nos.)	Stream Development (kms)	Nala Bunds (kms)	Ponds (Nos.)	On-farm area (Ha)	WUE area (Ha)
Aliganj	-	-	-	05	16391	6556

Table 16(b): Projected GW Recharge & savings by supply and demand-side management

Net Annual GW Availability (MCM)	Existing GW Draft for all uses (MCM)	Stage of GW Development (%)	Total recharge through interventions (MCM)	Total GW savings through interventions (MCM)	Projected Net GW Availability (MCM)	Projected Stage of GW Development after interventions (%)
79.28	71.37	90.02	1.10	13.87	94.25	75.72

re

Figure 25: Proposed demand and supply side interventions in Aliganj block

5.5 Groundwater Management Plan of Awagarh block

Block: AWAGARH District: Etah

4. General Information

State	Uttar Pradesh
District name	Etah
Block Name	AWAGARH
Location	
Geographical area	290.63Sq.Km.
Basin/Sub-basin	Central Ganga Plain
Principal Aquifer System	Alluvium
Major Aquifer System	Older Alluvium(AL03)
Normal Annual Rainfall	787 mm

5. Aquifer Disposition

Aquifer Disposition	• Aquifer Disposition: One aquifer group with 3 Aquifer layers exist.
	  o Aquifer 1 (mbgl): From Surface to 150
	  o Aquifer 2 (mbgl): 160.00 to 240.00
	  o Aquifer 3 (mbgl): 250 to 300
	• Fresh Aquifer Depth: Upto 300 mbgl.
	• Transmissivity (m2/day):
	• Sp. Yield:

Groundwater Monitoring Status	• Ground Water Monitoring Wells: 6
Ground Water Quality	• For Aquifer Group I: No Quality Problem In Shallow aquifer but There is Salinity Problem in deeper aquifer.
Aquifer Potential	• Aquifer Group I: lpm
Groundwater Resource	• Annual Extractable GW Recharge: 87.17 MCM • GW Draft: 59.55 MCM • Stage of GW Development: 0.68 % • Total in-storage resource of the block (fresh) is 27.18 MCM
Existing and Future Water Demand	• Present demand for All Usage: 87.17 MCM • Future Demand for Domestic and Industrial Use: 59.55 MCM

6. Aquifer Management Plan

Groundwater Management issues	• Location of feasible sites for successful wells. • • Decline in water levels in some parts. • • Decline in water levels in some parts. • GW quality No Quality Problem in Shallow aquifers whereas depper aquifers have Salinity problem.
AR & Conservation Possibilities	Construction of Recharge Structures mainly ponds and adoption of water use efficiency practices.
Groundwater Management Plan	• SUPPLY SIDE MANAGEMENT: Water conservation and Artificial Recharge to ground water and on Farm Activities. • DEMAND SIDE MANAGEMENT: Promoting Cultivation of Sugarcane ,rice crops ,pulses,oilseed and horticultural Crop.
Status of GW Exploration	Exploratory Wells: Observation Wells: Piezometers: 3
Aquifer Characteristics	Aquifer Group I: o Transmissivity: m2/day o Storativity:

- **Water Level Behaviour**

In Awagarh, there is no rise in water level in Pre-monsoon, but post-monsoon water level rises 0.0947 m/yr.

- **Issues**

Groundwater contribution to agriculture is 97.90%.

- **Groundwater Management Plan**

The proposed groundwater management plan for the block has been tabulated below. Upon implementation, 8.86 MCM of groundwater is expected to be available for additional utilization, and Stage of Groundwater Development is expected to decrease by 6.36%.

Table 17(a): Summarized details of interventions proposed

Block	Check Dams (Nos.)	Stream Development (kms)	Nala Bunds (kms)	Ponds (Nos.)	On-farm area (Ha)	WUE area (Ha)
Awagarh	-	-	-	05	7265	4359

Table 17(b): Projected GW Recharge & savings by supply and demand-side management

Net Annual GW Availability (MCM)	Existing GW Draft for all uses (MCM)	Stage of GW Development (%)	Total recharge through interventions (MCM)	Total GW savings through interventions (MCM)	Projected Net GW Availability (MCM)	Projected Stage of GW Development after interventions (%)
87.147	59.55	68.32	1.10	7.86	96.107	61.96

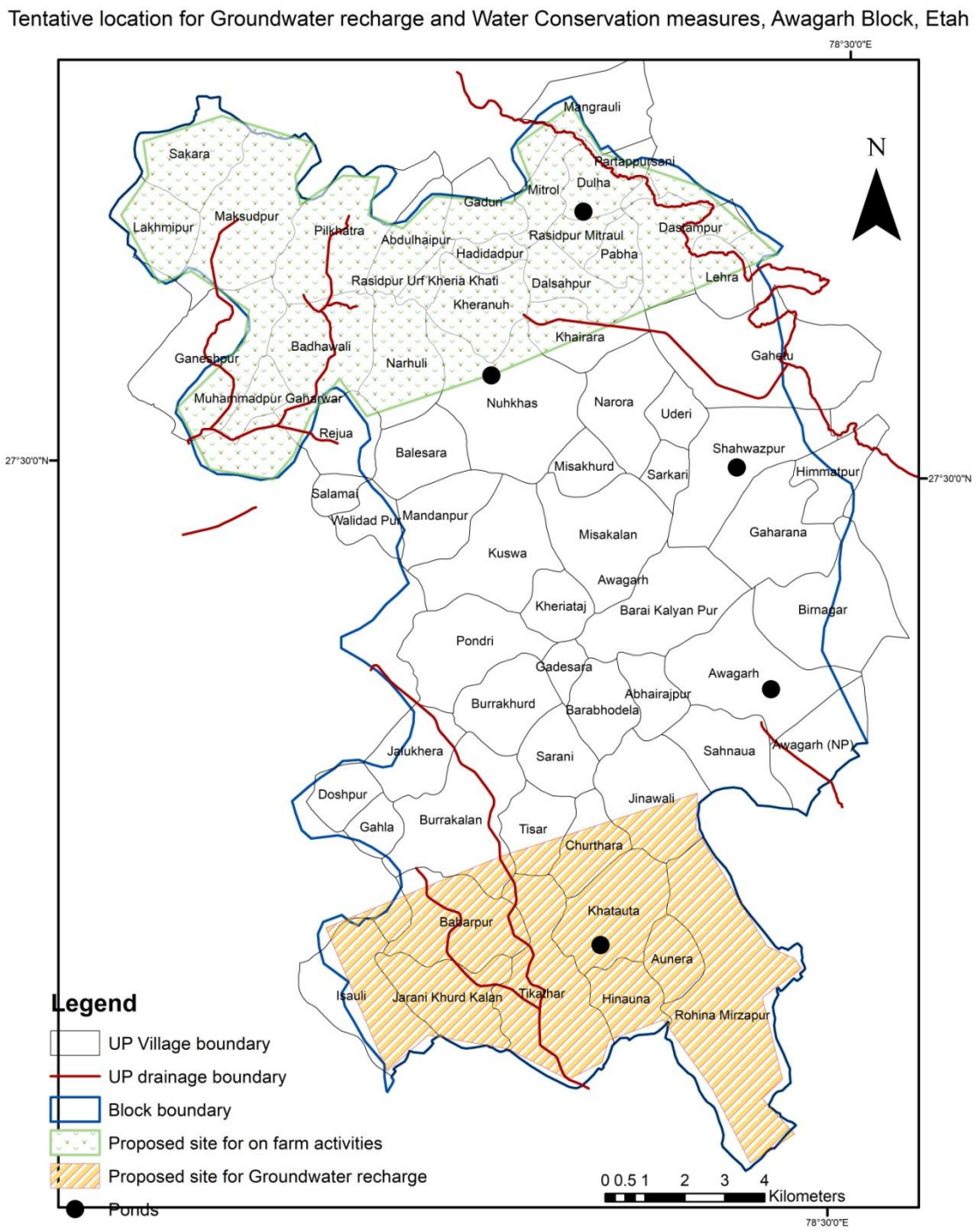


Figure 26: Proposed demand and supply side interventions in Awagarh block

5.6 Groundwater Management Plan of Jaithara block

Block: JAITHARA **District:** Etah

7. General Information

State	Uttar Pradesh
District name	Etah
Block Name	JAITHARA
Location	
Geographical area	320.65Sq.Km.
Basin/Sub-basin	Central Ganga Plain
Principal Aquifer System	Alluvium
Major Aquifer System	Older Alluvium(AL03)
Normal Annual Rainfall	787 mm

8. Aquifer Disposition

Aquifer Disposition	• Aquifer Disposition: One aquifer group with 3 Aquifer layers exist.
	  o Aquifer 1 (mbgl): From Surface to 150
	  o Aquifer 2 (mbgl): 160.00 to 240.00
	  o Aquifer 3 (mbgl): 250 to 300
	• Fresh Aquifer Depth: Upto 300 mbgl.
	• Transmissivity (m2/day):
	• Sp. Yield:

