NATIONAL AQUFER MAPPING AND MANAGEMENT PLAN

(NAQUIM)

FATEHPUR DISTRICT, UTTAR PRADESH

(AAP: 2018-19)

Government of India
Ministry of Jal Shakti
Central Ground Water Board
Northern Region
Lucknow, Uttar Pradesh

Government of India
Ministry of Jal Shakti
Central Ground Water Board
Northern Region, BhujalBhawan,
Sector-B, Sitapur Road Yojana
Aliganj, Lucknow-226021
Phone: (0522)-2363812
e-mail: rdnr-cgwb@nic.in

Preface

Groundwater has emerged as the preferred water source as a poverty reduction tool in India's rural areas due to its near-universal availability, dependability, and low capital cost. It has made significant contributions to the growth of Indian Economy and acted as an important catalyst for its socio-economic development. Its importance as a precious natural resource in the Indian context can be gauged from the fact that more than 85 % of India's rural domestic water requirements, more than 50 % of its urban water requirements; and more than 50 % of its irrigation requirements are being met from groundwater resources.

Increasing dependence on groundwater as a reliable source of water has resulted in its large-scale and indiscriminate exploitation in various parts of the country, without due regard to the recharging capacities of aquifers and other environmental factors. The unplanned and non-scientific exploitation of groundwater resources, mostly driven by individual initiatives has led to increased stress on the available resources which adverse impacts can be observed in the form of the long-term decline of groundwater levels, de-saturation of aquifer zones. It will also increase the energy consumption for the lifting of water from progressively deeper depth.

Central Ground Water Board has taken up the task of Aquifer Mapping and Ground Water Management Plan under NAQUIM in the state of Uttar Pradesh with an objective of (i) Delineation and characterization of aquifers in three dimensions (ii) Identification and quantification of issues and (iii) Development of management plans to ensure the sustainability of groundwater resources. Under this initiative, different management plans/interventions have been suggested for each aquifer system and also for the quality affected areas. The management options also include supply side management (which includes identification of the feasible areas for the artificial recharge and water conservation structures, which are helpful to arrest the declining water levels), and demand-side management options (which include crop diversification, water use efficiency practices in irrigation etc.).

The sincere efforts of ShJ.P. Gautam (Retd. Sc-D) and Sh Daya Shankar Singh, YP Central Ground Water Board, Northern Region, Lucknow are highly appreciated in preparing the NAQUIM report of Fatehpur District. I am sure that the Ground Water Management Plan of Fatehpur district and its aquifer maps would be an immense help to formulate the scientifically viable implementable strategies for efficient management of groundwater resources to ensure groundwater sustainability.

P.K.Tripathi
Head of Office

National Aquifer Mapping and Management Plan
Fatehpur District
Uttar Pradesh

Contributors

Author	Sh J.P.Gautam, Sc-D (Retd.) Sh Daya Shankar Singh, YP
Supervision and Guidance	Sh P.K.Tripathi, Head of Office
Thematic Layers	Sh Daya Shankar Singh, YP
Aquifer Model (3D & 2D)	Sh Sujatro Ray Chowdhuri, Sc-B Sh Daya Shankar Singh, YP
Ground Water Exploration	Sh Prashant Rai, Sc-D Sh Sujatro Ray Chowdhuri, Sc-B
Analysis of Geophysical Data and Interpretation	Dr. Shasikant Singh, Sc-B
Ground Water Management Plan	Sh Sujatro Ray Chowdhuri, Sc-B Sh Daya Shankar Singh, YP
Chemical Analysis	Scientists of Regional Chemical Lab, CGWB, NR

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(NAQUIM)

FATEHPUR DISTRICT, UTTAR PRADESH

(AAP 2018-19)

1.	**GENERAL INFORMATION**		
	i. Geographical Area (sq.km.)	:	4221.26 Sq. Km
	ii. Administrative Divisions		
	Number of Tehsil/Block	:	3/13
	Number of Gram Panchayats/Villages	:	840/1521
	iii. Population (as on 2011 census)	:	2310740
	Male	:	1215690
	Female	:	1095050
	iv. Average Annual Rainfall (mm) (Year 1970-2018)	:	825.86
	v. Rainfall in 2018 (mm)	:	519.8
2.	**GEOMORPHOLOGY**	:	Central Ganga Plain
	Major Physiographic Units	:	(i) Physiographic unit the lowland regions flood plain of Ganga and Yamuna. ii) The upland region border & the flood plain older alluvium.
	Major Drainages	:	Ganga and Yamuna river
3.	**LAND USE (Hectare.)**		
	a) Forest	:	7595
	b) Net area sown (Cultivable)	:	288696
	c) Cultivable Area (more than once)	:	141415
4.	**MAJOR SOIL TYPES**	:	Sandy loam
5.	**AREA UNDER PRINCIPAL CROPS (Hectare)**	:	392355 (Wheat, Rice, Sugarcane, Jwar, Pulses, Oil seeds, vegetables)
6.	**IRRIGATION BY DIFFERENT SOURCES (Hectare)**		
	Tube wells / Bore wells (ground Water)	:	168166
	Pubic	:	4842
	Private	:	163324
	Canals Pond (surface Water)	:	39671
	Net Irrigated Area	:	207868 Ha
	Gross Irrigated Area	:	316502 Ha
7.	**NUMBER OF GROUND WATER MONITORING WELLS (As on 2019)**		
	No. of Dug wells	:	20 (CGWB)
	No. of Piezometers	:	5 (GWD)
8.	**PREDOMINANT GEOLOGICAL FORMATIONS**	:	Quaternary alluvium
9.	**HYDROGEOLOGY AND AQUIFER GROUP**	:	Quaternary alluvium deposited by Ganga and Yamuna river

			systems. Aquifer (mbgl) Aquifer Group I: Down to 205 Aquifer Group II: 22.76-377 Aquifer Group III: 276-427 (Based on EW of CGWB)
	Major water bearing formation	:	Sand, silt and gravel
	Pre-monsoon Depth to water level during May' 2019 (data from CGWB & GWD)	:	1.9 to 36.41 mbgl.
	Post-monsoon Depth to water level during Nov' 2019 (data from CGWB & GWD)	:	0.1 to 34.41 mbgl.
10	**GROUND WATER EXPLORATION BY CGWB (As on 2018)**		
	No of wells drilled (EW, OW, PZ, SH, Total)	:	EW-12, OW-12, PZ-01, 2 SH
	Depth range (m)	:	146 - 384
	Discharge (liters per second)	:	500-2728lpm
	Storativity (S) (Saigaon EW)	:	9.96×10^{-5}
	Transmissivity (m^2/day) (Saigaon EW)	:	1267-6338 m^2/day
11	**GROUND WATER QUALITY**		
	Presence of chemical constituents more than permissible limit (e.g.)	:	Chloride, Sodium, Fluoride and Uranium in Malwan, Asothar and Mahua Block
	Testing of basic minerals is under progress		
	Type of water	:	Good
12	**DYNAMIC GROUND WATER RESOURCES (Ham) As on 31 March, 2017**		
	Annual Extractable Ground Water Recharge	:	148504.76
	Total Extraction	:	104182.87
	Net Ground Water Availability for future use	:	43210.28
	Stage of Ground Water Development	:	70.15
	Stage of Ground Water Development after interventions	:	60.60
13	**MAJOR GROUND WATER PROBLEMS AND ISSUES**	:	Declining trend of water level
14	**SUMMARIZED EXPECTED BENEFITS**		
	Provision for supplemental irrigation	:	1970.37 ham
	Conservation from On-farm Activities	:	5758.03 ham
	Saving from Drip & Sprinkler + HDPE Pipes	:	5758.03 ham
	Saving from Adoption of new Irrigation practices in S.cane area	:	1477.34 ham
	Total Recharge/ Saving	:	14963.77 ham
	Stage of Ground Water Development after Interventions (in %)	:	60.60

1.0 INTRODUCTION

Each and every human being in this world should get clean and safe drinking water. It is one of the most important component that enormously influence the life of human as well as other beings that are animals and plants. According to information 97% of earth's water supply is in the sea, which is not fit for human uptake. 2% of water is captured in the polar ice-caps and only 1% is available as fresh water in river, lakes, streams, reservoir & ground water which is available for irrigation, industries & household purposes.

Ground water is playing a vital role in the fulfilment of drinking, irrigational and industrial needs of the district. Although the ground water was in use since the ancient times, but with the population explosion, multi cropping practices in agriculture sector and rapid industrial development enhanced the need of water in the district. In recent time the dependency on ground water has increased manifold for socio-economic and agricultural development of the region to a great extent on easily availability with low capital cost. The scarcity of this vital resource can hamper the overall development of the area. The unplanned and unscientific development in various part of the state has led to stress on the availability of ground water resources with proper management. Due to paradigm shift from "ground water development" to "groundwater management" in the past two decades in the country, it is imperative to generate an accurate and comprehensive micro-level picture of groundwater through aquifer mapping in different hydrogeological settings. It would enable robust groundwater management plans in an appropriate scale. Aquifer mapping is a process wherein a combination of geologic, geophysical, hydrologic and chemical field and laboratory analyses are applied to characterize the quantity, quality and sustainability of ground water in aquifers. This would help achieving drinking water security, improved irrigation facility and sustainability in ground water resources development in Fatehpur District. Central Ground Water Board (CGWB) implemented the aquifer Mapping Programme in Fatehpur District, Uttar Pradesh with broad objective of preparing an aquifer wise management plan for the district. The present report is based upon the integration of existing data of CGWB & Department of State government during A.A.P. 2018-19. It will be very useful for the planners and various executive agencies

engaged in the development and management of ground water for agricultural, industrial and drinking purposes.

1.1 OBJECTIVE

The broad objective of the study is to establish the geometry of the underlying aquifer systems in horizontal and vertical domain and characterize them, so as to work out the development potential and prepare block wise management plan. It is envisaged to assess the aquifer wise availability, utilization and water quality, especially in problematic/vulnerable area. Finally, the aim of this study is to prepare block wise management plan to facilitate the suitable development and management of ground water resources.

1.2 SCOPE OF STUDY

The scope of the present study is broadly outlined within the framework of National Aquifer Management programme (NAQUIM) being implemented by CGWB. There is four major activities viz.:

(i) data collection/compilation
(ii) Data gap analysis
(iii) Data generation
(iv) Preparation of aquifer maps and management plan.

Data compilation includes collection of data and all maps from concerned Agencies, such as the Survey of India, Geological Survey of India, State Ground Water Department, U.P. Jal Nigam, Revenue Department., computerization and analyses of all acquired data, and preparation of a data base. Identification of Data Gap included ascertaining requirement for further data generation in respect of hydro-meteorological, hydrogeological, geophysical, chemical, studies. In continuity of data gap analysis, Data generation includes those of hydrometeorology, soil infiltration, and subsurface geophysics, chemical quality of ground water, Litholog and aquifer parameters. Generation of ground water chemical quality data was accomplished by collection of water samples and their laboratory analyses for all major parameters, heavy metals, pesticides and bacteria. Sub-surface

geophysical studies are incorporated vertical electrical sounding, two-dimensional image profiling, and borehole logging. Additional data pertaining to sub-surface lithology and aquifer parameters are obtained through drilling of additional exploratory wells and slim holes, pumping tests at the drilling sites and slug tests in a number as required and their analyses.

1.3 APPROACH AND METHODOLOGY

An approach and methodology adopted to achieve the major objective are Compilation of existing data collected from different sources and agencies and Identification of data gaps. Based on existing data various thematic layers and maps have been prepared in GIS environment and Aquifer maps incorporating the data and management plans are prepared.

1.4 STUDY AREA

The study area is located in Fatehpur district (25.93°N to 80.8°E) of Uttar Pradesh, in the Central Ganga Alluvial Plain. It is one of the thickly populated districts having a population of 2.3 million with geographical area of 4152 sq. km. The district is surrounded by Ganga and Yamuna Rivers on the north and south boundaries, with their tributaries playing an important role in topography of the district. It is bounded on the north-west by the district of Kanpur Nagar and on the south-east., by district Allahabad/Prayagraj. To the north beyond the Ganga lie the districts of Unnao, Rae Bareli and, for a short length, Pratapgarh, while on the south the Yamuna separates it from districts Banda and Hamirpur. In shape it is roughly rectangular. It is divided into13 blocks (Fig -1). The area in general has excellent Communication facility. Fatehpur is well connected to other places by railway lines and metaled toads. All the blocks and tehsils headquarters of the district are also connected by rail or road facilities.

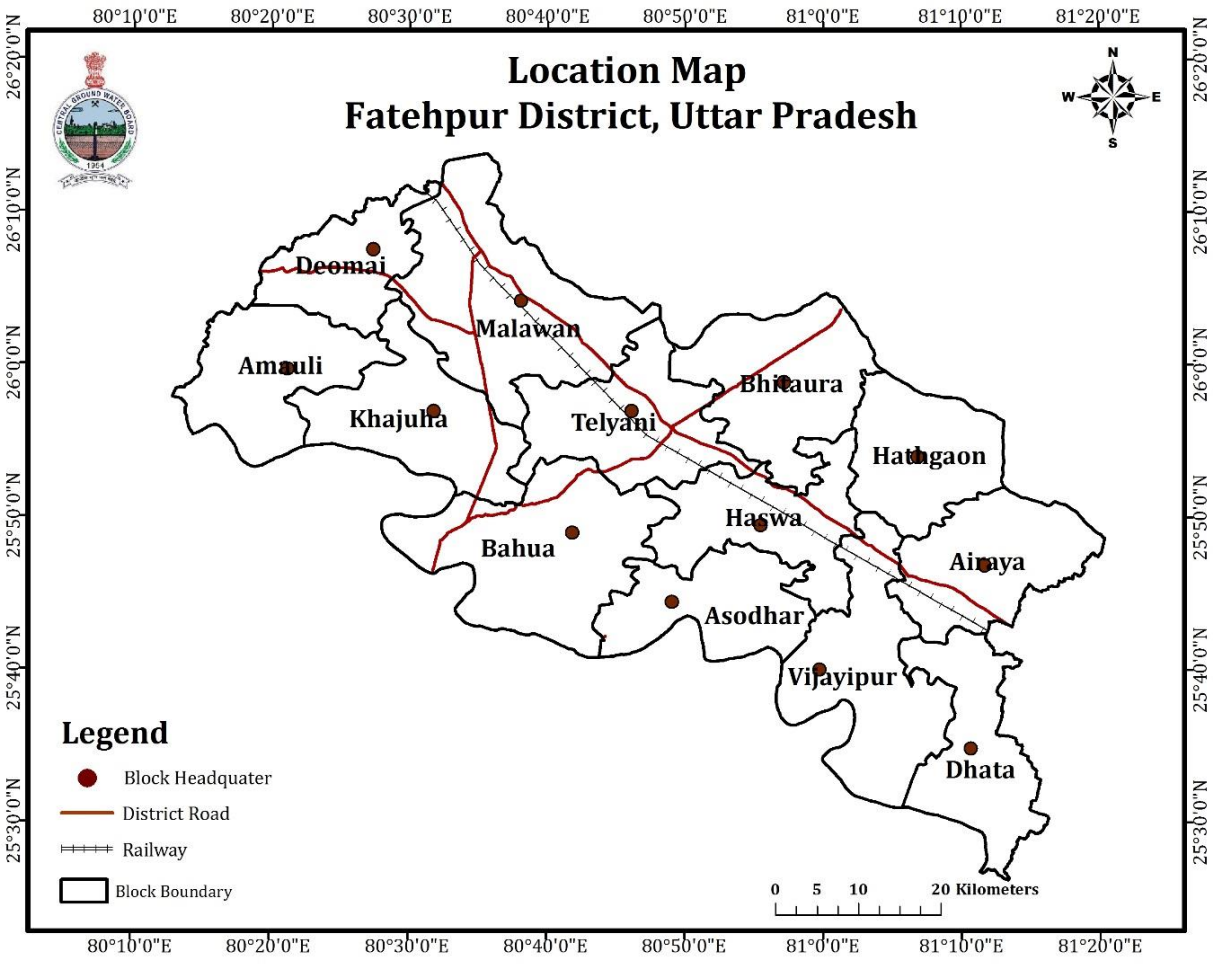


Fig: 1.1: Administrative Map of District Fatehpur (U.P.)