Groundwater Monitoring Status	• Ground Water Monitoring Wells: 4
Ground Water Quality	• For Aquifer Group I: No Quality Problem In Shallow aquifer but There is Salinity Problem in deeper aquifer.
Aquifer Potential	• Aquifer Group I: lpm
Groundwater Resource	• Annual Extractable GW Recharge: 57.38 MCM • GW Draft: 44.38 MCM • Stage of GW Development: 0.77 % • Total in-storage resource of the block (fresh) is 12.46 MCM
Existing and Future Water Demand	• Present demand for All Usage: 57.38 MCM • Future Demand for Domestic and Industrial Use: 44.38 MCM

9. Aquifer Management Plan

Groundwater Management issues	• Location of feasible sites for successful wells. • • Decline in water levels in some parts. • • Decline in water levels in some parts. • GW quality No Quality Problem in Shallow aquifers whereas depper aquifers have Salinity problem.
AR & Conservation Possibilities	Construction of Recharge Structures mainly ponds and adoption of water use efficiency practices.
Groundwater Management Plan	• SUPPLY SIDE MANAGEMENT: Water conservation and Artificial Recharge to ground water and on Farm Activities. • DEMAND SIDE MANAGEMENT: Promoting Cultivation of Sugarcane ,rice crops ,pulses,oilseed and horticultural Crop.
Status of GW Exploration	Exploratory Wells: 1 Observation Wells: 1 Piezometers: 3
Aquifer Characteristics	Aquifer Group I: o Transmissivity: m2/day o Storativity:

- **Water Level Behaviour**

In Jaithara, there is no rise in water level in Pre-monsoon, but post-monsoon water level rises 0.0840 m/yr. and 0.1360 m/yr. rises annually.

- **Issues**

Groundwater contribution to agriculture is 97.90%.

- **Groundwater Management Plan**

The proposed groundwater management plan for the block has been tabulated below. Upon implementation, 10.80 MCM of groundwater is expected to be available for additional utilization, and Stage of Groundwater Development is expected to decrease by 12.26 %.

Table 18(a): Summarized details of interventions proposed

Block	Check Dams (Nos.)	Stream Development (kms)	Nala Bunds (kms)	Ponds (Nos.)	On-farm area (Ha)	WUE area (Ha)
Jaithara	-	-	-	05	8016	7016

Table 18(b): Projected GW Recharge & savings by supply and demand-side management

Net Annual GW Availability (MCM)	Existing GW Draft for all uses (MCM)	Stage of GW Development (%)	Total recharge through interventions (MCM)	Total GW savings through interventions (MCM)	Projected Net GW Availability (MCM)	Projected Stage of GW Development after interventions (%)
57.38	44.38	77.35	1.10	9.70	68.18	65.09

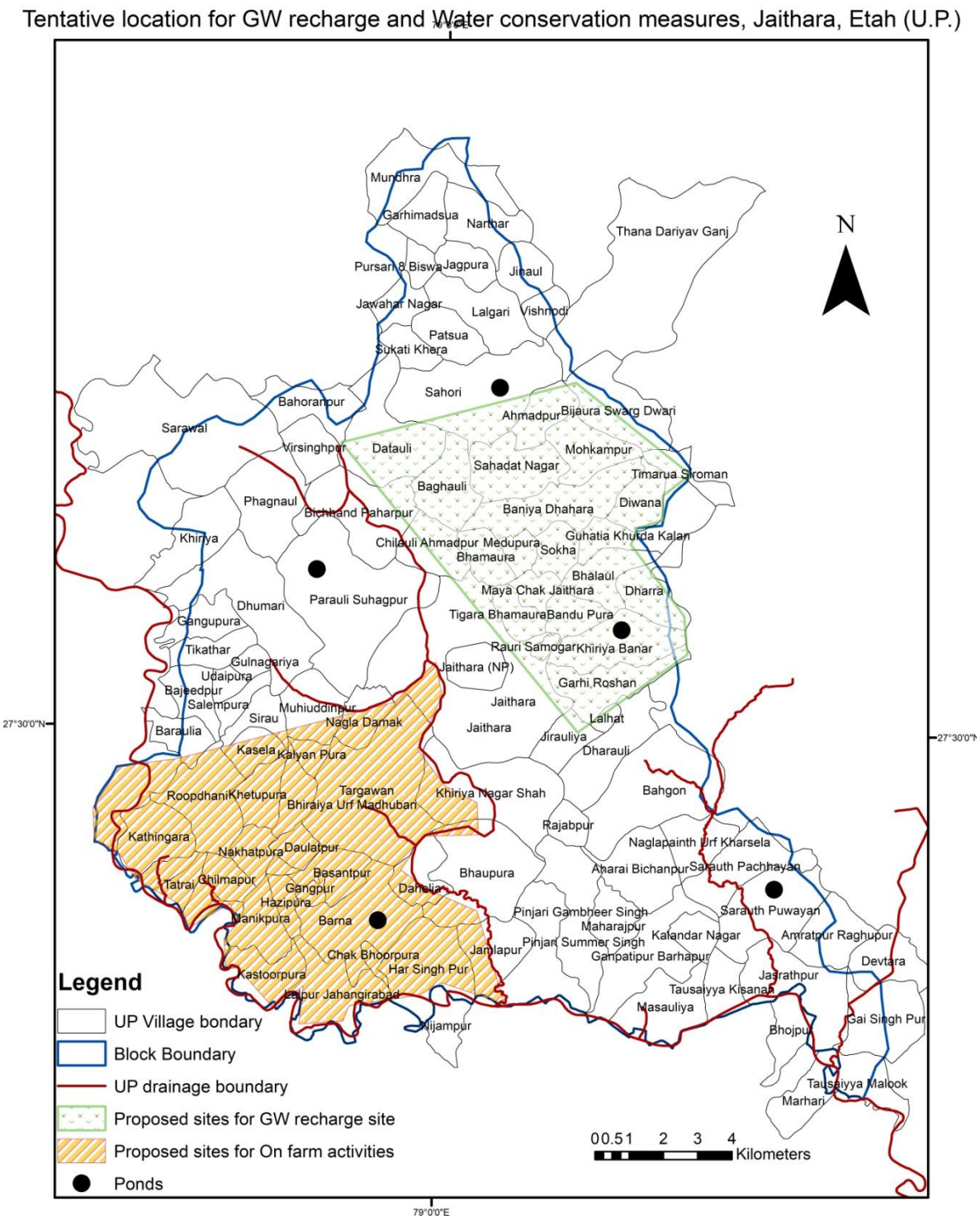


Figure 27: Proposed demand and supply side interventions in Jaithara block

5.7 Groundwater Management Plan of Jalesar block

Block: JALESAR **District:** Etah

10. General Information

State	Uttar Pradesh
District name	Etah
Block Name	JALESAR
Location	
Geographical area	307.96Sq.Km.
Basin/Sub-basin	Central Ganga Plain
Principal Aquifer System	Alluvium
Major Aquifer System	Older Alluvium(AL03)
Normal Annual Rainfall	787 mm

11. Aquifer Disposition

Aquifer Disposition	• Aquifer Disposition: One aquifer group with 3 Aquifer layers exist.
	  o Aquifer 1 (mbgl): From Surface to 150
	  o Aquifer 2 (mbgl): 160.00 to 240.00
	  o Aquifer 3 (mbgl): 250 to 300
	• Fresh Aquifer Depth: Upto 300 mbgl.
	• Transmissivity (m2/day): 688.00
	• Sp. Yield: 163.81

Groundwater Monitoring Status	• Ground Water Monitoring Wells: 8
Ground Water Quality	• For Aquifer Group I: No Quality Problem In Shallow aquifer but There is Salinity Problem in deeper aquifer.
Aquifer Potential	• Aquifer Group I: 1263 lpm
Groundwater Resource	• Annual Extractable GW Recharge: 51.27 MCM • GW Draft: 49.92 MCM • Stage of GW Development: 0.97 % • Total in-storage resource of the block (fresh) is 0.87 MCM
Existing and Future Water Demand	• Present demand for All Usage: 51.27 MCM • Future Demand for Domestic and Industrial Use: 49.92 MCM

12. Aquifer Management Plan

Groundwater Management issues	• Location of feasible sites for successful wells. • • Decline in water levels in some parts. • • Decline in water levels in some parts. • GW quality No Quality Problem in Shallow aquifers whereas depper aquifers have Salinity problem.
AR & Conservation Possibilities	Construction of Recharge Structures mainly ponds and adoption of water use efficiency practices.
Groundwater Management Plan	• SUPPLY SIDE MANAGEMENT: Water conservation and Artificial Recharge to ground water and on Farm Activities. • DEMAND SIDE MANAGEMENT: Promoting Cultivation of Sugarcane ,rice crops ,pulses,oilseed and horticultural Crop.
Status of GW Exploration	Exploratory Wells: 1 Observation Wells: 1 Piezometers: 2
Aquifer Characteristics	Aquifer Group I: o Transmissivity: 688.00 m2/day o Storativity: 163.81

- **Water Level Behaviour**

In Jalesar, there is no rise in water level in Pre-monsoon, but post-monsoon water level rises 0.1977 m/yr.

- **Issues**

Groundwater contribution to agriculture is 97.90%.

- **Groundwater Management Plan**

The proposed groundwater management plan for the block has been tabulated below. Upon implementation, 13.01 MCM of groundwater is expected to be available for additional utilization, and Stage of Groundwater Development is expected to decrease by 19.71 %.

Table 19(a): Summarized details of interventions proposed

Block	Check Dams (Nos.)	Stream Development (kms)	Nala Bunds (kms)	Ponds (Nos.)	On-farm area (Ha)	WUE area (Ha)
Jalesar	-	-	-	05	9223	8238

Table 19(b): Projected GW Recharge & savings by supply and demand-side management

Net Annual GW Availability (MCM)	Existing GW Draft for all uses (MCM)	Stage of GW Development (%)	Total recharge through interventions (MCM)	Total GW savings through interventions (MCM)	Projected Net GW Availability (MCM)	Projected Stage of GW Development after interventions (%)
51.27	49.92	97.37	1.10	11.91	64.28	77.66

Figure 28: Proposed demand and supply side interventions in Jalesar block

5.8 Groundwater Management Plan of Marhara block

Block: MARHARA **District:** Etah

13. General Information

State	Uttar Pradesh
District name	Etah
Block Name	MARHARA
Location	
Geographical area	200.97Sq.Km.
Basin/Sub-basin	Central Ganga Plain
Principal Aquifer System	Alluvium
Major Aquifer System	Older Alluvium(AL03)
Normal Annual Rainfall	787 mm

14. Aquifer Disposition

Aquifer Disposition	• Aquifer Disposition: One aquifer group with 3 Aquifer layers exist.
	  o Aquifer 1 (mbgl): From Surface to 150
	  o Aquifer 2 (mbgl): 160.00 to 240.00
	  o Aquifer 3 (mbgl): 250 to 300
	• Fresh Aquifer Depth: Upto 300 mbgl.
	• Transmissivity (m2/day):
	• Sp. Yield:

Groundwater Monitoring Status	• Ground Water Monitoring Wells: 2
Ground Water Quality	• For Aquifer Group I: No Quality Problem In Shallow aquifer but There is Salinity Problem in deeper aquifer.
Aquifer Potential	• Aquifer Group I: lpm
Groundwater Resource	• Annual Extractable GW Recharge: 38.17 MCM • GW Draft: 23.32 MCM • Stage of GW Development: 0.61 % • Total in-storage resource of the block (fresh) is 14.46 MCM
Existing and Future Water Demand	• Present demand for All Usage: 38.17 MCM • Future Demand for Domestic and Industrial Use: 23.32 MCM

15. Aquifer Management Plan

Groundwater Management issues	• Location of feasible sites for successful wells. • • Decline in water levels in some parts. • • Decline in water levels in some parts. • GW quality No Quality Problem in Shallow aquifers whereas depper aquifers have Salinity problem.
AR & Conservation Possibilities	Construction of Recharge Structures mainly ponds and adoption of water use efficiency practices.
Groundwater Management Plan	• SUPPLY SIDE MANAGEMENT: Water conservation and Artificial Recharge to ground water and on Farm Activities. • DEMAND SIDE MANAGEMENT: Promoting Cultivation of Sugarcane ,rice crops ,pulses,oilseed and horticultural Crop.
Status of GW Exploration	Exploratory Wells: 1 Observation Wells: 1 Piezometers: 2
Aquifer Characteristics	Aquifer Group I: o Transmissivity: m2/day o Storativity:

- **Water Level Behaviour**

In Marhara there is 0.0857 m/yr. Fall in water level in Pre-monsoon and post-monsoon 0.0417 m/yr. Fall in water level and 0.0615 m/yr. Fall annually.

- **Issues**

Groundwater contribution to agriculture is 97.90%.

- **Groundwater Management Plan**

The proposed groundwater management plan for the block has been tabulated below. Upon implementation, 7.83 MCM of groundwater is expected to be available for additional utilization, and Stage of Groundwater Development is expected to decrease by 10.52 %.

Table 20(a): Summarized details of interventions proposed

Block	Check Dams (Nos.)	Stream Development (kms)	Nala Bunds (kms)	Ponds (Nos.)	On-farm area (Ha)	WUE area (Ha)
Marhara	-	-	-	05	5024	8038

Table 20(b): Projected GW Recharge & savings by supply and demand-side management

Net Annual GW Availability (MCM)	Existing GW Draft for all uses (MCM)	Stage of GW Development (%)	Total recharge through interventions (MCM)	Total GW savings through interventions (MCM)	Projected Net GW Availability (MCM)	Projected Stage of GW Development after interventions (%)
38.17	23.32	61.11	1.10	6.73	46	50.69

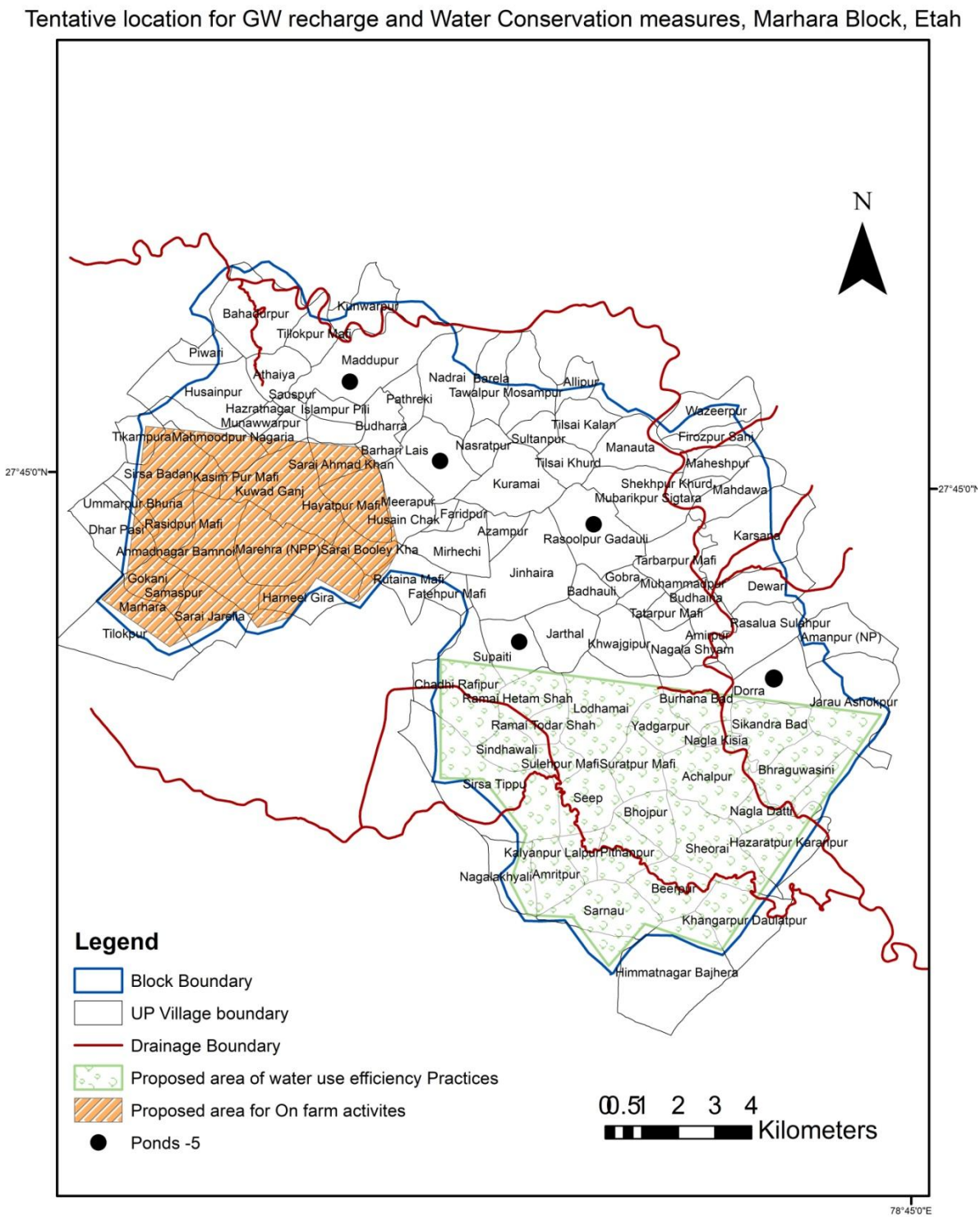


Figure 29: Proposed demand and supply side interventions in Marhara block

5.9 Groundwater Management Plan of Nidholi Kalan block

Block: NIDHAULI KALAN **District:** Etah

16. General Information

State	Uttar Pradesh
District name	Etah
Block Name	NIDHAULI KALAN
Location	
Geographical area	347.93Sq.Km.
Basin/Sub-basin	Central Ganga Plain
Principal Aquifer System	Alluvium
Major Aquifer System	Older Alluvium(AL03)
Normal Annual Rainfall	787 mm