1.5 DEMOGRAPHY

According to the Census 2011 , the district has an area of 4,064.99 sq. km. and as per the census of 2011, the district has a population of 26,32,733 (females 12,48,011 males 13,84722), the rural population being 23,10,740 and the urban 3,21,993.

Table 1.1: Population of the Fatehpur District as on census 2011

Block	Population in 20011			Population in 2001			Decadal Growth
	Male	Female	Total	Male	Female	Total	
Deomai	70926	62982	133908	64003	56808	120811	9.78
Malwan	112937	100222	213159	100351	88727	189078	11.30
Amauli	83555	74799	158354	76702	68031	144733	8.60
Khajuha	94456	86483	180939	88134	79072	167206	7.59
Teliyani	76404	68170	144574	66530	58936	125466	13.22
Bhitaura	107736	97848	205584	94096	83831	177927	13.45
Haswa	104493	93786	198279	93152	82692	175844	11.31
Bahua	90521	79296	169817	78444	67837	146281	13.86
Asother	91459	82516	173975	85598	74480	160078	7.99
Hathgaon	98044	90997	189041	90637	84009	174646	7.61
Airayan	93255	85078	178333	89772	81859	171631	3.76
Vijayeepur	98999	88437	187436	85028	75819	160847	14.19
Dhata	92905	84436	177341	81896	74190	156086	11.99
Total	**1215690**	**1095050**	**2310740**	**1094343**	**976291**	**2070634**	**10.36**

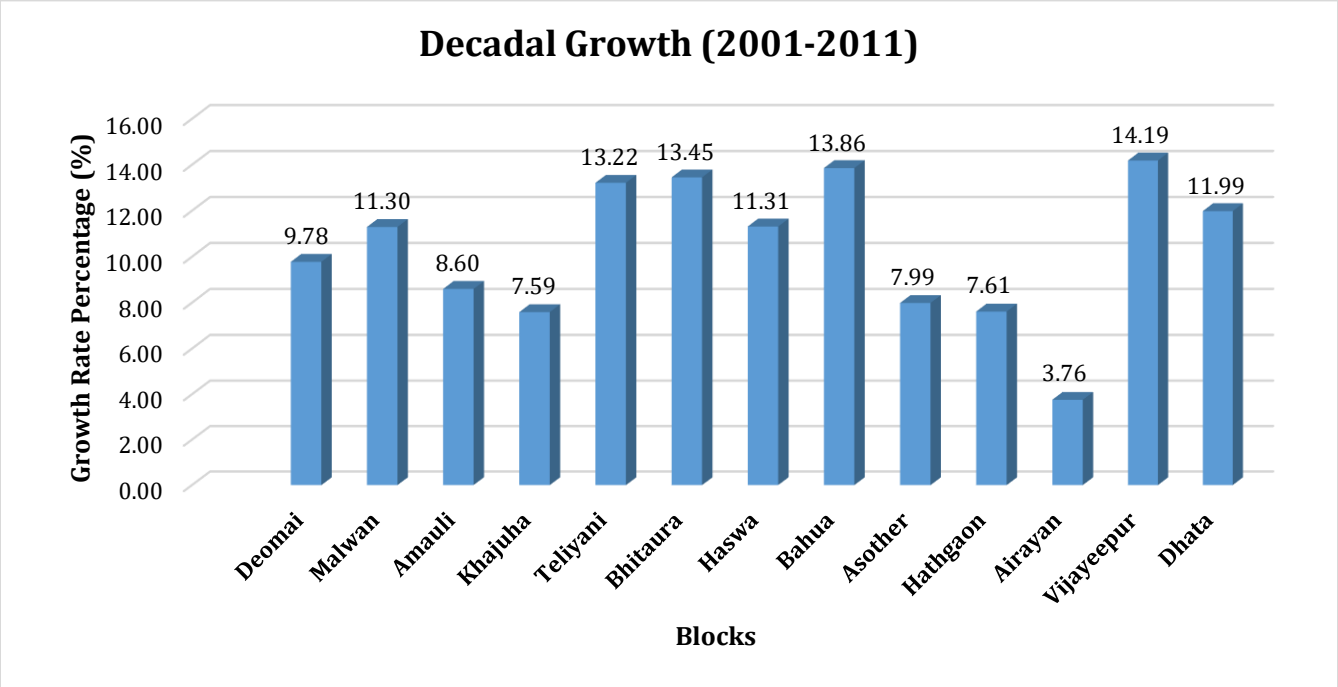


Fig: 1.2: Block-wise decadal Growth Rate from 2001-11 of District Fatehpur (U.P.)

1.6 DATA AVAILABILITY & DATA GAP ANALYSIS GAP ANALYSIS

The data pertaining to various attributes of ground water were collected from available literatures of Central Ground Water Board, State Departments and other agencies. The compiled data were plotted on 1:50,000 scale map and analysis of Data Gap was carried out for ascertaining additional requirement of Hydrogeological, Hydrological, Hydrochemical, and Geophysical Studies. Data Requirement, Data Availability and Data Gap Analysis are summarized in Table-1.2.

Table 1.2: Population of the Fatehpur District as on census 2011

S. No.	Study Aspect	Data Requirement	Data Availability	Data Gap
1	Rainfall and Other Climatic data	IMD Meteorological Station & 4 rain gauge stations of revenue department in the area	Rainfall data of Study area Available	No
2	Soil	Soil Map and Soil infiltration rate	Soil Map	Soil Infiltration test requires for Infiltration rate.
3	Land Use	Latest Land use Pattern in GIS Environment	Land Use available in Satellite data and UP Statistics Department- 2018-19	No
4	Geomorphology	Digitized Geomorphological Map	Digitized Geomorphological Map Available	No
5	Geophysics	Geophysical Survey in all Toposheet	55 VES Required & 2D Line Imaging	No
6	Exploration	Data of Exploratory well along with	42 wells, Exploratory wells	No

		aquifer parameters	and 1 Pz exist Aquifer parameters not available	
7	Recharge Parameters	Recharge parameters of different soil and aquifer types based on field studies	Recharge parameters are available in Ground Water Resource Estimation	No
8	Discharge Parameters	Discharge parameters for different Ground Water abstraction structure	Discharge parameters are available in Ground Water Resource Estimation	No

1.7 URBAN AREA INDUSTRIES AND MINING ACTIVITIES

Products like steel pipes, utensils, steel furniture, pulleys, weights and measures etc. are produced in different units located in urban centers of the district and provide employment. According to District Industries Center (DIC) Baghpat, No of registered units till 2009 was 8846 and after 2009, with the average of 500units per year it is increasing.

YEAR	NUMBER OF REGISTERED UNITS
Upto 2008-09	8846
2009-10	549
2010-11	519
2011-12	551
Total	**10465**

These industries are related to different types of industries types as explained by the District Industries Center (DIC) Baghpat. It shows that Soda water, Paper & Paper products water related, Leather based are the type of industries which are related to ground water.

Table 1.3: DETAILS OF EXISTING MICRO & SMALL ENTERPRISES AND ARTISAN UNITS IN THE DISTRICT

NIC CODE NO.	TYPE OF INDUSTRY	NUMBER OF UNITS
20	Agro based	2171
22	Soda water	4
23	Cotton textile	177
24.	Woollen, silk & artificial Thread based clothes.	36
25.	Jute & jute based	76
26.	Ready-made garments & embroidery	541
27.	Wood/wooden based furniture	754
28.	Paper & Paper products	87
29.	Leather based	437
31.	Chemical/Chemical based	112
30.	Rubber, Plastic & petro based	85
32.	Mineral based	104
33.	Metal based (Steel Fab.)	514
35.	Engineering units	120
36.	Electrical machinery and transport equipment	139
97.	Repairing & servicing	3863
1.	Others	1222

1.8 CROPPING PATTERN AND IRRIGATION PRACTICES

The loamy soils of the block area are very fertile. About 51% of the total geographical area of the district is sown area. The main *rabi* crops are wheat and oil seeds while paddy and pulses are the main crops of *kharif*. Cropping and irrigation intensity both are more than 100% which are leading the stress on water resources.

Table 1.4: Details of the Cropping Pattern 2017-18 in Fatehpur District (Area in Ha)

S. No.	Block	Area Sown			Gross Sown area			Area Irrigated		Cropping Intensity	Irrigation intensity
		Net Area Sown	Area sown more than once	Total	Rabi	Kharif	Jayad	Net Irrigated	Gross Irrigated		
1	Deomai	17532	12509	30041	16195	12825	1021	15411	24492	171.350	158.925
2	Malwan	23982	14154	38136	22423	14917	796	22131	33648	159.019	152.040
3	Amauli	27348	9991	37339	20808	15998	516	15003	19213	136.533	128.061
4	Khajuha	24485	11549	36034	20548	14722	755	15636	23282	147.168	148.900
5	Teliyani	16309	12728	29037	15622	12006	1409	15695	28036	178.043	178.630
6	Bhitaura	22349	12364	34713	20989	12639	1085	20882	32271	155.322	154.540
7	Haswa	22118	10106	32224	20662	10869	693	18072	25988	145.691	143.803
8	Bahua	18720	11670	30390	17375	12716	299	15735	24169	162.340	153.600
9	Asother	26620	10686	37306	22213	14782	311	13624	19932	140.143	146.301
10	Hathgaon	19583	8216	27799	17042	9910	847	17693	25097	141.955	141.847
11	Airayan	18358	7864	26222	16580	9124	518	15207	22179	142.837	145.847
12	Vijayeepur	26392	6056	32448	19135	13050	252	13653	17010	122.946	124.588
13	Dhata	20517	8820	29337	16830	12282	212	13385	18410	142.989	137.542
	Total	**284313**	**136713**	**421026**	**246422**	**165840**	**8714**	**212127**	**313727**	**149.718**	**147.279**

In the district, wheat and rice are the main crops in comparison to other crops while for production of Pulses 70282 ha area has been used in 2017-18 as shown in figure 1.3.

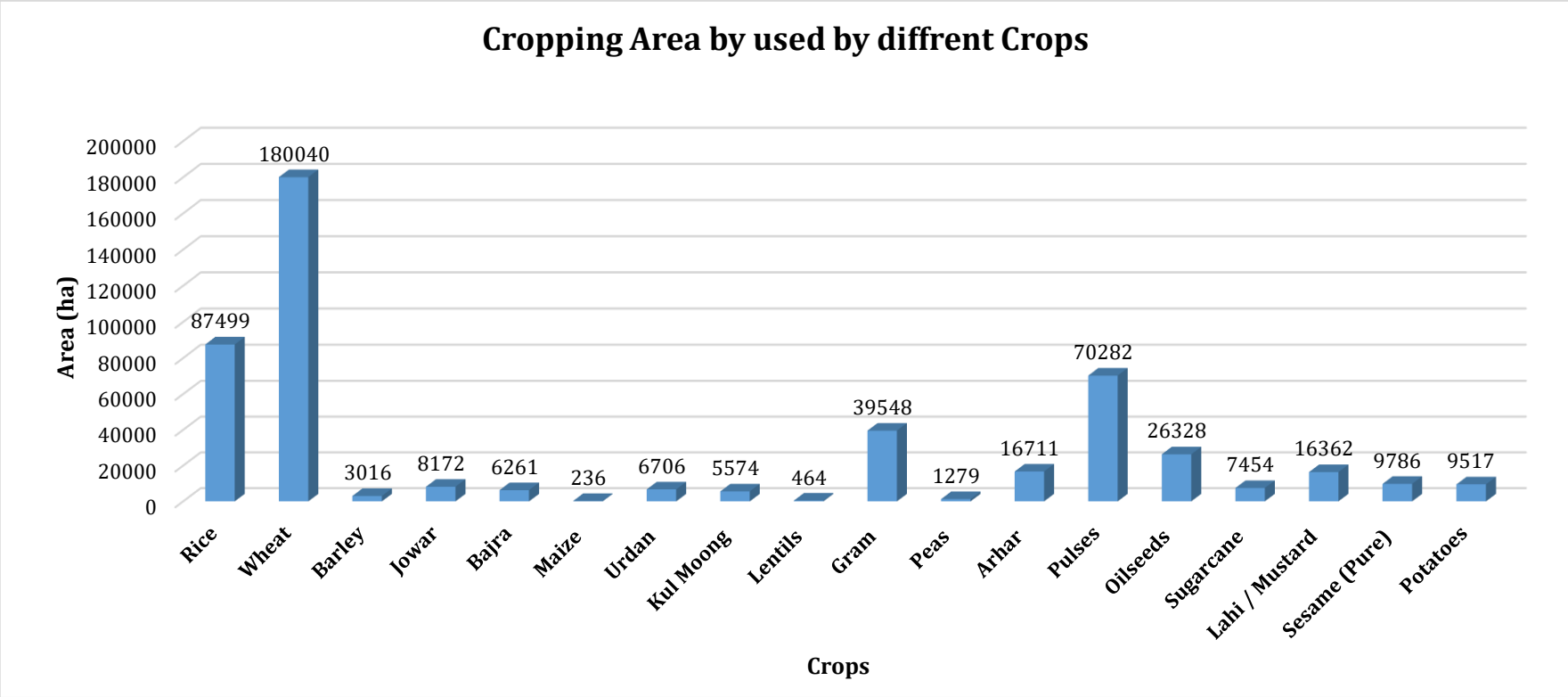


Fig: 1.3: Cropping Area by used by different Crops District Fatehpur (U.P.)

Table 1.5: Details of area under Different Crops 2017-18 in Fatehpur District

Crops	Deomai	Malwan	Amauli	Khajuha	Teliyani	Bhitaura	Haswa	Bahua	Asother	Hathgaon	Airayan	Vijayeepur	Dhata	Total
Rice	6626	9425	1514	6376	11622	10552	6637	9189	7070	6424	3911	3108	5045	**87499**
Wheat	13341	19662	12366	13969	13787	16990	14939	13609	11909	14516	13857	10687	10408	**180040**
Barley	185	110	514	296	28	246	204	101	449	110	120	358	295	**3016**
Jowar	378	276	1530	746	164	246	616	536	893	414	304	1170	899	**8172**
Bajra	95	229	143	218	23	57	137	108	1645	132	318	1752	1404	**6261**
Maize	121	27	13	9	9	10	25	4	0	6	6	6	0	**236**
Urdan	487	509	1166	1034	265	237	503	677	519	280	306	470	253	**6706**
Kul Moong	431	583	152	370	1298	818	558	246	162	278	239	276	163	**5574**
Lentils	1	3	95	72	0	0	0	64	216	0	0	7	6	**464**
Gram	1366	1381	4898	4528	742	1376	2875	2591	6909	1481	1976	5515	3910	**39548**
Peas	253	48	110	88	53	129	140	56	40	120	91	90	61	**1279**
Arhar	956	757	2350	2065	547	600	1076	1219	2062	713	606	2316	1444	**16711**
Pulses	3494	3281	8771	8157	2905	3160	5152	4853	9908	2872	3218	8674	5837	**70282**
Foodgrains	24241	33010	24851	29771	28538	31261	27710	28400	31874	24474	21734	25755	23888	**355507**
Oilseeds	2299	2699	3241	2574	1415	1844	1698	1520	2061	1596	1822	1746	1813	**26328**
Sugarcane	816	376	1654	1402	292	268	159	371	75	200	76	579	1186	**7454**
Lahi / Mustard	1556	1957	1663	1522	957	1448	1055	849	1392	1145	996	884	938	**16362**
Sesame (Pure)	729	742	1538	1043	458	395	643	663	593	450	810	851	871	**9786**
Potatoes	421	616	309	328	651	1402	1604	338	257	1208	1160	428	795	**9517**

In the district, about 81% of the area irrigated by the ground water (as shown in figure 1.4 and table 1.6; 1.7) and rest out of 19 %, 18 % of the area irrigated by the canals. This much of dependency on the ground water is leading the ground water stress. Amouli and Airayan blocks are using more than 99% of the ground water as shown in figure 1.5.