17. Aquifer Disposition

Aquifer Disposition	• Aquifer Disposition: One aquifer group with 3 Aquifer layers exist.
	  ○ Aquifer 1 (mbgl): From Surface to 150
	  ○ Aquifer 2 (mbgl): 160.00 to 240.00
	  ○ Aquifer 3 (mbgl): 250 to 300
	• Fresh Aquifer Depth: Upto 300 mbgl.
	• Transmissivity (m2/day): 5472.00
	• Sp. Yield: 430.83999999999997

Groundwater Monitoring Status	• Ground Water Monitoring Wells: 1
Ground Water Quality	• For Aquifer Group I: No Quality Problem In Shallow aquifer but There is Salinity Problem in deeper aquifer.
Aquifer Potential	• Aquifer Group I: 3800 lpm
Groundwater Resource	• Annual Extractable GW Recharge: 88.21 MCM • GW Draft: 71.12 MCM • Stage of GW Development: 0.81 % • Total in-storage resource of the block (fresh) is 16.60 MCM
Existing and Future Water Demand	• Present demand for All Usage: 88.21 MCM • Future Demand for Domestic and Industrial Use: 71.12 MCM

18. Aquifer Management Plan

Groundwater Management issues	• Location of feasible sites for successful wells. • • Decline in water levels in some parts. • • Decline in water levels in some parts. • GW quality No Quality Problem in Shallow aquifers whereas depper aquifers have Salinity problem.
AR & Conservation Possibilities	Construction of Recharge Structures mainly ponds and adoption of water use efficiency practices.
Groundwater Management Plan	• SUPPLY SIDE MANAGEMENT: Water conservation and Artificial Recharge to ground water and on Farm Activities. • DEMAND SIDE MANAGEMENT: Promoting Cultivation of Sugarcane ,rice crops ,pulses,oilseed and horticultural Crop.
Status of GW Exploration	Exploratory Wells: 1 Observation Wells: 1 Piezometers: 0
Aquifer Characteristics	Aquifer Group I: o Transmissivity: 5472.00 m2/day o Storativity: 430.83999999999997

- **Water Level Behaviour**

In Nidholi kalan, there is 0.0378 m/yr. Rise in water level in Pre-monsoon and post-monsoon 0.0091 m/yr. Fall in water level and 0.0058 m/yr. Rise annually.

- **Issues**

Groundwater contribution to agriculture is 97.90%.

- **Groundwater Management Plan**

The proposed groundwater management plan for the block has been tabulated below. Upon implementation, 7.50 MCM of groundwater is expected to be available for additional utilization, and Stage of Groundwater Development is expected to decrease by 6.33%.

Table 21(a): Summarized details of interventions proposed

Block	Check Dams (Nos.)	Stream Development (kms)	Nala Bunds (kms)	Ponds (Nos.)	On-farm area (Ha)	WUE area (Ha)
Nidhauli Kalan	-	-	-	05	6958	5218

Table 21(b): Projected GW Recharge & savings by supply and demand-side management

Net Annual GW Availability (MCM)	Existing GW Draft for all uses (MCM)	Stage of GW Development (%)	Total recharge through interventions (MCM)	Total GW savings through interventions (MCM)	Projected Net GW Availability (MCM)	Projected Stage of GW Development after interventions (%)
88.21	71.12	80.63	1.10	6.40	95.71	74.30

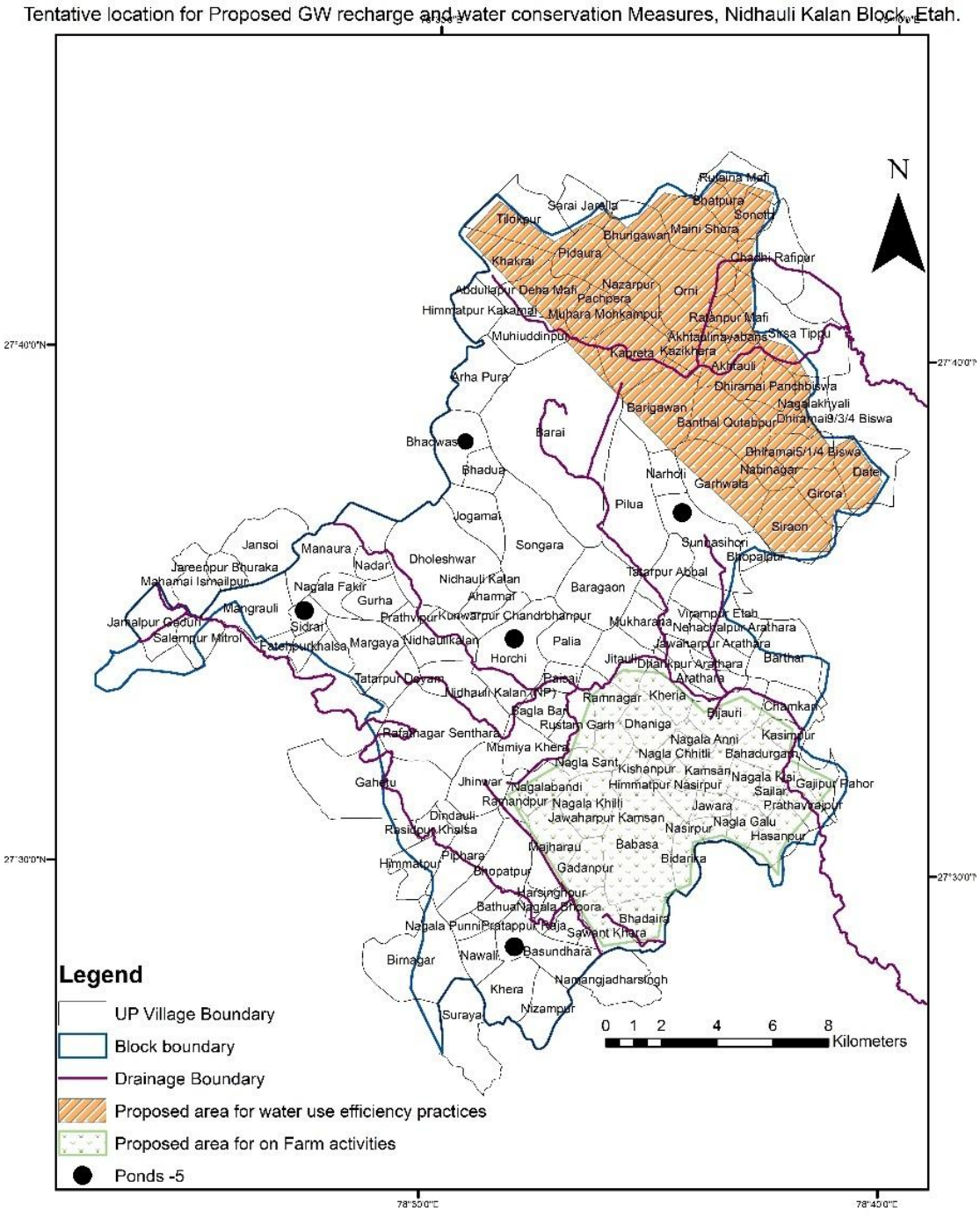


Figure 30: Proposed demand and supply side interventions in, Nidholi Kalan Block

5.10 Groundwater Management Plan of Sakit block

Block: SAKIT **District:** Etah

19. General Information

State	Uttar Pradesh
District name	Etah
Block Name	SAKIT
Location	
Geographical area	379.16Sq.Km.
Basin/Sub-basin	Central Ganga Plain
Principal Aquifer System	Alluvium
Major Aquifer System	Older Alluvium(AL03)
Normal Annual Rainfall	787 mm

20. Aquifer Disposition

Aquifer Disposition	• Aquifer Disposition: One aquifer group with 3 Aquifer layers exist.
	  o Aquifer 1 (mbgl): From Surface to 150
	  o Aquifer 2 (mbgl): 160.00 to 240.00
	  o Aquifer 3 (mbgl): 250 to 300
	• Fresh Aquifer Depth: Upto 300 mbgl.
	• Transmissivity (m2/day): 698.00
	• Sp. Yield: 578.49000000000001

Groundwater Monitoring Status	• Ground Water Monitoring Wells: 4
Ground Water Quality	• For Aquifer Group I: No Quality Problem In Shallow aquifer but There is Salinity Problem in deeper aquifer.
Aquifer Potential	• Aquifer Group I: 1533 lpm
Groundwater Resource	• Annual Extractable GW Recharge: 73.80 MCM • GW Draft: 52.02 MCM • Stage of GW Development: 0.70 % • Total in-storage resource of the block (fresh) is 21.36 MCM
Existing and Future Water Demand	• Present demand for All Usage: 73.80 MCM • Future Demand for Domestic and Industrial Use: 52.02 MCM

21. Aquifer Management Plan

Groundwater Management issues	• Location of feasible sites for successful wells. • • Decline in water levels in some parts. • • Decline in water levels in some parts. • GW quality No Quality Problem in Shallow aquifers whereas depper aquifers have Salinity problem.
AR & Conservation Possibilities	Construction of Recharge Structures mainly ponds and adoption of water use efficiency practices.
Groundwater Management Plan	• SUPPLY SIDE MANAGEMENT: Water conservation and Artificial Recharge to ground water and on Farm Activities. • DEMAND SIDE MANAGEMENT: Promoting Cultivation of Sugarcane ,rice crops ,pulses,oilseed and horticultural Crop.
Status of GW Exploration	Exploratory Wells: 1 Observation Wells: 1 Piezometers: 3
Aquifer Characteristics	Aquifer Group I: o Transmissivity: 698.00 m2/day o Storativity: 578.49000000000001

- **Water Level Behaviour**

In Sakit there is 0.1084 m/yr. Rise in water level in Pre-monsoon and post-monsoon 0.0899 m/yr. A rise in water level and 0.0908 m/yr. Rise annually.

- **Issues**.

Groundwater contribution to agriculture is 97.90%.

- **Groundwater Management Plan**

The proposed groundwater management plan for the block has been tabulated below. Upon implementation, 4.77 MCM of groundwater is expected to be available for additional utilization, and Stage of Groundwater Development is expected to decrease by 4.28 %.

Table 22(a): Summarized details of interventions proposed

Block	Check Dams (Nos.)	Stream Development (kms)	Nala Bunds (kms)	Ponds (Nos.)	On-farm area (Ha)	WUE area (Ha)
Sakit	-	-	-	05	4759	3791

Table 22(b): Projected GW Recharge & savings by supply and demand-side management

Net Annual GW Availability (MCM)	Existing GW Draft for all uses (MCM)	Stage of GW Development (%)	Total recharge through interventions (MCM)	Total GW savings through interventions (MCM)	Projected Net GW Availability (MCM)	Projected Stage of GW Development after interventions (%)
73.80	52.02	70.48	1.10	3.67	78.57	66.20

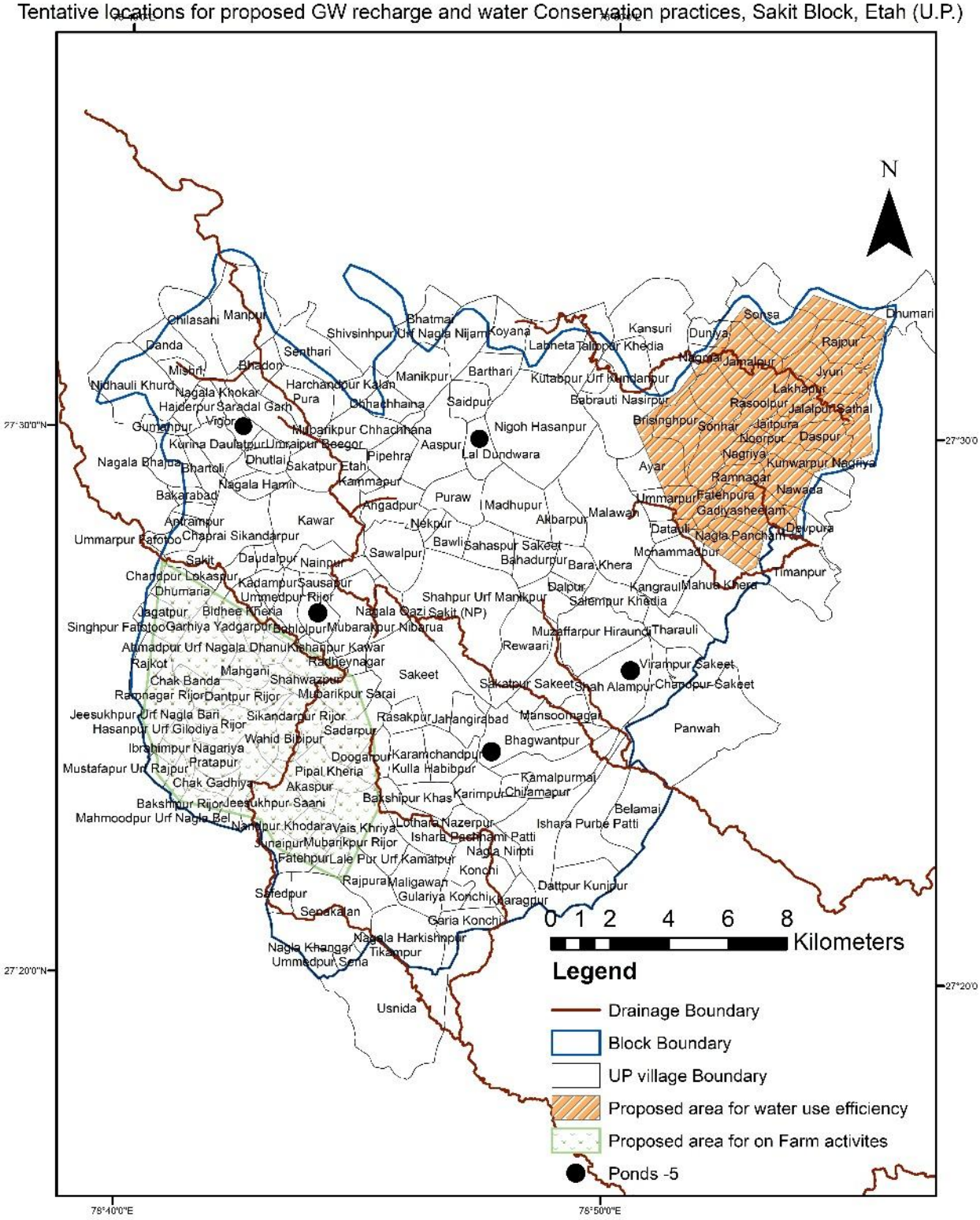


Figure 31: Proposed demand and supply side interventions in Sakit block

5.11 Groundwater Management Plan of Shitalpur block

Block: SHITALPUR **District:** Etah

22. General Information

State	Uttar Pradesh
District name	Etah
Block Name	SHITALPUR
Location	
Geographical area	317.33Sq.Km.
Basin/Sub-basin	Central Ganga Plain
Principal Aquifer System	Alluvium
Major Aquifer System	Older Alluvium(AL03)
Normal Annual Rainfall	787 mm

23. Aquifer Disposition

Aquifer Disposition	• Aquifer Disposition: One aquifer group with 3 Aquifer layers exist.
	  o Aquifer 1 (mbgl): From Surface to 150
	  o Aquifer 2 (mbgl): 160.00 to 240.00
	  o Aquifer 3 (mbgl): 250 to 300
	• Fresh Aquifer Depth: Upto 300 mbgl.
	• Transmissivity (m2/day):
	• Sp. Yield:

Groundwater Monitoring Status	• Ground Water Monitoring Wells: 2
Ground Water Quality	• For Aquifer Group I: No Quality Problem In Shallow aquifer but There is Salinity Problem in deeper aquifer.
Aquifer Potential	• Aquifer Group I: lpm
Groundwater Resource	• Annual Extractable GW Recharge: 96.58 MCM • GW Draft: 84.26 MCM • Stage of GW Development: 0.87 % • Total in-storage resource of the block (fresh) is 11.64 MCM
Existing and Future Water Demand	• Present demand for All Usage: 96.58 MCM • Future Demand for Domestic and Industrial Use: 84.26 MCM

24. Aquifer Management Plan

Groundwater Management issues	• Location of feasible sites for successful wells. • • Decline in water levels in some parts. • • Decline in water levels in some parts. • GW quality No Quality Problem in Shallow aquifers whereas depper aquifers have Salinity problem.
AR & Conservation Possibilities	Construction of Recharge Structures mainly ponds and adoption of water use efficiency practices.
Groundwater Management Plan	• SUPPLY SIDE MANAGEMENT: Water conservation and Artificial Recharge to ground water and on Farm Activities. • DEMAND SIDE MANAGEMENT: Promoting Cultivation of Sugarcane ,rice crops ,pulses,oilseed and horticultural Crop.
Status of GW Exploration	Exploratory Wells: Observation Wells: Piezometers: 1
Aquifer Characteristics	Aquifer Group I: o Transmissivity: m2/day o Storativity:

- **Water Level Behaviour**

In Shitalpur, there is 0.1030 m/yr. Rise in water level in Pre-monsoon and post-monsoon 0.0514 m/yr. The rise in water level and 0.0757 m/yr. Rise annually.

- **Issues**

Groundwater contribution to agriculture is 97.90%.

- **Groundwater Management Plan**

The proposed groundwater management plan for the block has been tabulated below. Upon implementation, 15.36 MCM of groundwater is expected to be available for additional utilization, and Stage of Groundwater Development is expected to decrease by 9.31 %.