Table 1.6: Distribution of Surface and Ground Water for Irrigation in 2017-18 in Fatehpur District (Area in ha)

S.No.	Blocks	Canal	Tube well			Well	Pond	Other	Total
			Public	Private	Total				
1	Deomai	4129	352	10881	11233	0	31	18	15411
2	Malwan	4639	400	17073	17473	0	2	17	22131
3	Amauli	15	798	14152	14950	0	13	25	15003
4	Khajuha	5433	320	9817	10137	0	47	19	15636
5	Teliyani	3273	327	12076	12403	0	0	19	15695
6	Bhitaura	4144	454	16271	16725	0	0	13	20882
7	Haswa	2244	647	15154	15801	0	9	18	18072
8	Bahua	4605	603	10515	11118	0	0	12	15735
9	Asother	7045	675	5878	6553	0	4	22	13624
10	Hathgaon	1816	48	15811	15859	0	0	18	17693
11	Airayan	0	498	14696	15194	0	1	12	15207
12	Vijayeepur	1025	953	11441	12394	218	2	14	13653
13	Dhata	857	369	12122	12491	0	1	36	13385
Total		**39225**	**6444**	**165887**	**172331**	**218**	**110**	**243**	**212127**

Table 1.7: Irrigation by Surface and Ground Water in 2017-18, Fatehpur District

Sl. No.	Block	Area Irrigated by Surface Water (ha)	Area Irrigated by Ground Water (ha)	Contribution of GW (%)
1	Deomai	4178	11233	72.89
2	Malwan	4658	17473	78.95
3	Amauli	53	14950	99.65
4	Khajuha	5499	10137	64.83
5	Teliyani	3292	12403	79.03
6	Bhitaura	4157	16725	80.09
7	Haswa	2271	15801	87.43
8	Bahua	4617	11118	70.66
9	Asother	7071	6553	48.10
10	Hathgaon	1834	15859	89.63
11	Airayan	13	15194	99.91
12	Vijayeepur	1259	12394	90.78
13	Dhata	894	12491	93.32
	Total	**39796**	**172331**	**81.18**

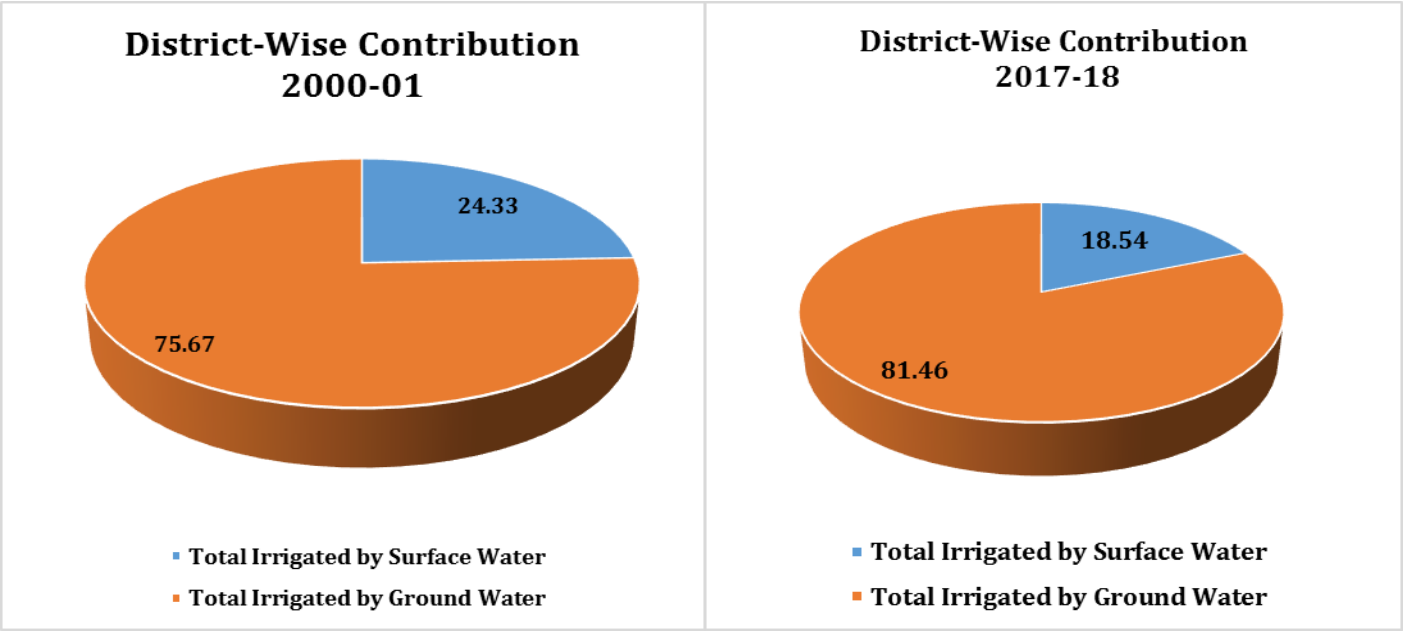


Fig: 1.4: Irrigation by Surface and Ground water Fatehpur District (2016)

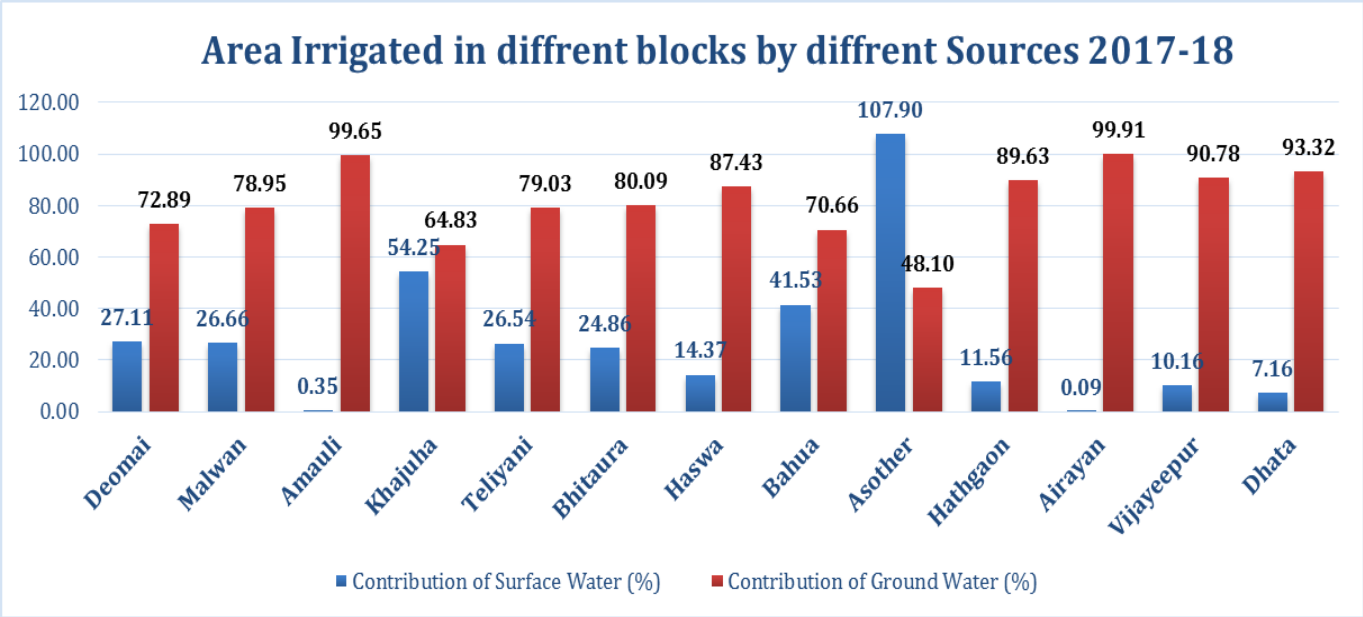


Fig: 1.5: Block-wise Graphical Presentation of Irrigation by Surface and Ground water Fatehpur District (2017-18)

In the district no of ground water extraction sources have also increased very much. In some blocks it has been increased by up to 900% as in Bithaura, Amauli and Malwan block of the district as shown in figure 1.6. From this data it is very clear that what will be the future?

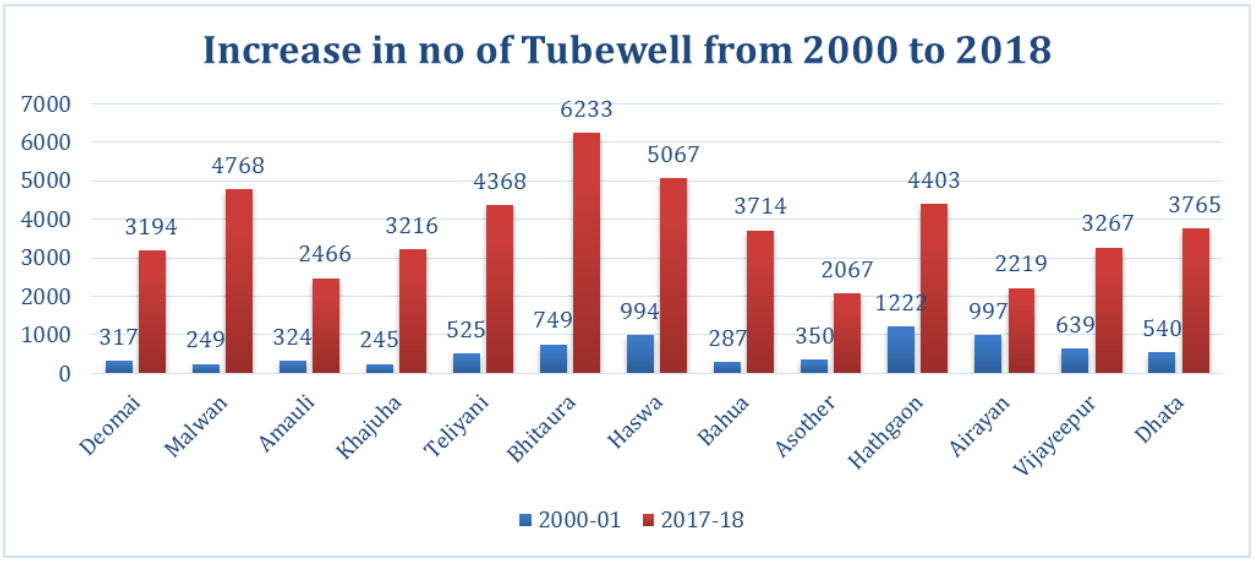


Fig: 1.6: Increase in number of Tube wells from 2000 to 2018

While at this time also, the ratio of shallow tube well is very high in comparison of medium or deep tube wells as shown in table 1.8.

Table 1.8: Details of the Irrigation Sources

Sl. No.	Block	Canal Length (km)	Govt Tube Wells No.	Well	(Shallow Tube Wells) in No.				Medium Tube Wells	Deep Tube wells
					Electric Pumps	Diesel Pumps	Others	Total No.		
1	Deomai	78	20	6	891	1961	2	2854	197	117
2	Malwan	123	26	4	1026	3515	46	4587	89	62
3	Amauli	11	97	14	820	1049	12	1881	105	369
4	Khajuha	105	51	0	950	1565	13	2528	428	209
5	Teliyani	104	12	7	432	3619	16	4067	233	49
6	Bhitaura	121	13	207	513	5316	18	5847	133	33
7	Haswa	182	25	224	361	4118	27	4506	253	59
8	Bahua	180	31	300	229	2631	123	2983	263	137
9	Asother	111	51	0	23	1628	1	1652	123	241
10	Hathgaon	126	3	0	387	3694	36	4117	246	37
11	Airayan	96	32	0	131	1636	16	1783	303	101
12	Vijayeepur	98	107	0	249	2106	40	2395	577	188
13	Dhata	115	62	15	386	2215	56	2657	779	252
	Total	**1450**	**530**	**777**	**6398**	**35053**	**406**	**41857**	**3729**	**1854**

1.9 RAINFALL & CLIMATE

The climate is typical sub humid punctuated by long and intense summer and mild winter. About 90% of annual rain fall is received from south west monsoon. May is the hottest month with temperature shooting up to 46.5^{0}C. January is generally the coldest month and temperature drops generally 8^{0}C but occasionally even up to 4^{0}C. The highest relative humidity in the morning during the month of August is 86% and the lowest is 25% during the month of May.

The Normal annual rainfall in the district is 609.5 mm for the period 2011 to 2020. The Rainfall Data of Ten Years (2011 to 2020) shows that average annual rainfall is 609.5

mm in the district and the maximum rainfall occurs during the monsoon period i.e. June to Sept. i.e. 521 mm and it is 85.48% of annual rainfall as shown in table 1.9 and figure 1.7.

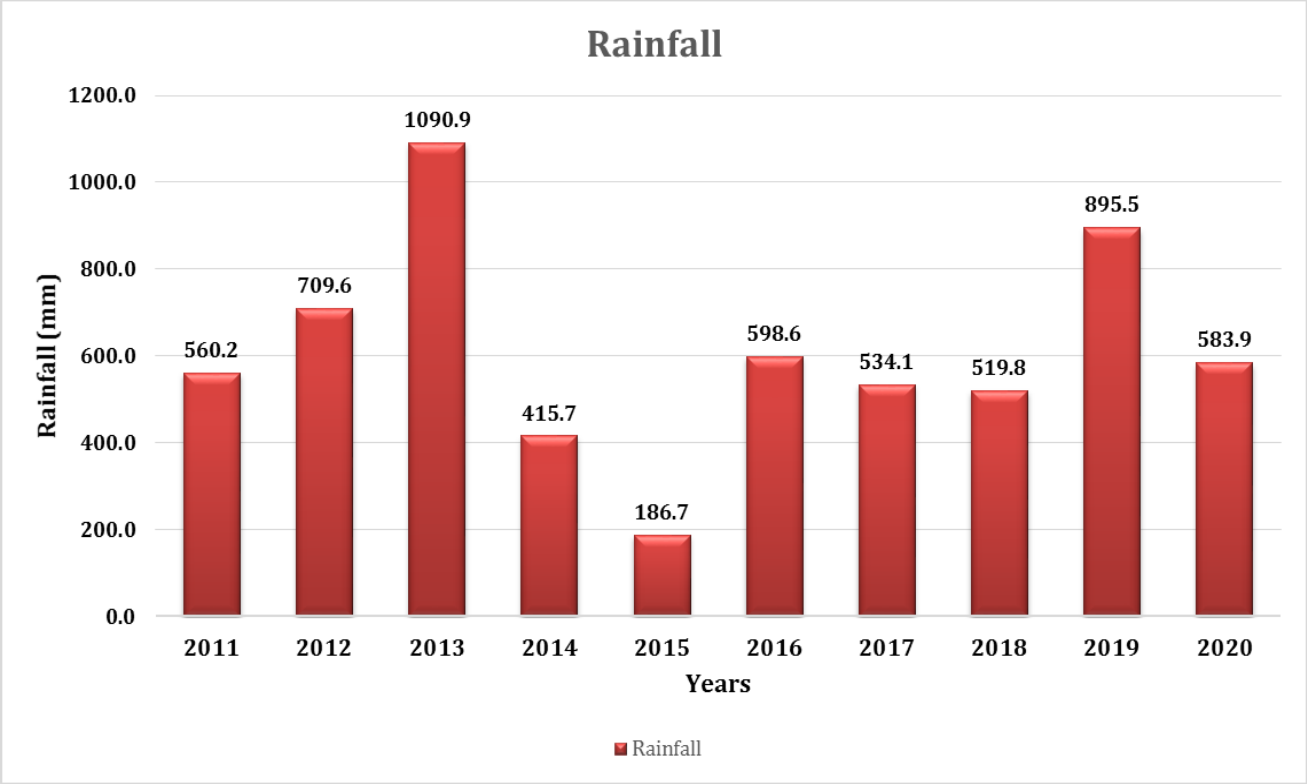


Fig-1.7: Average Annual Rainfall (mm) (Year 2011-2020) in Fatehpur District, U.P.