Table 23(a): Summarized details of interventions proposed

Block	Check Dams (Nos.)	Stream Development (kms)	Nala Bunds (kms)	Ponds (Nos.)	On-farm area (Ha)	WUE area (Ha)
Shitalpur	-	-	-	05	11106	7406

Table 23(b): Projected GW Recharge & savings by supply and demand-side management

Net Annual GW Availability (MCM)	Existing GW Draft for all uses (MCM)	Stage of GW Development (%)	Total recharge through interventions (MCM)	Total GW savings through interventions (MCM)	Projected Net GW Availability (MCM)	Projected Stage of GW Development after interventions (%)
96.58	84.26	87.24	1.10	14.26	111.94	77.93

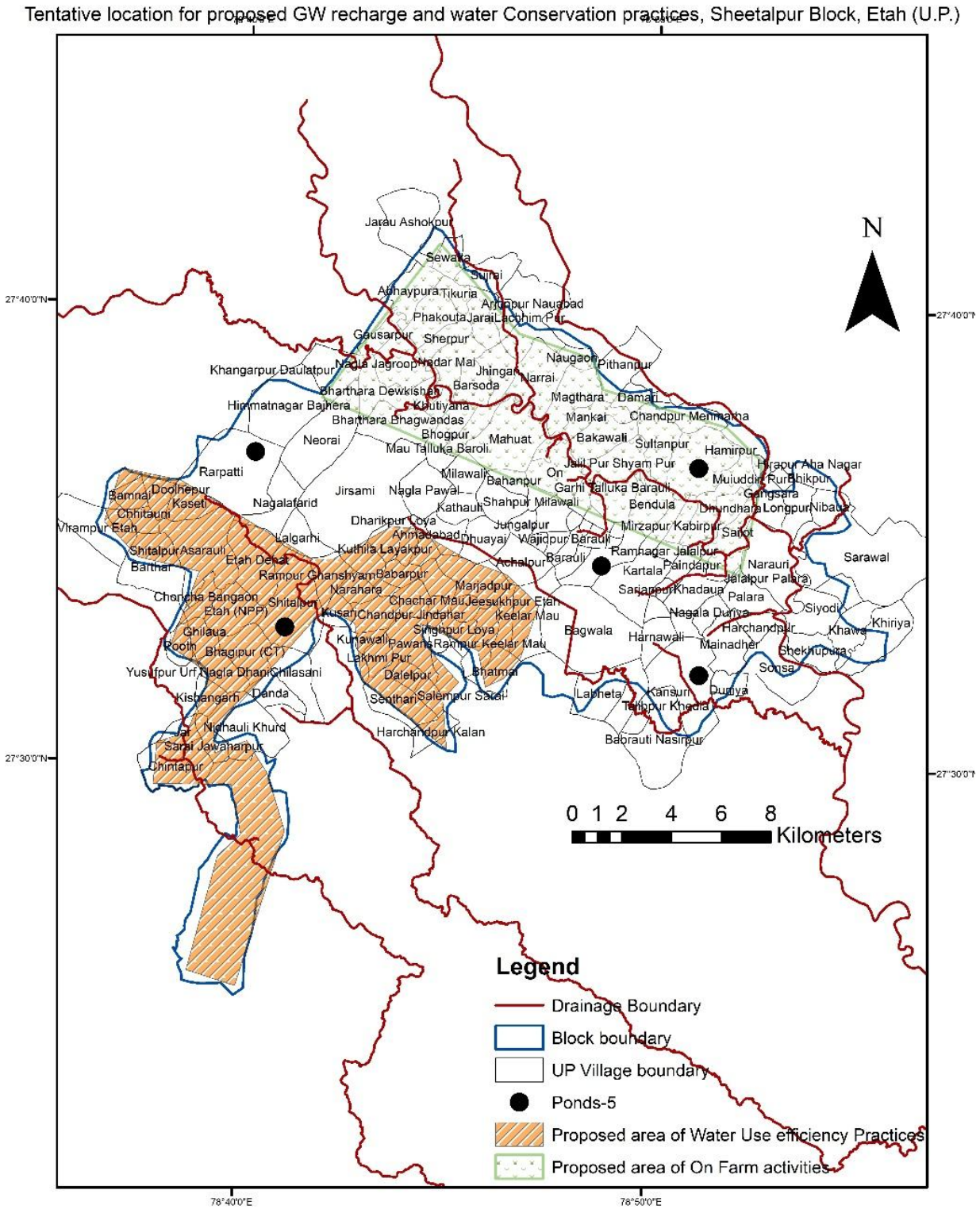


Figure 32: Proposed demand and supply side interventions in Sheetalpur block

ANNEXURE – 1

(BASIC GW QUALITY DATA OF UNCONFINED AQUIFER)

Sl. No.	Block	Lat	Long	pH	Conductivity	Hardness as $CaCO_3$
					µmho/cm at 25°C	mg/L
1	Aliganj	27.5004	79.1784	8.07	500	160
2	Awagarh	27.4474	78.4796	8.21	660	190
3	Jaithara	27.5136	79.0152	8.01	438	190
4	Jalesar	27.4702	78.3140	8.65	1691	190
5	Marhara	27.7289	78.6251	7.87	735	250
6	Nidholi Kalan	27.5804	78.5005	8.24	880	210
7	Sakit	27.4422	78.7805	8.12	510	160
8	Shitalpur	27.5694	78.6731	8.23	421	160

Sl. No.	Block	CO_3	HCO_3	Ca Hardness	Mg Hardness	Na	K	F
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
1	Aliganj	nil	281	2	22	47	4.7	1.25
2	Awagarh	nil	354	24	31	71	2.9	1.11
3	Jaithara	nil	232	36	24	19	2.9	0.52
4	Jalesar	96	207	16	36	300	7.0	BDL
5	Marhara	nil	220	36	38	61	7.0	0.48
6	Nidholi Kalan	nil	354	12	43	105	6.6	BDL
7	Sakit	nil	305	24	24	72	4.3	0.59
8	Shitalpur	nil	220	24	24	27	4.6	0.40

Sl. No.	Block	NO_3	SO_4	Cl	SiO_2	PO_4	SAR	RSC
		mg/L	mg/L	mg/L	mg/L	mg/L		
1	Aliganj	BDL	8	7	22	nd	2.1	2.7
2	Awagarh	6.3	12	14	20	nd	2.3	2.1
3	Jaithara	BDL	10	14	25	nd	0.6	0.0
4	Jalesar	40	91	269	17	nd	9.5	2.8
5	Marhara	34	53	85	22	nd	1.7	-1.3
6	Nidholi Kalan	7.5	52	57	20	nd	3.2	1.7
7	Sakit	BDL	25	21	21	nd	2.5	1.8
8	Shitalpur	BDL	13	14	26	nd	0.9	0.4

ANNEXURE – 2

(TRACE METAL DATA OF UNCONFINED AQUIFER)

Sl. No.	Block	Fe	Mn	Cu	Zn	As	Pb	U	Cr
		(ppm)	(ppm)	(ppm)	(ppm)	(ppb)	(ppb)	(ppb)	(ppb)
1	Aliganj	0.00	0.02	0.00	0.01	0.00	0.00	7.00	0.00
2	Awagarh	0.00	0.04	0.00	0.00	1.00	0.00	9.00	2.00
3	Jaithara	0.07	0.10	0.00	1.10	1.00	1.00	6.00	12.00
4	Jalesar	0.00	0.04	0.00	0.16	0.00	0.00	16.00	0.00
5	Marhara	0.00	0.00	0.00	0.04	0.00	0.00	8.00	0.00
6	Nidholi Kalan	0.14	0.10	0.00	0.26	0.00	0.00	25.00	0.00
7	Sakit	0.00	0.25	0.00	0.00	1.00	0.00	2.00	0.00
8	Shitalpur	0.00	0.03	0.00	0.01	0.00	0.00	17.00	0.00

ANNEXURE – 3

(Block-wise actual irrigated area (in sq km) by various means in the district)

BLOCKS	Canals	Tube-well		Wells	Ponds	Others	Total
		Public	Private				
Jalesar	3730	0	0	0	0	334	15210
Awagarh	5478	0	0	0	0	333	17970
Marehra	3307	0	0	0	0	246	15376
Nidhauli Kalan	3845	0	0	0	0	36	21147
Shitalpur	5340	0	0	0	0	596	18317
Sakit	3233	0	0	0	0	1936	20118
Jaithara	0	0	0	0	0	2044	20269
Aliganj	3629	0	0	0	0	2555	20821
Total	28562	0	0	0	0	8080	149228

Annexure-IV

Rain fed situation

Condition			Suggested Contingency measures		
Early season drought (delayed onset)	**Major Farming situation[a]**	**Normal Crop**	**Change in crop / croppingsystem[c] including variety**	**Agronomic measures**	**Remarks on Implementation**
Delay by 2 weeks (1st week of July)	Deep, loamy soils	Sorghum: **Composite-** Varsha, CSV-13, CSV-15,SPB-1388 and Vijeta **Hybrid-** CSH-9, 16,14,18,13 and CSH-23	No change	Prefer medium maturing varieties, Thinning, Interculture,	Prefer disease free certified seed from areliable source Like SDC/ SAUs
		Pearl millet,- **Composite-** ICMB-155, WCC-75,ICTP-8203 and Raj-171 **Hybrid-** Pusa-23 &	No change	Prefer medium maturing varieties, Thinning, Interculture,	