Table 1.9: Rainfall Data (mm) Of Fatehpur District, U.P. (2011-2020)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
2011	1.1	3.7	0.0	3.0	1.9	165.8	82.0	157.2	145.5	0.0	0.0	0.0	**560.2**
2012	39.2	14.0	0.0	1.4	0.0	10.0	326.7	195.1	123.2	0.0	0.0	0.0	**709.6**
2013	0.0	96.5	0.0	0.0	0.0	474.8	219.3	208.7	22.1	69.5	0.0	0.0	**1090.9**
2014	39.7	28.6	24.9	0.0	0.0	23.8	134.8	39.8	58.6	44.1	0.0	21.4	**415.7**
2015	15.6	5.4	40.5	11.2	0.0	4.1	72.5	19.2	1.9	4.8	5.9	5.6	**186.7**
2016	6.2	0.0	28.2	0.0	5.4	61.5	234.8	163.8	74.5	24.2	0.0	0.0	**598.6**
2017	7.2	0.0	0.0	5.4	48.1	6.5	265.2	152.5	49.2	0.0	0.0	0.0	**534.1**
2018	0.0	0.0	0.0	1.3	47.7	1.7	188.3	226.0	54.8	0.0	0.0	0.0	**519.8**
2019	15.35	14.3	1.53	2.37	0.81	24.14	283.45	129.54	343.66	53.25	0	27.13	**895.5**
2020	27.53	7.15	35.71	8.23	35.49	91.08	131.29	179.68	63.66	0	4.07	0.02	**583.9**
Average	15.2	17.0	13.1	3.3	13.9	86.3	193.8	147.2	93.7	19.6	1.0	5.4	**609.5**

1.10 GEOMORPHOLOGY

Geomorphologically, the district form a part of the Central Ganga Plain and exhibits fluvial features typical of the flood plains. These physical manifestations show that the plain of the Fatehpur district can be categorized as the composite flood plains and the meander flood plains. The former occupy major part of the district while the latter includes the tracts along river Ganga and Yamuna as shown in figure 1.8.

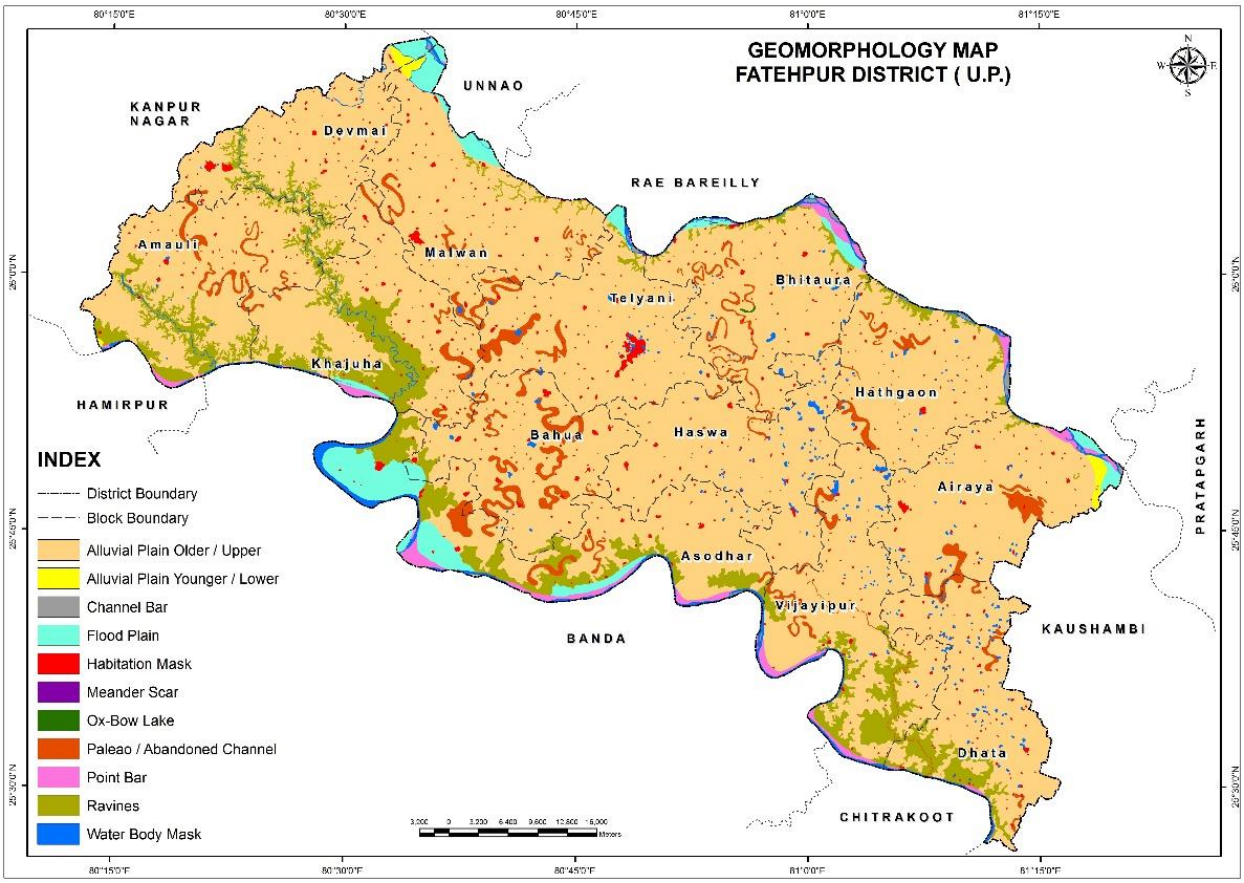


Fig 1.8: Geomorphology Map of Fatehpur District (U.P.)

The meander flood plains occur in the northern part of the district along river Ganga covering northern parts of *Malawan, Teliyani,* Bhitaura. Hathgaon *and Airawan blocks* and in the southern part of the district along river Yamuna covering south part of Amauli, Khajuha, Asothar, Vijayeepur and Dhata blocks, these plains are low lying. The river meanders are found within this area and form ox-bow Lake due to abandoning of the channels. The rivers erode their concave banks and deposit permanent bars etc, on the

convex banks. This lateral erosion and deposition has laid down comparatively coarser alluvium in the area.

The composite flood plains occupy the entire central part of the district extending from NE *to SW. These flood* plains bear features of' more *than one* phase of the *flood* plain formation. Numerous abandoned channels and ox-bow lakes of varying dimensions are located in the area (Fig-IV).

1.11 PHYSIOGRAPHY & DRAINAGE

The main and major drainage of the district belongs to Ganga River system, of which Rivers Yamuna and Rind are tributaries. Physiographical, the area can be divided into two units: (i) the lowland region trans-Ganga extending to south of Ganga River and (ii) Doab Yamuna which lies between south of Ganga and Yamuna on northern side.

The area is a part of the flat Gangetic alluvial plain and slopes gently from northwest to southeast. The gradient following the drainage lines of the principal rivers. The altitude of the area varies from 120 m. to 100 mamsl. In general the district may be divided into the following physiographic units:

(i) The low land regions

(ii) The upland regions

The low lands region comprises the present flood plains of the rivers, the Ganga and the Yamuna as shown in figure 1.9. The width of the flood plain is more along the concave banks of the rivers, Along Ganga and Yamuna, low lands are much narrow. The upland region borders the flood plains and comprises of older alluvium. The major part of the district falls within the upland region.

The Ganga and Yamuna are two major rivers draining the district. The Ganga flows along the northern boundary of the district for the entire length. It has a wide sandy bed changing its channel almost every year. The Yamuna flows in a south-eastern direction along the southern boundary of the district for the entire length. Rind and its tributary flowing in the western part of the district.

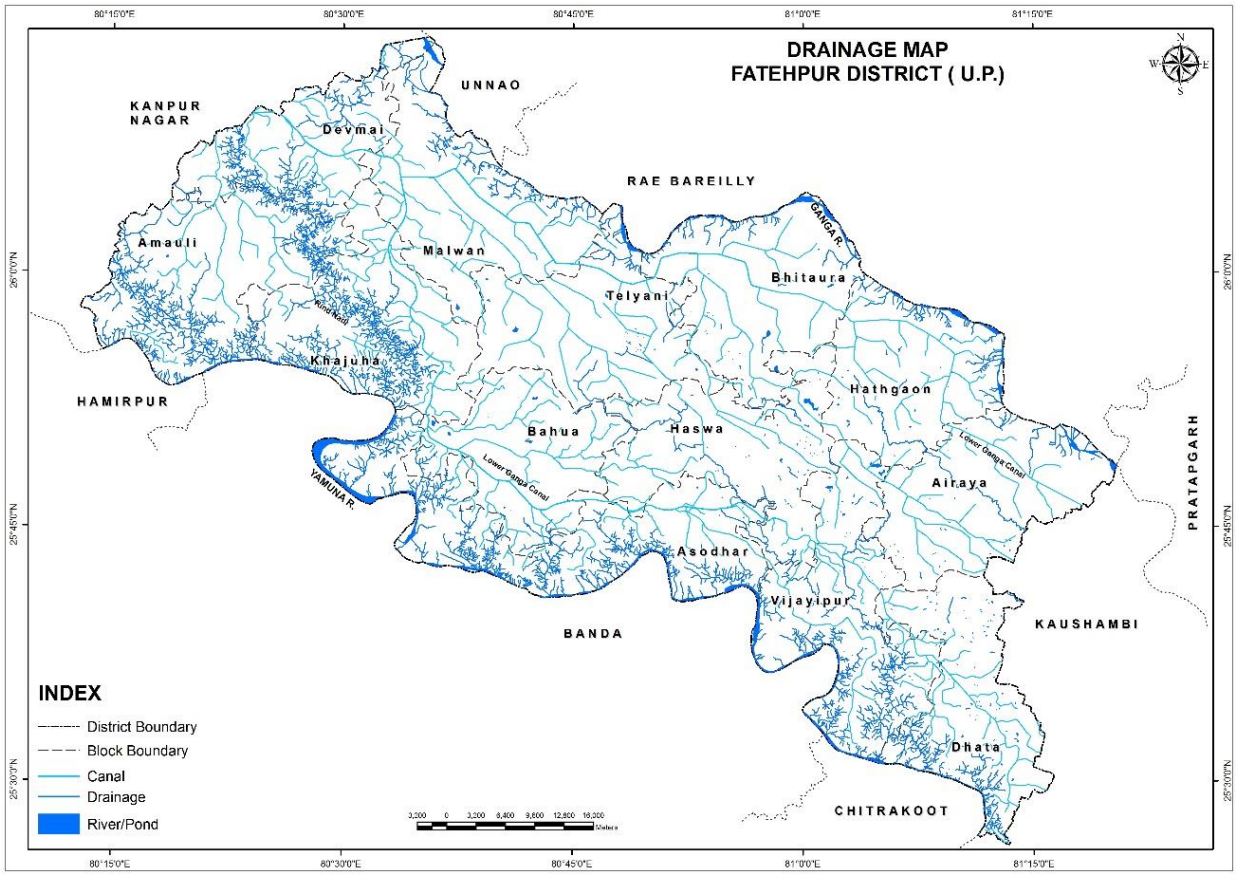


Fig 1.9: Drainage Map of Fatehpur District (U.P.)

1.12 SOILS

The soils found in the district exhibit a great variety of composition and appearance the name of various soil types are given as such:

1. Sandy to loamy sand soils
2. Sandy loam soils
3. Loam clayey-loam soils
4. Clayey-loam soil
5. Fine textured soils
6. Sandy loam soils reddish-brown
7. Sandy loam to Loam soils dark-colored
8. Ravinous and Gullied land
9. Clayey loam soil brownish grey

The diversity in the soil is mainly due to the influence of the various rivers and partly due to the presence of peculiar soils of Bundelkhand along the course of the Yamuna River. The major part of the district consists of ordinary soils known locally as Bhur or sand which is found on the ridges, matiar or clay in the depressions and dumat or loam in the plains. Reh prevails in the clay dominant areas. Prominent patches have been observed in part of eastern part of Teliyani block, Bhitaura, Hathgaon and northern part of Haswa and Khajuha blocks. Purely alluvial soils of the river valley are present notably in the Kachhar of the Ganga and Yamuna rivers formed by repeated deposits of silt, brought down by rivers during floods.

Broadly and water holding property wise, the soil of the district has been classified in to three parts as Coarse Loamy, Fine Loamy and Fine type as shown in figure3333.

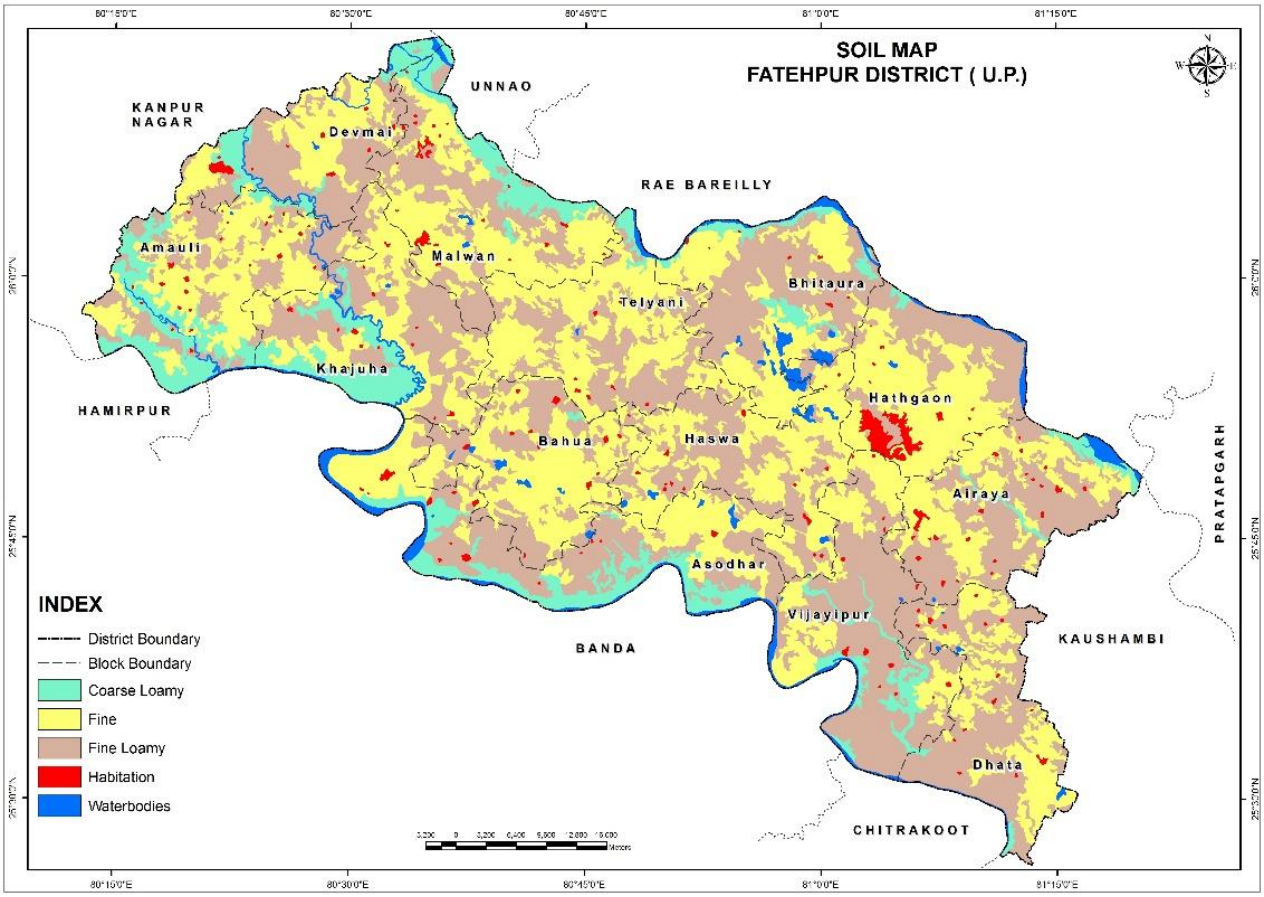


Fig: 1.10 Soil Map of Fatehpur District (U.P.)

CHAPTER-2

DATA COLLECTION, GENERATION, INTERPRETATION, INTEGRATION AND AQUIFER MAPPING

2.1 HYDROGEOLOGY

The groundwater is being extracted from a three-tier aquifer system of quaternary sediments deposited over concealed basement making to major fresh water aquifer group in the Ganga Basin. Geologically, the area is formed by sub-recent to recent composed of the ordinary Gangetic alluvium. The alluvium rests on the northeast ward sloping basement consisting of geneisses, granites and patches of Vindhayan rocks. The area is underlain by the unconsolidated sediments of Quaternary to recent period which comprise silt, clay, sand of various grades or gravel and kankar in varying proportions.