		322 and ICMH-451			
		Pigeon Pea Narendra arhar-1, Narendra arhar-2, Azad,	No Change	Ridge Planting Thinning, Inter-culture,	
		Urd- Uttara, Azad-2, Azad-3,Pant-U-35, Pant U-40	No change	Manual weeding, Linesowing	
		Maize: **Composite-** Naveen, Azad uttam, Pragati,Gaurav and KH-510 **Hybrid-** Ganga-11, HQPM-5and Prakash, JH-3459	No change	Prefer medium maturing varieties, Thinning, *Inter-culture*,Mulching	Linked with SDC/SAUs
Condition			**Suggested Contingency measures**		
Early season drought (delayed onset)	**Major Farming situation[a]**	**Normal Crop**	**Change in crop/cropping system[c]**	**Agronomic measures[d]**	**Remarks on Implementation[e]**
Delay by 4 weeks (July 3rd week)	Deep, loamy soils	Sorghum: **Composite-** Varsha, CSV-13, CSV-15,SPB-1388 and Vijeta **Hybrid-** CSH-9, 16,14,18,13 and CSH-23	No change	Adopt 10-15% more seed Prefer medium maturing varieties, *Inter-culture*, Spray of 2% MOP	Prefer disease free certified seed from areliable source Like SDC/ SAUs
		Pearl millet,- **Composite-** ICMB-155, WCC-	No change	Adopt 10-15% more seed Prefer medium maturing varieties,	
		75,ICTP-8203 and Raj-171 **Hybrid-** Pusa-23 & 322 and ICMH-451		*Inter-culture*, Spray of 2% MOP	
		Pigeon Pea – Narendra arhar-1, Narendra		Adopt 10-15% more seed Prefermedium maturing varieties,	

				Inter-culture,	
		arhar-2, Azad,	No change	Mulching Spray of 2% MOP	
		Urd- Uttara, Azad-2, Azad-3, Pant-U-35, Pant U-40	No change	Use 10-15% more seed Usemedium maturing varieties, *Inter-culture*, Mulching Spray of2% MOP	
		Maize: **Composite-** Naveen, Azad uttam, Pragati,Gaurav and KH-510 **Hybrid-** Ganga-11, HQPM-5and Prakash, JH-3459	Replace wit Pearl millet or Sorghum or Urd	Use 10-15% more seed Use medium maturing varieties, *Inter-culture*, Mulching Spray of 2% MOP	

Condition			**Suggested Contingency measures**		
Early season drought	**Major Farming situation[a]**	**Normal Crop**	**Change in crop/cropping system[c]**	**Agronomic measures[d]**	**Remarks on Implementation[e]**

(delayed onset)					
Delay by 6 weeks (Aug. 1st week)	Deep, loamy soils	Sorghum: **Composite-** Varsha,CSV-13, CSV-15,SPB-1388 and Vijeta **Hybrid-** CSH-9, 16,14,18,13 and CSH-23	Replace with Pearl millet or Urd	Use 10-15% more seed Use medium maturing varieties, *Inter-culture*, Mulching Spray of 2% MOP	Linked with SDC/SAUs
		Pearl millet: **Composite-** ICMB-155, WCC-75,ICTP-8203 and Raj-171 **Hybrid-** Pusa-23 & 322 and ICMH-451	No change	Use 10-15% more seed Use medium maturing varieties, *Inter-culture*, Mulching Spray of 2% MOP	Linked with SDC/SAUs
		Pigeon Pea – Narendra arhar-1, Narendra arhar-2, Azad,	Replace with Pearl millet or Urd	Use 10-15% more seed Use medium maturing varieties, *Inter-culture*, Mulching Spray of 2% MOP	Linked with SDC/SAUs
		Urd- Uttara, Azad-2, Azad-3, Pant-U-35, Pant U-40	No change	Use 10-15% more seed Use medium maturing varieties, *Inter-culture*, Mulching Spray of 2% MOP	Linked with SDC/ SAUs

Condition			**Suggested Contingency measures**		
Early season drought (delayed onset)	**Major Farming situation[a]**	**Normal Crop/cropping system[b]**	**Change in crop/cropping system[c]**	**Agronomic measures[d]**	**Remarks on Implementation[e]**
Delay by 8 weeks (Aug. 3rd week)	Deep, loamy soils	Pearl millet: **Composite-** ICMB-155, WCC-75,ICTP-8203 and Raj-171 **Hybrid-** Pusa-23 & 322 and ICMH-451	Keep fallow and conserve moisture	Moisture conservation and preparation for rabisowing	-
		Urd- Uttara, Azad-2, Azad-3,Pant-U-35, Pant U-40	Keep fallow and conserve moisture	Moisture conservation and preparation for rabisowing	-

Condition			**Suggested Contingency measures**		
Early season drought **(Normal onset)**	**Major Farming situation[a]**	**Normal Crop/cropping system[b]**	**Crop management[c]**	**Soil nutrient & moisture conservation measues[d]**	**Remarks on Implementation[e]**
Normal onset followed by 15-20 days dry spell aftersowing leading to poor germination/crop stand etc.	Deep loamy soils	Sorghum: **Composite-** Varsha, CSV-13, CSV-15,SPB-1388 and Vijeta**Hybrid-** CSH-9, 16,14,18,13 and CSH-23	Life saving irrigation Re sowing if plant population less than 70%	, Manual weeding	
		Pearl millet: **Composite-** ICMB-155, WCC-75,ICTP-8203 and Raj-171 **Hybrid-** Pusa-23 & 322 andICMH-451	Life saving irrigation Re sowing if plant population less than 70%	Manual weeding	
		Pigeon Pea – Narendra arhar-1, Narendraarhar-2, Azad,	Life saving irrigation Re sowing if plant population less than 70%	Mulching , Manual weeding	
		Urd- Uttara, Azad-2, Azad-3, Pant-U-35, Pant U-40	Life saving irrigation Re sowing if plant population less than 70%	Manual weeding	
		Maize **Composite-** Naveen, Azad uttam, Pragati,Gaurav and KH-510 **Hybrid-** Ganga-11, HQPM-5and Prakash, JH-3459	Life saving irrigation Re sowing if plant population less than 70%	Mulching , Manual weeding	

Condition			**Suggested Contingency measures**

Mid season drought (long dry spell, consecutive 2 weeks rainless (>2.5 mm) period)	**Major Farming situation[a]**	**Normal Crop/cropping system[b]**	**Crop management[c]**	**Soil nutrient & moisture conservation measues[d]**	**Remarks on Implementation[e]**
At vegetative stage	Deep loamy soils	Sorghum : **Composite-** Varsha, CSV-13, CSV-15,SPB-1388 and Vijeta**Hybrid-** CSH-9, 16,14,18,13 and CSH-23	Life saving irrigation if available	Spray of 2% MOP.	
		Pearl mille **Composite-** ICMB-155, WCC-75,ICTP-8203 and Raj-171 **Hybrid-** Pusa-23 & 322 andICMH-451	Life saving irrigation if available	Spray of 2% MOP.	
		Pigeon Pea – Narendra arhar-1, Narendraarhar-2, Azad,	Life saving irrigation ifavailable	Spray of 2% MOP.	
		Urd- Uttara, Azad-2, Azad-3,Pant-U-35, Pant U-40	Life saving irrigation if available	Spray of 2%MOP.	
		Maize **Composite-** Naveen, Azad uttam, Pragati,Gaurav and KH-510 **Hybrid-** Ganga-11, HQPM-5and Prakash, JH-3459	Life saving irrigation if available	Spray of 2%MOP.	

Condition			**Suggested Contingency measures**		
Mid season drought(long dry spell)	**Major Farming situation[a]**	**Normal Crop**	**Crop management[c]**	**Soil nutrient &moisture conservation measues[d]**	**Remarks on Implementation[e]**
At flowering / fruiting stage	Deep loamysoils	Sorghum **Composite-** Varsha, CSV-13, CSV-15,SPB-1388 and Vijeta	Life saving irrigation, if avaialble	Spray 2% solution ofUrea and 2%MOP.	