2.1.1 GEOLOGY

Fatehpur district forms a part of Central Ganga Plain and occupies the alluvial tracts of both Ganga and Yamuna rivers. The area is underlain by the unconsolidated sediments of Quaternary to Recent periods which comprises of silt. Clay, sands of various grades or gravel and kankar in varying proportions as shown in figure 2.1. The unconsolidated sediments deposited over the undulating surface of the basement (granite/Vindhayan sandstones) rocks as shown in table 2.1. It exhibits the existence of thick succession of granular and clastic **formations.** The depth of basement varies between 100 to 200 mbgl along southern boundary of the district along river Yamuna, 200 to 350 mbgl in the central part of the district and 300-450 mbgl along Ganga River bordering the northern part of the district

Table 2.1: Geological Succession

Age	Formation	Lithology
Recent	Newer Alluvium	River alluvium and residual soil.
Sub Recent	Older Alluvium	Alluvium consist sand clay, pebble, kankar, Gravel.
…….. Unconformity ……..		
Precambrian to Lower Cambrian	Vindhyan	Lime stone Dolemite shale sand & Quartzite.

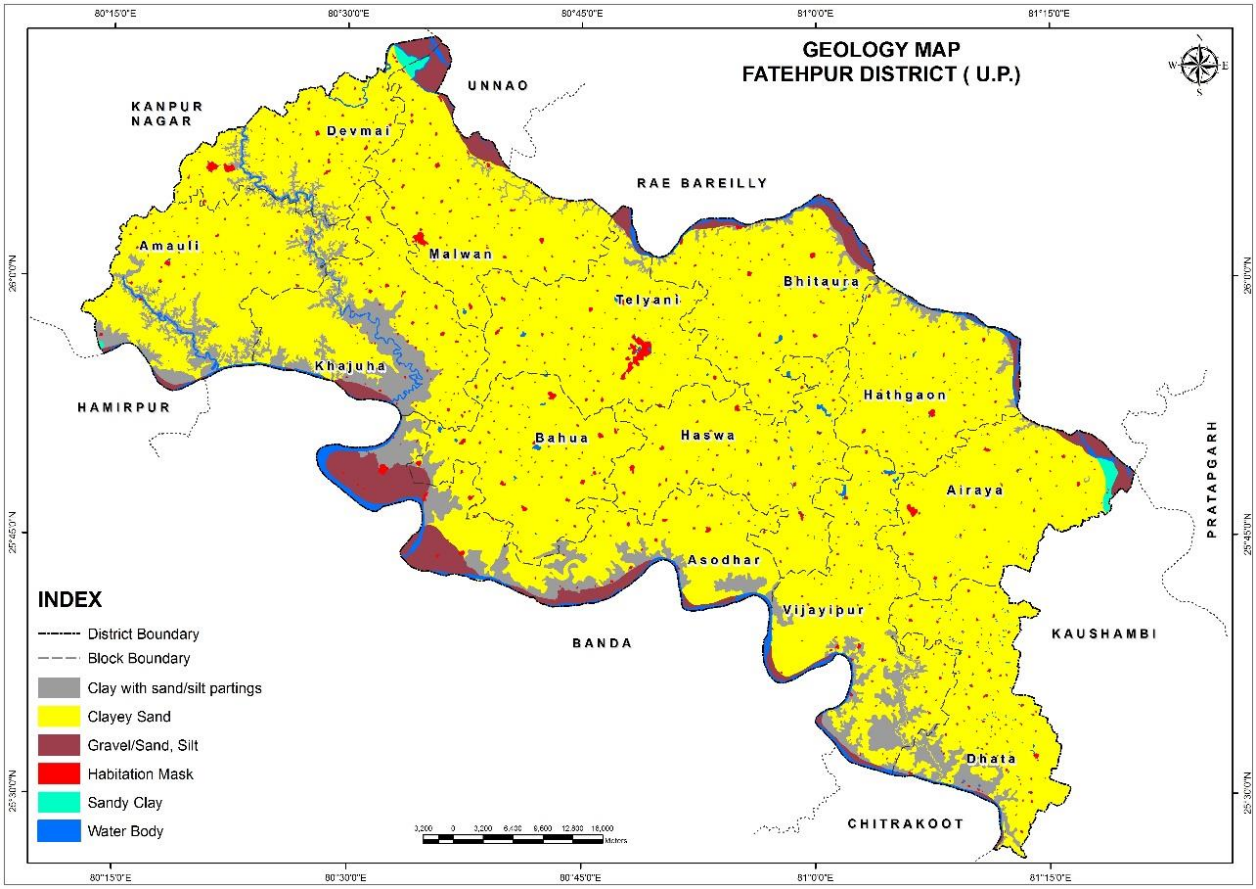


Fig 2.1: Geological Map of Fatehpur District (U.P.)

2.1.2 GROUND WATER CONDITIONS

Ground water occurs under phreatic to semi confined and confined conditions. The near surface aquifer is under unconfined / water table condition. The shallow phreatic aquifer is tapped by dug wells. The monitoring of water levels are carried out during May (pre-monsoon) and, November (post-monsoon) to study the impact of rainfall on ground water regime, water samples are also collected during month of May for determining the changes in chemical quality of ground water. On the basis of 2019 the depth to water level ranges from 1.9 to 36.41 mbgl during pre-monsoon where as it ranges from 0.45 to 34.41 mbgl in post-monsoon. The pre & post-monsoon water level fluctuation varies from 0.3 to 6.5m. The water level data is presented in table 2.2.

Table 2.2: Water level of Pre-Post Monsoon-2019

S.No.	Block	Location	Type of well	Pre	Post	Fluctuation
1	Airayan	Mohammadpur gaunti	P	17.35	13.45	3.9
2	Dhata	Block h.q. dhata	P	18.6	12.55	6.1
3	Dhata	Dhata-2	W	6.35	3.2	3.2
4	Dhata	Narsinghpur kabrha	P	24.75	21.05	3.7
5	Dhata	Arhali	P	8.75	3.15	5.6
6	Airayan	Sultanpur ghosh	P	2.25	0.6	1.7
7	Dhata	Pr. School bairi	P	21.55	20.1	1.5
8	Dhata	Anjna kabir	P	27.62	27	0.6
9	Dhata	Dendasai	P	36.41	34.41	2
10	Hathgaon	Pr. School manmohanpur	P	27.5	24	3.5
11	Dhata	Saidpur panchmai	P	15.4	15.1	0.3
12	Hathgaon	Pure adhari	P	19.3	17.7	1.6
13	Vijayeepur	Dariyamau	P	25.42	23.42	2
14	Hathgaon	Hathgaon	W	22.7	18	4.7
15	Hathgaon	Pr. School bandipur	P	17.8	16.05	1.8
16	Hathgaon	Pr. School kharhara	P	17.85	15	2.9
17	Hathgaon	Palia buzurg	P	10.25	9.4	0.9
18	Vijayeepur	Ahmadganj tihar	P	7.6	6.8	0.8
19	Vijayeepur	Khasmau	P	14.3	13.2	1.1
20	Vijayeepur	Taini	P	18.97	17.52	1.5
21	Bhitaura	Husainganj	W	7.45	6.2	1.3
22	Vijayeepur	Kishanpur	W	19.4	18.5	0.9
23	Haswa	Bhairwan	P	18.05	15.35	2.7
24	Haswa	Manawan	W	12.75	10.35	2.4
25	Haswa	Naraini	P	14.55	12.4	2.2
26	Bhitaura	Pr. School lakri	P	9.55	5.95	3.6
27	Haswa	Bahrampur	P	15.2	12.55	2.7
28	Asothar	Konder	P	3.2	0.55	2.7
29	Haswa	Usraina	P	23	17.8	5.2
30	Haswa	Pr. School tiker	P	16.5	13.85	2.7
31	Haswa	Block h.q. haswa	P	18.63	15.45	3.2
32	Bhitaura	Sahimapur	W	7.3	7	0.3
33	Bhitaura	Garieva	W	8.82	6.82	2
34	Asothar	Sidhaon	P	1.9	0.1	1.8
35	Bhitaura	Phakuwa	P	8.5	6.25	2.3
36	Bhitaura	Saidnapur	P	6.6	4.95	1.7

37	Teliyani	Bastapur	P	2.2	0.45	1.8
38	Asothar	Bholapur	P	16.15	13.8	2.4
39	Teliyani	Trilokipur	P	14.7	10.55	4.2
40	Teliyani	Korai	W	17.1	14	3.1
41	Teliyani	Manjhoopur	P	2.45	0.65	1.8
42	Teliyani	Korai	P	18.1	14	4.1
43	Bahuwa	Mohmmadpur	W	18.9	17.25	1.7
44	Bahuwa	Chakaskaran	P	20	17.2	2.8
45	Bahuwa	Khatauli	P	15.05	11.05	4
46	Teliyani	Pr. School chakheri	P	6.95	4.65	2.3
47	Bahuwa	Baragaon	P	13.85	10.6	3.3
48	Teliyani	Pr. School sarai khargu	P	12.05	9.4	2.7
49	Bahuwa	Sujanpur	P	22.4	19.15	3.3
50	Teliyani	Pr. School sarai shahjada	P	8.6	5.7	2.9
51	Malawan	Kalyanpur	W	10.2	8.35	1.9
52	Teliyani	Panai chauraha	P	23.95	19.55	4.4
53	Bahuwa	Pr.school ladigawan	P	25.5	21.6	3.9
54	Malawan	Sheorajpur	W	10.25	8.35	1.9
55	Bahuwa	Gauri	W	5.3	1.8	3.5
56	Malawan	Muradipur	W	7.1	5.3	1.8
57	Malawan	Gudhrauli	P	18.65	13.95	4.7
58	Deomai	Bakevar	P	9.65	6.5	3.2
59	Khajuha	Zafarganj	W	25.65	19.46	6.2
60	Deomai	Padhara	P	11.75	5.55	6.2
61	Khajuha	Pr. School khootamal	P	30	29.3	0.7
62	Deomai	Sujawalpur	P	7.65	5.65	2
63	Deomai	Musafa	P	9.45	6.6	2.9
64	Deomai	Ibrahimpur tanda	P	27.5	23.6	3.9
65	Deomai	Ghanshyampur	P	14.6	8.1	6.5

2.1.2.1 Pre-Monsoon:

Figure 2.2, shows that deeper water levels are observed in the form of patches in some blocks as Khajuha, Dhata, Hathgaon and Hasua while in the southern part of the district has more depth of water level in pre-monsoon.

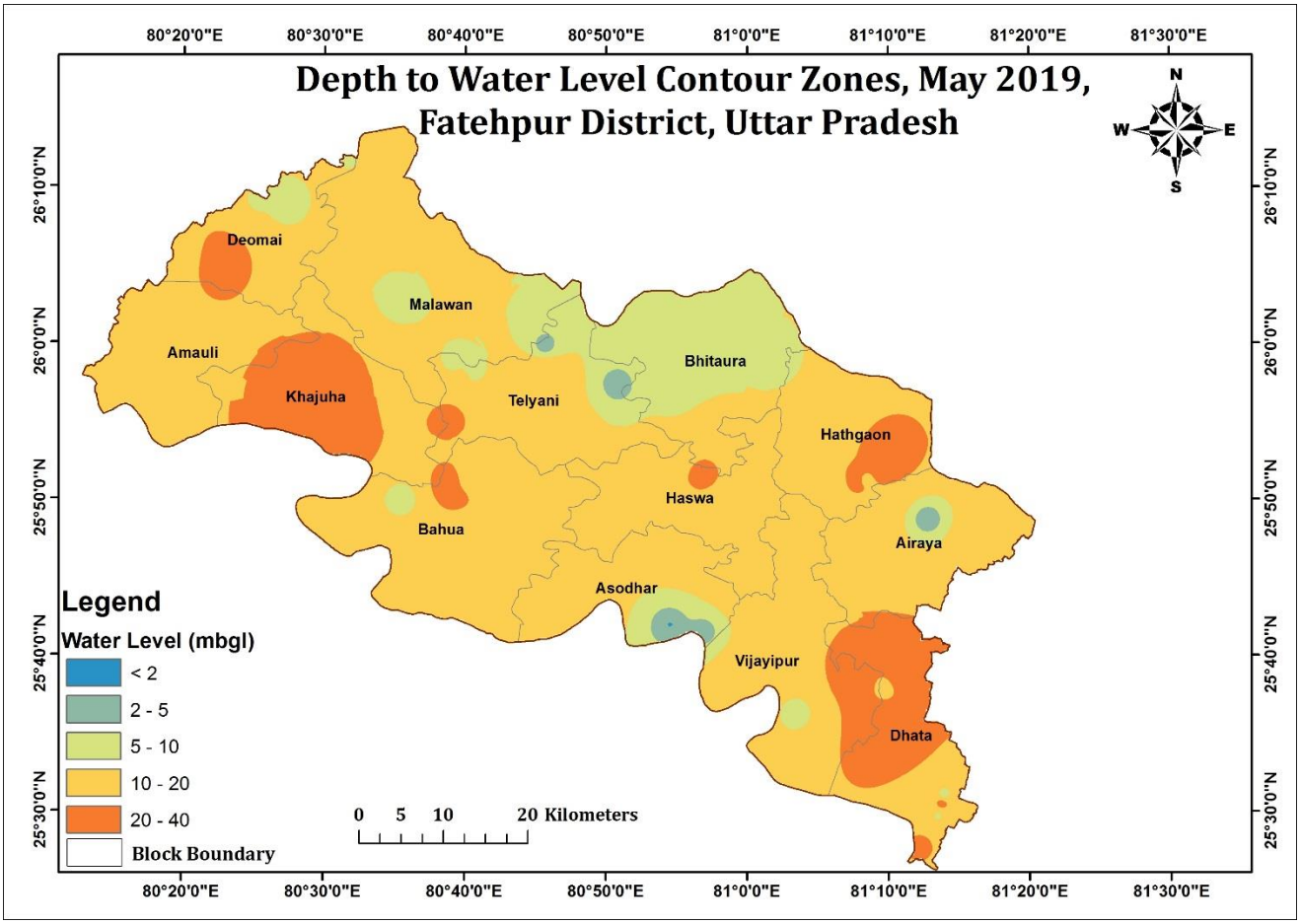


Fig 2.2: Depth to Water Level Pre-monsoon Map of Fatehpur District, UP

2.1.2.2 Post-Monsoon:

Same condition is observed in Post-monsoon period that deeper water levels are observed in the form of patches in some blocks as Khajuha, Dhata, and Hathgaon. In the figure 11, water level is deeper in southern part in comparison to northern part as shown in figure 2.3.

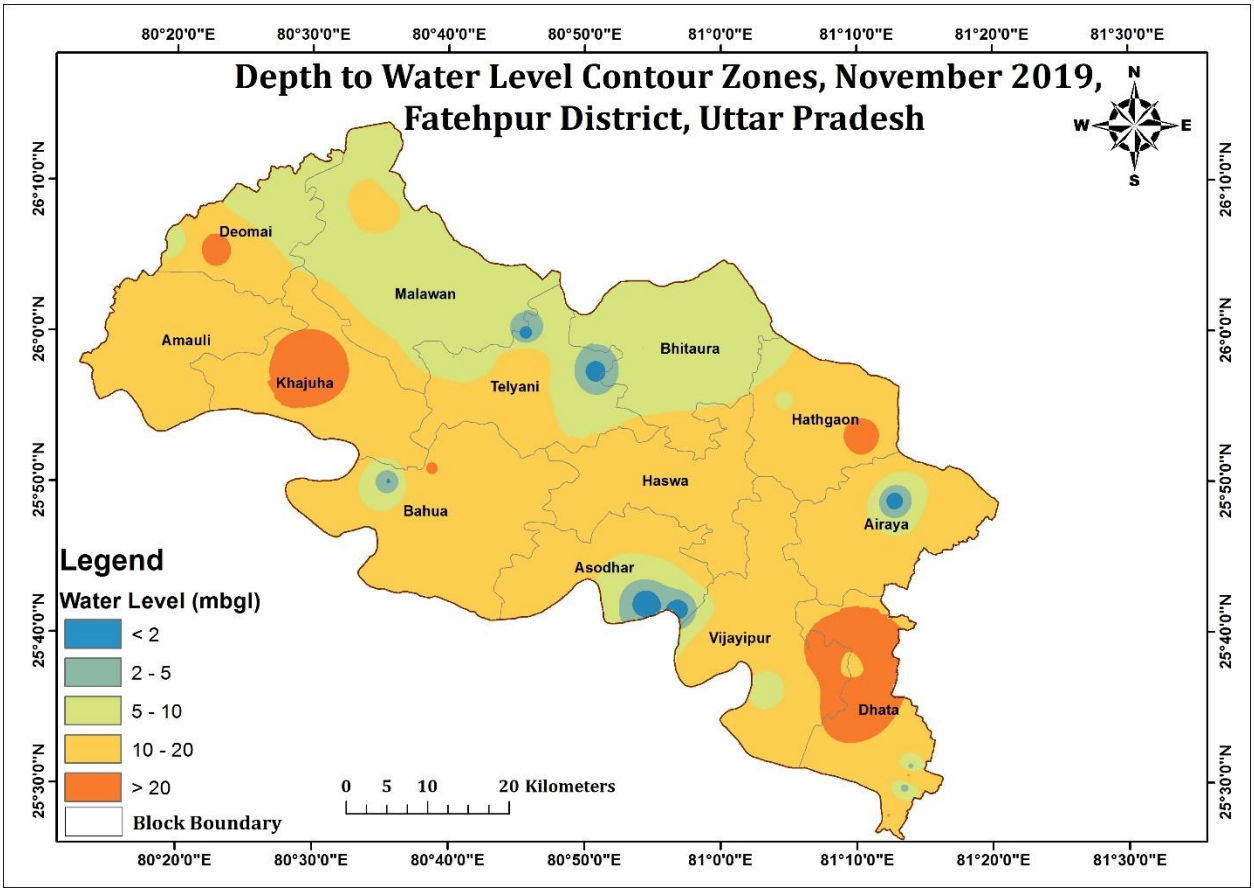


Fig 2.3: Depth to Water Level Post-monsoon Map of Fatehpur District, UP

2.1.2.3 Water Level Fluctuation

Maximum water level fluctuation is showing in the northeastern and south-western part of the study area, while in the central and northern-central part has the lowest fluctuation. In whole the study area, water level declining is taking place from the 2 meter to 7 meter.

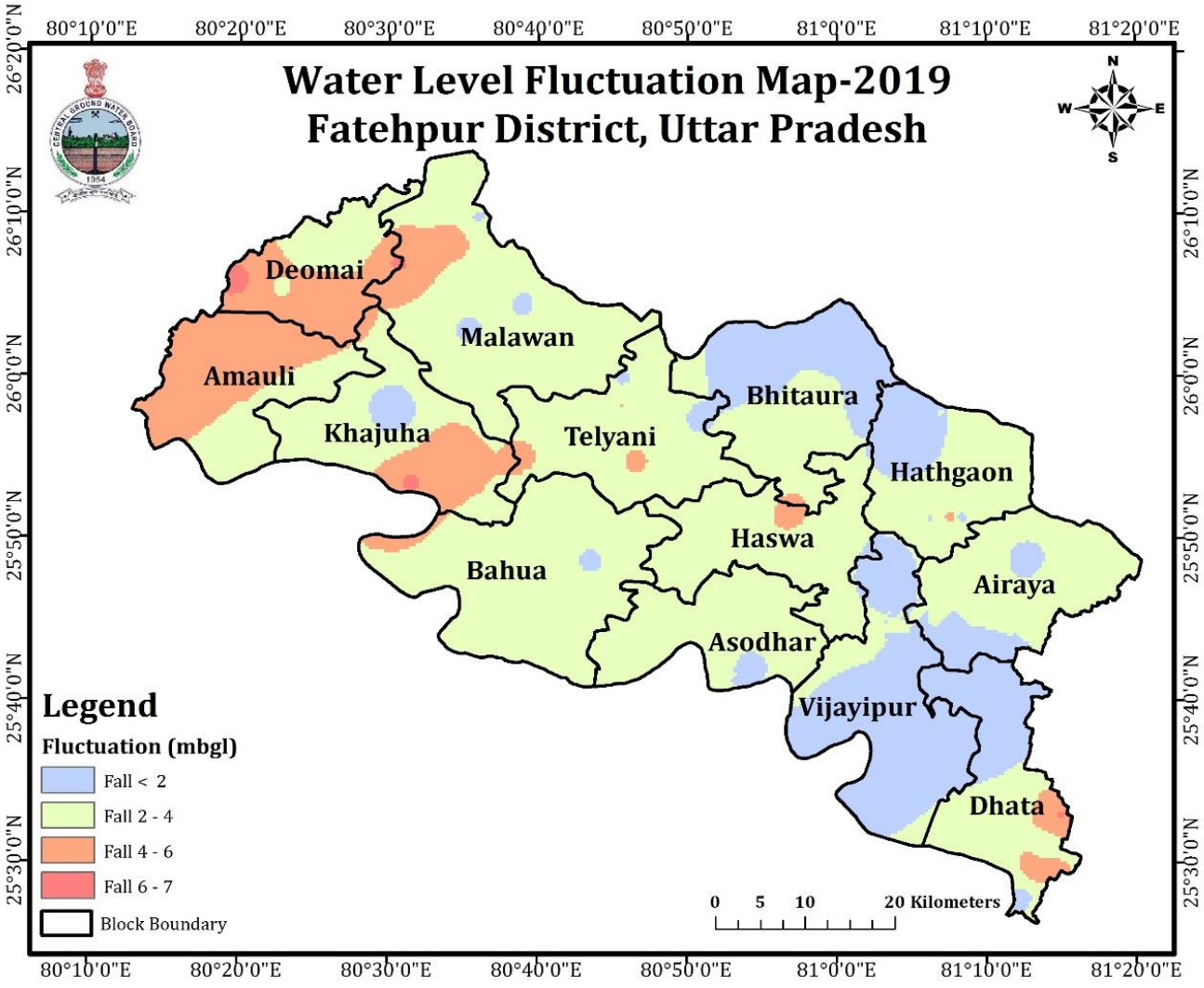


Fig 2.4: Depth to Water Level Fluctuation Map (Pre-Post) of Fatehpur

2.1.3 Long-term Trend of Water Level:

Long term trend of water level has been monitored for ten year period 2010 to 201 9 from 13 wells.

A perusal of the table show that there is a rising trend of 0.176 to 0.840 m/year and the falling trend is 0.050 to 1.916 m/year during the pre-monsoon period while in the post-monsoon period there is a rising trend of 0.111 to 0.794 m/year and the falling trend is 0.032 to 0.988 m/year as shown in table 2.

Table 2.3: Trend of Water Level – All From Year 2010-2019

Location	Pre Monsoon		Post Monsoon		Annual	
	Rise (m/year)	Fall (m/year)	Rise (m/year)	Fall (m/year)	Rise (m/year)	Fall (m/year)
Jahanabad				0.813		0.867
Bindki1	0.7956		0.7944		0.8262	
Fatehpur2	0.8409					
Umradipur		0.0502	0.1115			0.1115
Bela		0.1351		0.1037		0.1056
Sarain bakewar		0.191		0.2816		0.2854
Ramapur	0.6897					
Musfha		0.6972		0.3522		0.4369
Naubasta				0.1661	0.0637	
Barwa		1.916		0.9887		1.2666
Bahua				0.346		0.3766
Lalauli	0.1767		.3361		0.1818	
Asother		0.0934		0.0327		0.0569

2.2 AQUIFER PARAMETERS

There are 42 wells are there in the Fatehpur district which were explored till now as shown in table 2.4. In which, 27 exploratory wells, 12 Observatory wells, two sink holes and one piezometer are there and other details are given below:

No of wells drilled (EW, OW, PZ, SH, Total) : EW-27, OW-12, PZ-01, SH-02

Depth range (m) : 78 - 251

Discharge (litres per second) : 715-2728lpm

Storativity (S) (Saigaon EW) : 9.6×10^{-5}

Transmissivity (m^2/day) (Saigaon EW) : 1267-6338 m^2/day

Table 2.4: Exploration data of Fatehpur District

S.No.	Block/ Taluka	Location	Type of Well	Depth Drilled (m bgl)	Zones tapped (mbgl)	S.W.L (m.bgl)	Discharge (lpm)
1	Asothar	Asothar	EW	205	62-68, 82-91, 94-100	17.29	2256
2	Bithora	Basohani(200m)	EW	300	72-84, 104-116	14.66	2165
3	Bithora	Basohani(300)	EW	300	180-190, 204-210, 213-219	22.55	2165
4	Amauli	Dapsaura	EW	205	77-89, 95-104, 131-137	27.75	2347
5	Dhata	Dhata	EW	110	56-65, 68-80	28.18	2256
6	Teliani	Govt. ITI College	EW	280		25.58	2619
7	Asothar	Mahakhera	EW	170	70-76, 86-98, 101-107	24.78	2301
8	Haswa	Murav	EW	205	100-112, 115-118, 185-162	23.97	2165
9	Devmai	Parsadepur	EW	305	188-197, 211-220, 230-236	23.57	2074
10	Hathgaon	Sanvat	EW	305	104-110, 118-127, 157-163	24.95	2256
11	Airayan	Mahammadpur Gaunti	EW	305	218-222, 230-238, 241-251	23.57	715
12	Malwan	Umargahna	EW	260	175-187, 193-199, 210-220	23.57	2074
13	Asothar	Asothar	OW	123	62-68, 83-89, 94-100	17.15	2256

14	Bithora	Basohani(200m)	OW	118	73-82, 105-114	14.42	2165
15	Bithora	Basohani(300)	OW	254	184-190, 204-210, 213-219	21.8	2165
16	Amauli	Dapsaura	OW	141	78-87, 97-103, 131-137	27.65	2347
17	Dhata	Dhata	OW	82	58-64, 69-78	27.6	2256
18	Teliani	Govt. ITI College	OW	194	149-158, 181-190	25.52	2619
19	Asothar	Mahakhera	OW	111	70-76, 88-97, 101-107	24.31	2301
20	Haswa	Murav	OW	183	104-110, 115-118, 159-162	23.33	2165
21	Devmai	Parsadepur	OW	240	190-196, 212-218, 230-236	23.43	2074
22	Hathgaon	Sanvat	OW	179	104-110, 119-125, 157-163	24.55	2256
23	Airayan	Mahammadpur Gaunti	OW	254	218-222, 230-238,	23.43	715
24	Malwan	Umargahna	OW	223	176-185, 193-199, 211-217	23.43	2074
25		ALAMPUR	EW	323.65	132.00-144.00, 165.00-174.00, 200.00-209.00, 212.00-224.00	10.84	2104 (PYT)
26		AMOLI 26°00'36" 80°18'45" 63B/8	PZ	241.7	134-140 143-146 150-153 156-159 163-169	20.56	1835 (Compressor)

27		ARAIYA MUSHAYAK 25°49'24" 81°11'42"	EW	335.17 314.0 GR	56-62 122-128 130-136 145-151 169-175 193-205	-	-
28		HASAUPUR	EW	332.3	184.00-193.00, 203.00-215.00, 224.00-230.00, 233.00-239.00	7.15	2104
29		JAHANPUR MAJRE DIGH 25°56'40" 80°37'15" 63C/9	EW	260.76 113	59-71, 85-91, 98.00-107.00	9.07	2728
30		KURAIN	SH	282.15 282.15			-
31		SAIGAON 26°07'55" 80°30'35" 63C/9	EW	384.2 384.2 QTZ	197-209 215-221 224-233 236-245	11.37	2437
32		SLMI GAREWA 25°43'39" 81°03'15"	EW	191.88	46-52 55-59 80-86 94-102 114-126	-	-
33		SUKETI	SH				
34		SULTANGARH	EW	243 118	63-75 81-93 99-105 108-114	-	-

35		JAHANABAD	EW	209.15 185	100.00-120.00, 150.00-165.00, 168.00-180.00	18	1800
36		BINDKI	EW	195.6 195	119.00-135.00, 155.00-165.00, 170.00-190.00	11	1457
37		AMOULI	EW	181.5 175	98.00-110.00, 130.00-148.00, 153.00-165.00	16	1000
38		NAGAR PALIKA	EW	188.05 173.17	114.00-128.00, 140.00-168.00	12.69	2403
39		KHAGA	EW	182.98 150	92.00-104.00, 108.00-120.00, 124.00-140.00	11.5	2403
40		LALAULI	EW	146.3 112.17	70.00-86.00, 90.00-106.00	16.29	2403
41		SAIGAON	EW	253 248	200-221 226-232 239-245	13.47	500 By compressor
42		BAHUA	EW	200 180	140, 174	17.56	1500

These are the exploratory wells which are constructed during the 'NAQUIM' project as shown in figure 2.5.

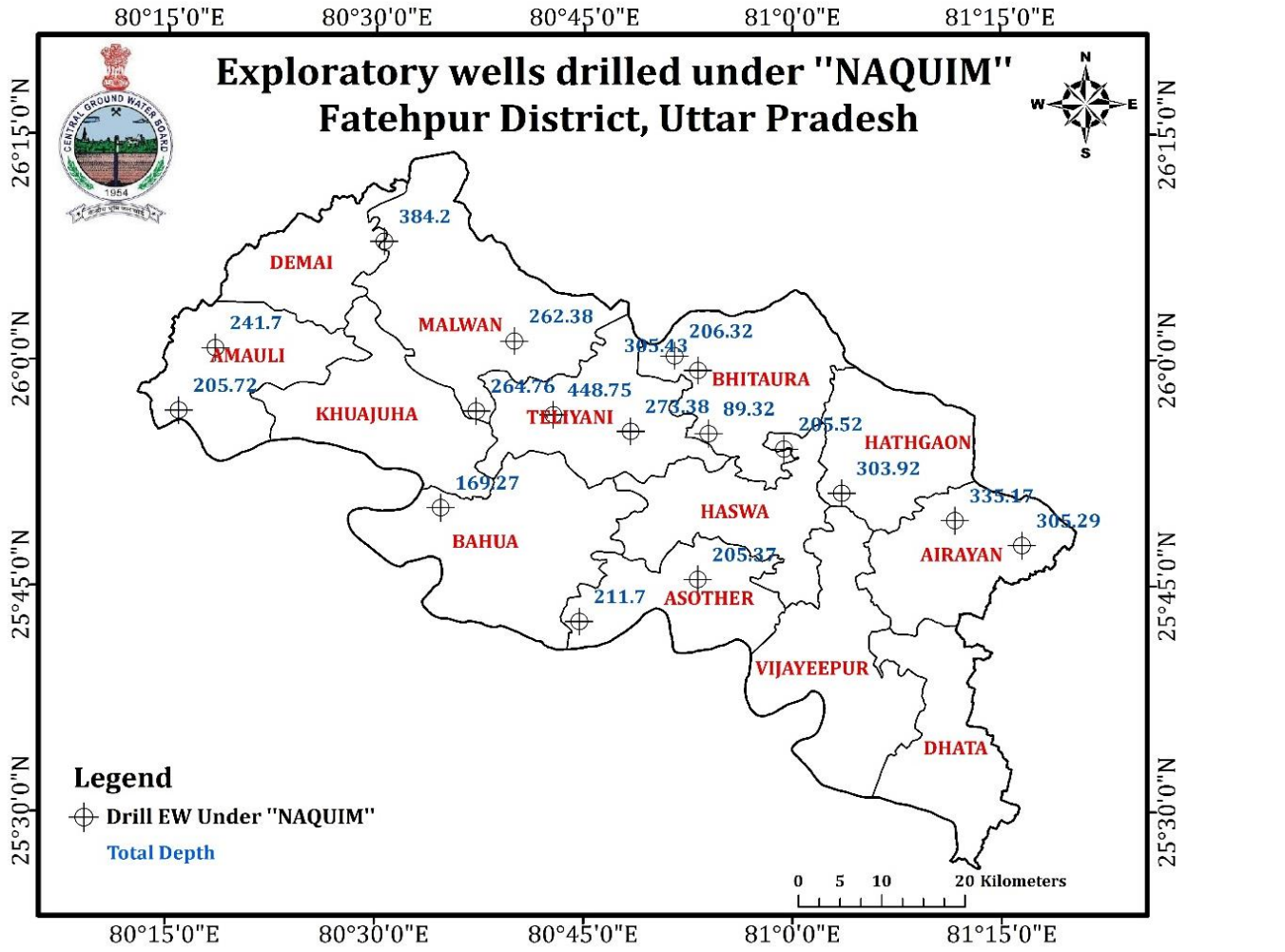


Fig 2.5: Exploratory wells, constructed under the 'NAQUIM' project

2.2.1 AQUIFER MAP AND AQUIFER CHARACTERISTIC:

On the basis of Litholog of exploratory wells, three aquifer system have been identified on the basis of thickness and continuation of lithological materials. Some lithological materials having good water holding and percolation property such as sand, and sand mixed while some materials have good water holding property but not percolation properties such as clay or clay mix. So, on the basis of these properties there are three groups of aquifers into

the subsurface, which ranges down up to 205 mbgl; second aquifers depth range from 22.76 to 377mbgl and third aquifer ranges from 276 to 427mbgl. At the depth of 334, 247, 448, 273,162,258 the basement encountered at Airaya Mushayak, Jahanpur Majre Digh, Amoli, Damanpur, ITI Fatehur, Mahakherra and Umar Gahna locations respectively.