		Hybrid- CSH-9, 16,14,18,13 and CSH-23			
		Pearl millet,- **Composite-** ICMB-155, WCC-75,ICTP-8203 and Raj-171 **Hybrid-** Pusa-23 & 322 and ICMH-451	Life saving irrigation	Spray 2% solution ofUrea and 2%MOP.	
		Pigeon Pea – Narendra arhar-1, Narendra arhar-2, Azad,	Life saving irrigation	Spray 2%MOP. Mulching	
		Urd- Uttara, Azad-2, Azad-3, Pant-U-35, Pant U-40	Life saving irrigation	Spray 2%MOP. Mulching	
		Maize **Composite-** Naveen, Azad uttam, Pragati,Gaura v and KH-510 **Hybrid-** Ganga-11, HQPM-5 and Prakash, JH-3459	Life saving irrigation	Spray 2% solution ofUrea and 2%MOP. Mulching	

Condition			**Suggested Contingency measures**		
Terminal drought (Early withdrawal ofmonsoon)	**Major Farming situation**[a]	**Normal Crop**	**Crop management**[c]	**Rabi Crop planning**[d]	**Remarks on Implementation**[e]
	Deep loamy soils	Sorghum **Composite-** Varsha, CSV-13, CSV-15,SPB-1388 and Vijeta **Hybrid-** CSH-9, 16,14,18,13 and CSH-23	In case of severe drought, harvest for fodder	Prepare Field for rabisowing	

		Pearl millet,- **Composite-** ICMB-155, WCC-75,ICTP-8203 and Raj-171 **Hybrid-** Pusa-23 & 322 and ICMH-451	In case of severe drought, harvest for fodder	Prepare Field for rabisowing	
		Pigeon Pea – Narendra arhar-1, Narendraarhar-2, Azad,	Life saving irrigation Spray 2%MOP		
		Urd- Uttara, Azad-2, Azad-3, Pant-U-35, Pant U-40	If crop not reviving use the crop as fodder. If 75% mature than harvest.	Prepare Field for rabisowing	

.

Drought - Irrigated situation

Condition			**Suggested Contingency measures**		
	Major Farming situation[f]	**Normal Crop/cropping system[g]**	**Change in crop/cropping system[h]**	**Agronomic measures[i]**	**Remarks on Implementation[j]**
Delayed release of	Deep loamy soils	Paddy: (Transplanted)	No change	Direct seeded/ Drum seeded Paddy	Linked with
water in canals		Govind, Narendra-118,97 ,		Prefer early maturing varieties ie.	SDC/SAU's
due to low rainfall		Ashwani, **(**Early) Saket-4,		Saket-4, Ratna, Pant-12, Narendra-80,	
		Ratna, Pant-12, Narendra-80,		2026 NDR-118	
		2026 **(**Medium) Sarjoo-52,		Transplant 3-4 seed lings / hil	
		Pant-4, Narendra-359,		Wet and dry irrigation,	
		2026,2064		weed management	
		Maize **Composite-** Naveen,	No change		Linked with
		Azad uttam, Pragati,Gaurav		Irrigate at critical stage	SDC/SAU's
		and KH-510		Ridge planting	
		Hybrid- Ganga-11, HQPM-5			
		and Prakash, JH-3459			

Condition			**Suggested Contingency measures**		
	Major Farming situation[f]	**Normal Crop/cropping system[g]**	**Change in crop/cropping system[h]**	**Agronomic measures[i]**	**Remarks on Implementation[j]**

Limited release ofwater in canals due to low rainfall	Deep loamy soils	Rice: (Transplanted) Govind, Narendra-118,97 , Ashwani, **(**Early) Saket-4, Ratna, Pant-12, Narendra-80, 2026 **(**Medium) Sarjoo-52, Pant-4, Narendra-359, 2026,2064	No change	• Direct seeded/ Drum seeded Paddy/ SRI • Use early maturing varieties ie. Saket-4, Ratna, Pant-12, Narendra-80, 2026 NDR-118 • Transplant 3-4 seed lings /hill • Wet and dry irrigation, weed management • Ensure application ofMOP	Prefer disease free certified seed from a reliable source
		Maize **Composite-** Naveen, Azad uttam, Pragati,Gaurav and KH-510 **Hybrid-** Ganga-11, HQPM-5and Prakash, JH-3459	No change	• Prefer short duration varieties • Irrigation at Critical stage • Ridge planting • Weed management • Ensure application ofMOP	

Condition			**Suggested Contingency measures**		
	Major Farming situation [f]	**Normal Crop/croppingsystem[g]**	**Change in crop/cropping system[h]**	**Agronomic measures[i]**	**Remarks on Implementation [j]**
Non release of water in canals under delayed onset of monsoon in catchment	Deep loamy soils	RIce: (Transplanted) Govind, Narendra-118,97 , Ashwani, **(**Early) Saket-4, Ratna, Pant-12, Narendra-80, 2026 **(**Medium) Sarjoo-52, Pant-4, Narendra-359, 2026,2064	Replace with Sorghum / Pearl millets/Pigeon Pea/Til	Light irrigation at critical stages Ridge planting/lin esowing, 10-15% increase seed Weed management	Prefer disease free certified seed from a reliable source

		Maize **Composite-** Naveen, Azad uttam, Pragati,Gaurav and KH-510 **Hybrid-** Ganga-11, HQPM-5and Prakash, JH-3459	Replace by Jowar/ Pearl millets/Pigeo n Pea/Til	Light irrigation at critical stages Ridge planting/lin esowing, 10-15% increase seed Weed management	

Condition			**Suggested Contingency measures**		
	Major Farming situation[f]	**Normal Crop/cropping system[g]**	**Change in crop/cropping system[h]**	**Agronomic measures[i]**	**Remarks on Implementation[j]**
Lack of inflows into tanks due to insufficient /delayed onset of monsoon					

Condition			**Suggested Contingency measures**		
	Major Farming situation[f]	**Normal Crop/cropping system[g]**	**Change in crop/croppingsystem[h]**	**Agronomic measures[i]**	**Remarks on Implementation[j]**
Insufficient groundwater recharge due tolow rainfall	Deep loamy soils	Rice: (Transplanted) Govind, Narendra-118,97 , Ashwani, **(**Early) Saket-4, Ratna, Pant-12, Narendra-80, 2026 **(**Medium) Sarjoo-52, Pant-4,Narendra-359, 2026,2064	Replace with Sorghum / Pearl millets/Pigeon Pea/Til	• Light irrigation at critical stage, • Ridge planting /line sowing, • 10-15% increase seed • Weed management	Linked with SDC/SAU's

		Maize **Composite-** Naveen, Azad uttam, Pragati,Gaurav and KH-510 **Hybrid-** Ganga-11, HQPM-5 and Prakash, JH-3459	Replace by Jowar/ Pearl millets/Pigeon Pea/Til	• Light irrigation at critical stage, • Ridge planting /line sowing, • 10-15% increase seed • Weed management	Linked with SDC/SAU's

Unusual rains (untimely, un seasonal etc) (for both Rain fed and irrigated situations)

Condition				
Continuous high rainfallin a short span leading to water logging	**Vegetative stage[k]**	**Flowering stage[l]**	**Crop maturity stage[m]**	**Post harvest[n]**
Paddy	Bunding around the field	Bunding around the field	Drain out excess water	Shift the produceto safer place
Maize Sorghum Pearl millet Pigeon pea Urdbean	Drain out excess water from the fields			
Heavy rainfall with high	Not applicable			

speed winds in a short span[2]				
Outbreak of pests and diseases due to un seasonal rains				
Paddy	Spray of Chloropyriphos 2.5 lt./ hac for termite and For stemborer (Cartap@25 kg/ hac)	Dusting of Methyl parathion @15 kg/hac for Gandhi Bug and Chlorothalonil @2ml/lt of water for	-	

		false smut.		
Maize	Spray of Chloropyriphos 2.5 lt./ hac for termite and For stemborer (Cartap @25 kg/ hac)	Spray of Validamycin @2.7 ml/lt. ofwater solution for banded leaf and sheath blight.	-	-
Sorghum	Spray of Chloropyriphos 2.5 lt./ hac for termite and For stemborer (Cartap@25 kg/ hac)	Spray of Carbandazim (0.05%)+ dithane M 45 (0.2%) for early andlate leaf spots and rust.	-	-
Pearl millet	Spray of Chloropyriphos @3.50 lt./ hac for early shoot borar	Spray of Mancozeb(0.2%) for rust.		
Pigeon pea	Spray of Chloropyriphos 2.5 lt./ hacfor termite	Spray of Chloropyriphos 2.5 lt./ hacOr Monocrtophos @1.25lt/hac for control podborar	-	-
Urdbean	Spray of Chloropyriphos 2.5 lt./ hacfor termite	Spray of Dimethoate 1.00 lt./ hac Or imidachlorpide @250 ml/hac forcontrol of thrips/	-	-

Floods : Not applicable

Extreme events: Heat wave / Cold wave/Frost/ Hailstorm /Cyclone: Occasional events

Extreme event type				
	Seedling / nursery stage	**Vegetative stage**	**Reproductive stage**	**At harvest**
Heat Wave				
Paddy	Drain out the ponded water if any and irrigate with fresh water	-	-	-
Horticulture				
Mango	Frequent irrigation	Frequent irrigation	Frequent irrigation	_

Guava	Frequent irrigation	Frequent	Frequent irrigation	
		irrigation		
Cold wave				
Potato	-	Frequent irrigation & Preventive spraying of fungicide		
Horticulture				
Mango	-	Frequent irrigation		
Guava	-	Frequent irrigation		
Frost				
Potato	-	Frequent irrigation & Preventive spraying of fungicide		