Lithologically, in all the parts of Fatehpur District clay is reported on the surface while at Ladheri sand is reported on the surface. After this varying depth of clay, the sand sediments lithology is being reported as shown in figure 2.6.

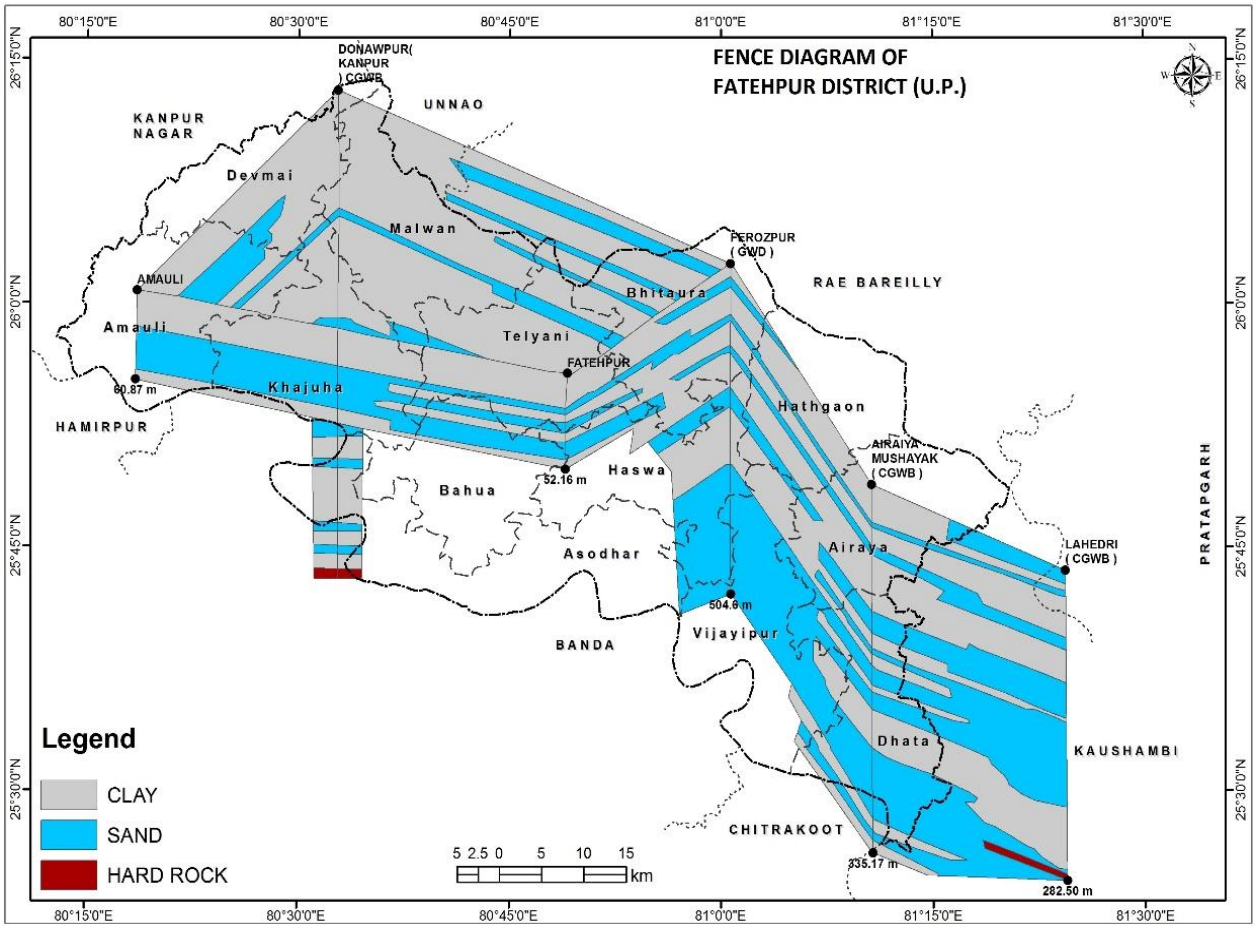


Fig 2.6 (a): Fence Diagram of Fatehpur District

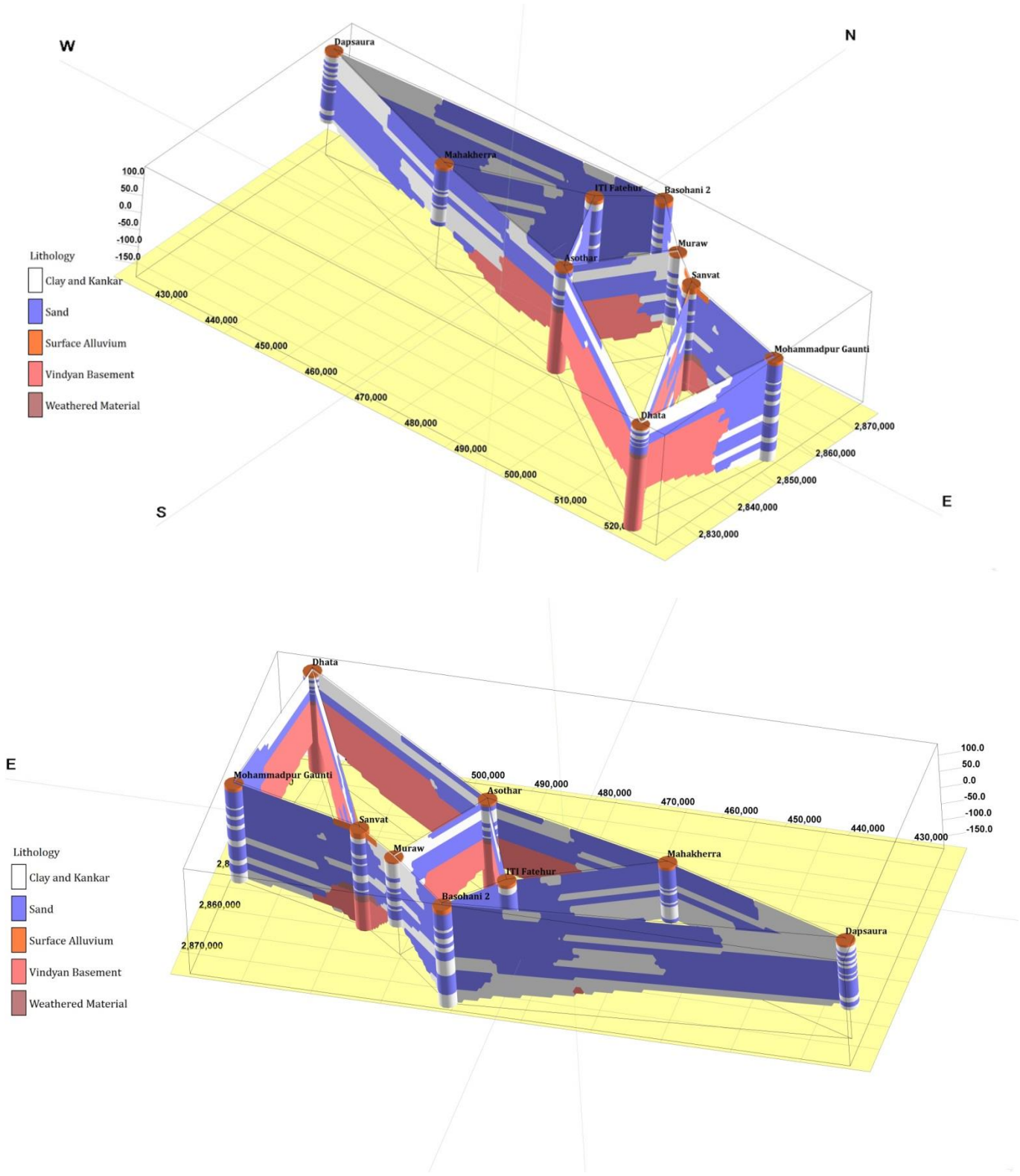


Fig 2.6 (b): Fence Diagram of Fatehpur District

Along the west to east cross section of Fatehpur district, firstly the clay type of lithology is being encountering after that a thin layer is reporting at the depth of 40mbgl and as shown in table 2.5; after that a very thick layer of sandy lithology is being encountering as shown in figure 2.7.

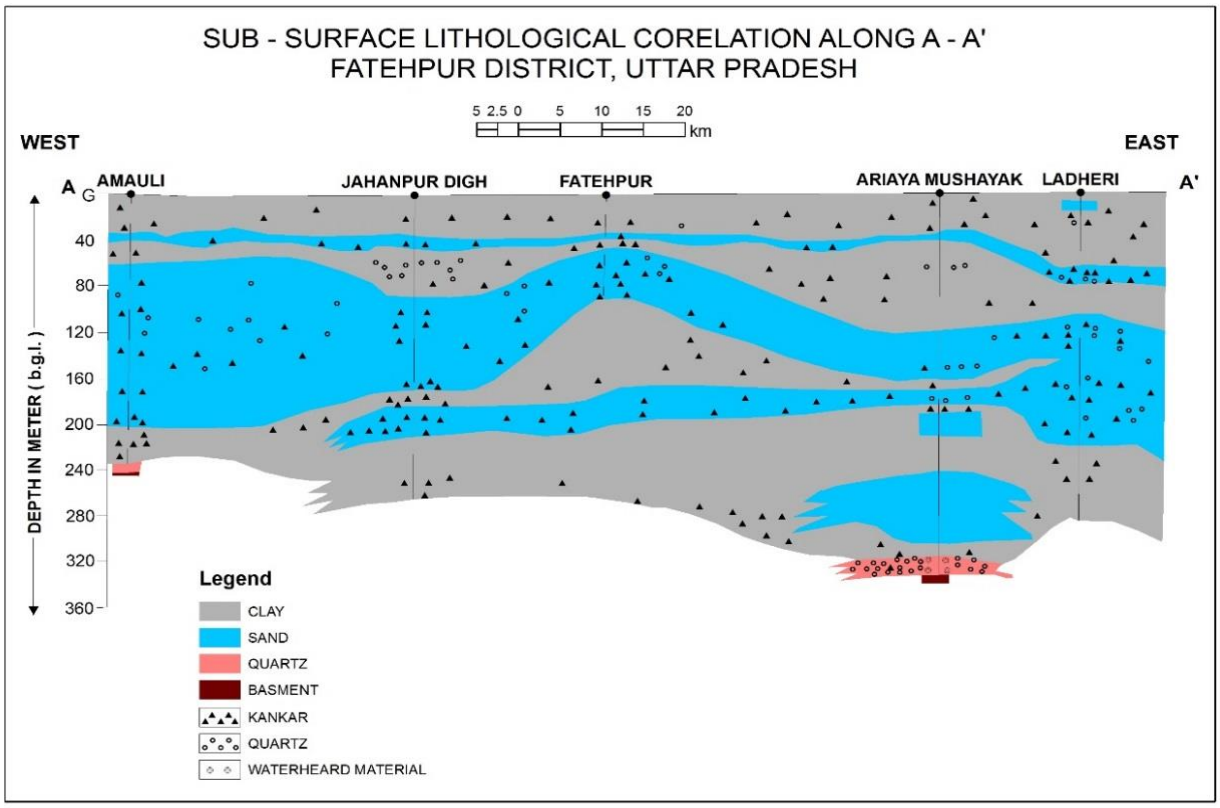


Fig 2.7: Sub-Surface Lithological Correlation along A-A of Fatehpur

3D Model were also prepaired by the grouping the water potential/ holding sediments, where 3 aquifer groups (Aquifer Group I, Aquifer Group II, and Aquifer Group III) has been classified with their respective impervious layers (Clay Horizon I, Clay Horizon II and Clay Horizon III) and after it overlain on Vindhyan Basement as shown in Figure 2.8 (a, b) and in figure 2.9 (a and b).

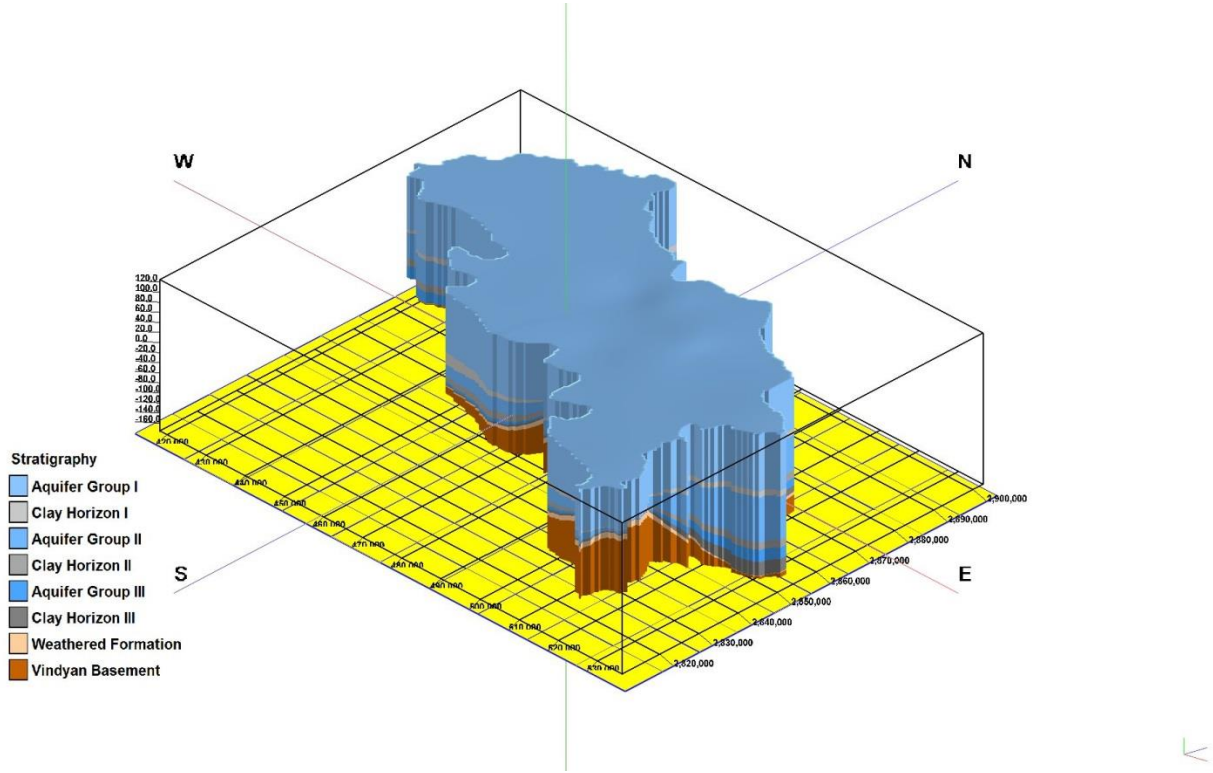


Fig 2.8 (a): 3D Aquifer Model of Fatehpur

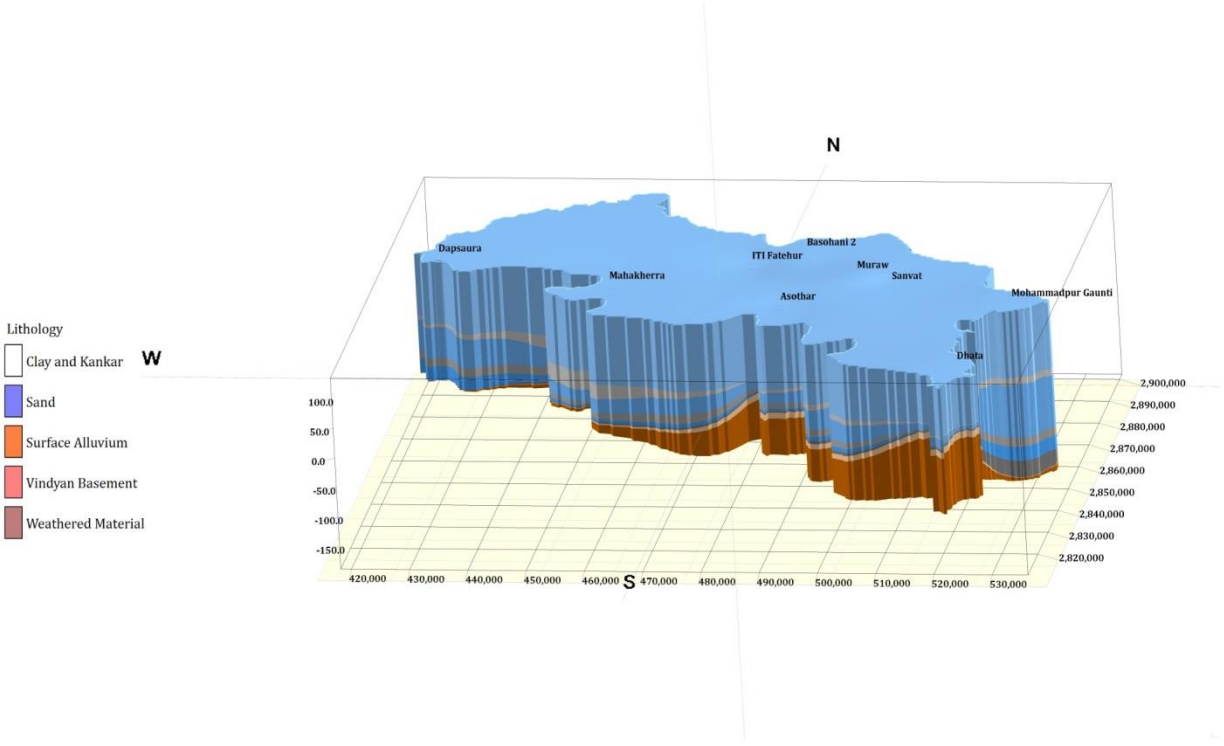


Fig 2.8 (b) : 3D Aquifer Model of Fatehpur

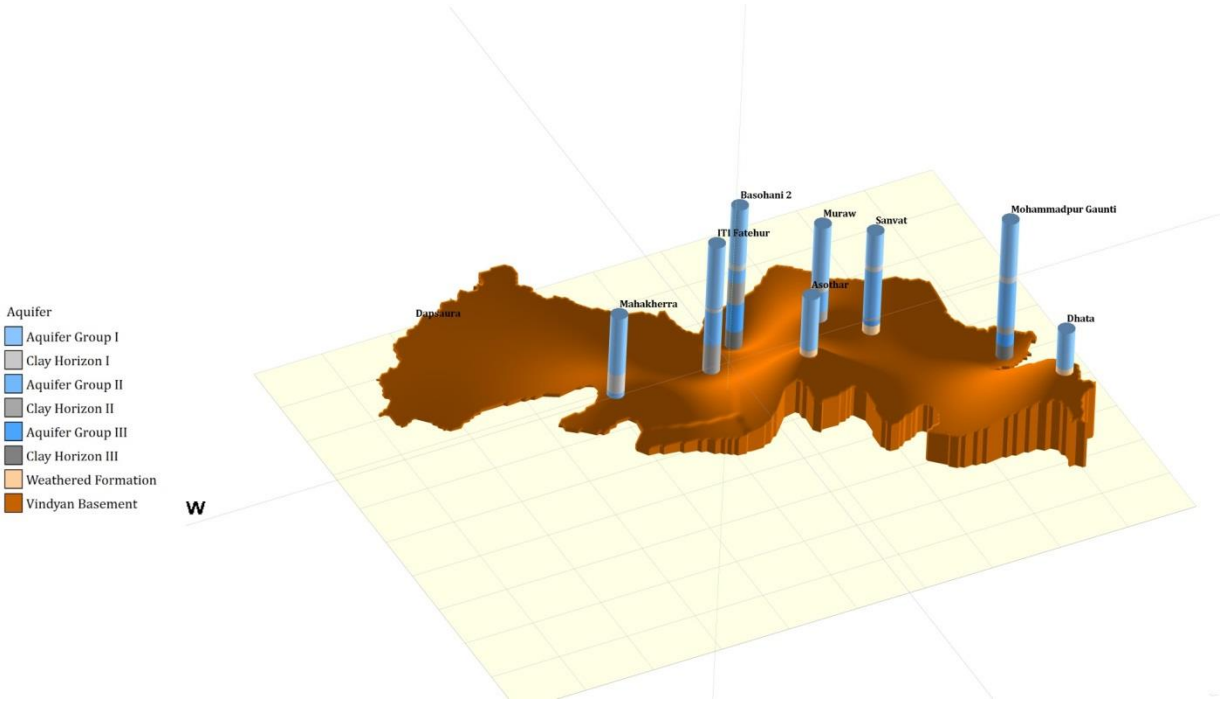


Fig 2.9 (a): 3D Basement Model of Fatehpur

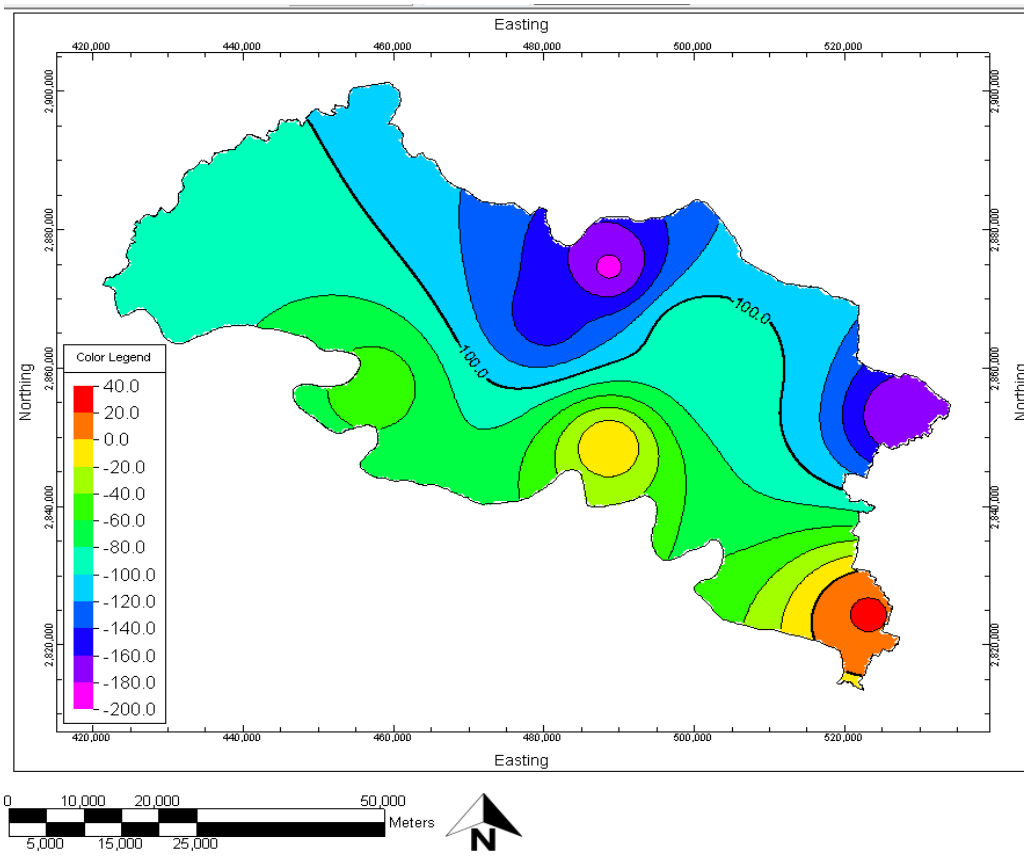


Fig 2.9 (b): Basement Map of Fatehpur

Along the north to south cross section of Fatehpur district, the thickness of clay type of lithology is increasing from north to south and it is underlain by the sand type of lithology. At the northern part of the district the basement depth is high in comparison to the southern part of the district as shown in figure 2.8 and table 2.5.

Table 2.5: Lithological Data of the Fatehpur District

Bore	From Depth	To Depth	Lithology
Asothar	0	7	Surface Alluvium
Asothar	7	20	Sand
Asothar	20	58	Clay and Kankar
Asothar	58	71	Sand
Asothar	71	82	Clay and Kankar
Asothar	82	99	Sand
Asothar	99	104	Clay and Kankar
Asothar	104	109	Sand
Asothar	109	122	Weathered Material
Asothar	122	300	Vindyan Basement
Basohani 2	0	15	Surface Alluvium
Basohani 2	15	62	Sand
Basohani 2	62	70	Clay and Kankar
Basohani 2	70	88	Sand
Basohani 2	88	104	Clay and Kankar
Basohani 2	104	116	Sand
Basohani 2	116	130	Clay and Kankar
Basohani 2	130	156	Sand
Basohani 2	156	162	Clay and Kankar
Basohani 2	162	202	Clay and Kankar
Basohani 2	202	260	Sand
Basohani 2	260	300	Clay and Kankar
Basohani 2	300	300	Weathered Material
Basohani 2	300	300	Weathered Material
Dapsaura	0	7	Surface Alluvium
Dapsaura	7	19.8	Clay and Kankar
Dapsaura	19.8	24	Clay and Kankar
Dapsaura	24	33	Sand
Dapsaura	33	40	Clay and Kankar
Dapsaura	40	50	Sand
Dapsaura	50	58	Clay and Kankar
Dapsaura	58	64	Sand
Dapsaura	64	72	Clay and Kankar

Dapsaura	72	90	Sand
Dapsaura	90	94	Clay and Kankar
Dapsaura	94	104	Sand
Dapsaura	104	110	Clay and Kankar
Dapsaura	110	162	Sand
Dapsaura	162	176	Clay and Kankar
Dapsaura	176	190	Sand
Dapsaura	190	200	Clay and Kankar
Dapsaura	200	200	Weathered Material
Dapsaura	200	200	Vindyan Basement
Dhata	0	5	Surface Alluvium
Dhata	5	13	Clay and Kankar
Dhata	13	21	Sand
Dhata	21	32	Clay and Kankar
Dhata	32	40	Sand
Dhata	40	43	Clay and Kankar
Dhata	43	53	Sand
Dhata	53	55	Clay and Kankar
Dhata	55	77	Sand
Dhata	77	89	Weathered Material
Dhata	89	300	Vindyan Basement
ITI Fatehur	0	10	Surface Alluvium
ITI Fatehur	10	29	Clay and Kankar
ITI Fatehur	29	91	Sand
ITI Fatehur	91	98	Clay and Kankar
ITI Fatehur	98	130	Sand
ITI Fatehur	130	139	Clay and Kankar
ITI Fatehur	139	208	Sand
ITI Fatehur	208	270	Clay and Kankar
ITI Fatehur	270	270	Weathered Material
ITI Fatehur	270	270	Vindyan Basement
Mahakherra	0	9	Surface Alluvium
Mahakherra	9	65	Sand
Mahakherra	65	70	Clay and Kankar
Mahakherra	70	76	Sand
Mahakherra	76	84	Clay and Kankar
Mahakherra	84	108	Sand
Mahakherra	108	113	Clay and Kankar
Mahakherra	113	120	Sand
Mahakherra	120	159	Clay and Kankar
Mahakherra	159	170	Sand

Mahakherra	170	170	Weathered Material
Mahakherra	170	170	Vindyan Basement
Mohammadpur Gaunti	0	10	Surface Alluvium
Mohammadpur Gaunti	10	60	Sand
Mohammadpur Gaunti	60	65	Clay and Kankar
Mohammadpur Gaunti	65	85	Sand
Mohammadpur Gaunti	85	95	Clay and Kankar
Mohammadpur Gaunti	95	114	Sand
Mohammadpur Gaunti	114	126	Clay and Kankar
Mohammadpur Gaunti	126	160	Sand
Mohammadpur Gaunti	160	178	Clay and Kankar
Mohammadpur Gaunti	178	220	Sand
Mohammadpur Gaunti	220	235	Clay and Kankar
Mohammadpur Gaunti	235	260	Sand
Mohammadpur Gaunti	260	290	Clay and Kankar
Mohammadpur Gaunti	290	290	Weathered Material
Mohammadpur Gaunti	290	290	Vindyan Basement
Muraw	0	5	Surface Alluvium
Muraw	5	50	Clay and Kankar
Muraw	50	62	Sand
Muraw	62	82	Clay and Kankar
Muraw	82	93	Sand
Muraw	93	98	Clay and Kankar
Muraw	98	120	Sand
Muraw	120	136	Clay and Kankar
Muraw	136	145	Sand
Muraw	145	150	Clay and Kankar
Muraw	150	178	Sand
Muraw	178	200	Clay and Kankar
Muraw	200	200	Weathered Material
Muraw	200	200	Vindyan Basement
Sanvat	0	17	Surface Alluvium
Sanvat	17	32	Clay and Kankar
Sanvat	32	67	Sand
Sanvat	67	78	Clay and Kankar
Sanvat	78	95	Sand
Sanvat	95	100	Clay and Kankar
Sanvat	100	130	Sand
Sanvat	130	152	Clay and Kankar
Sanvat	152	176	Sand
Sanvat	176	181	Clay and Kankar

Sanvat	181	192	Sand
Sanvat	192	212	Weathered Material
Sanvat	212	300	Vindyan Basement

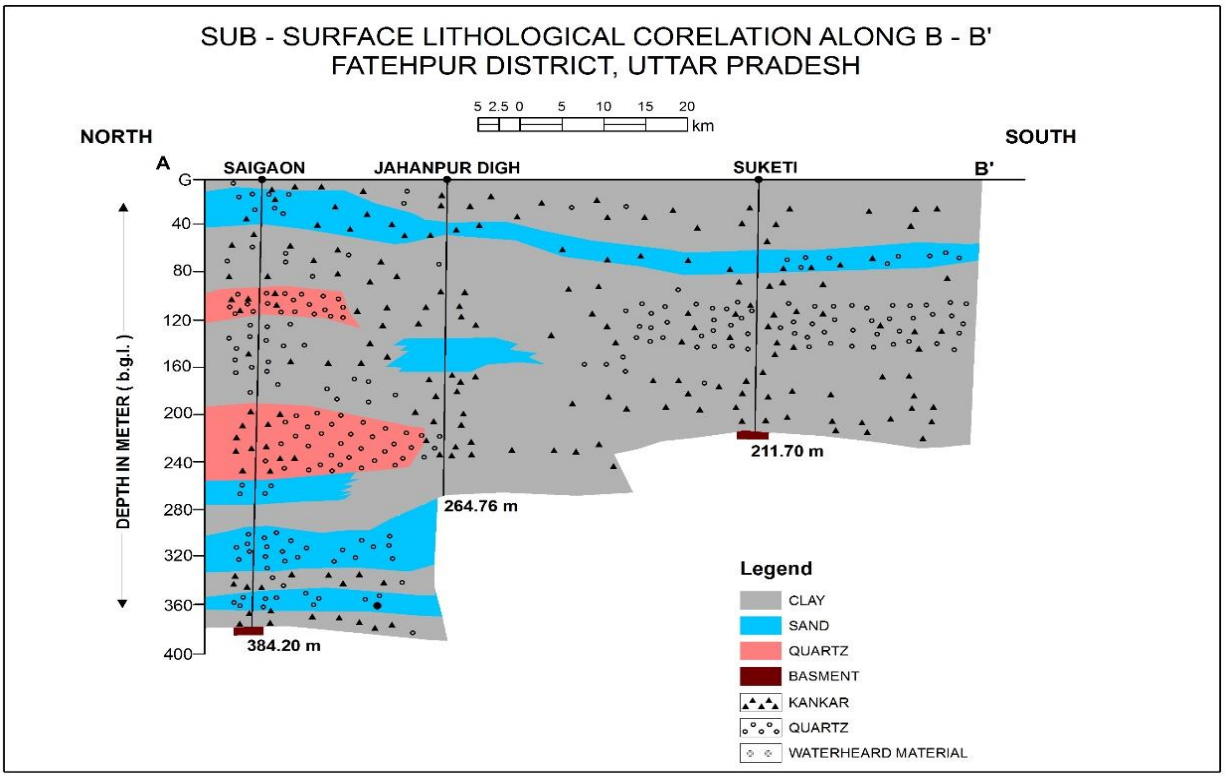


Fig 2.10: Sub-Surface Lithological Correlation along B-B of Amauli Block, Fatehpur

2.3 Water Quality

Ground water quality plays an important role in the development. The quality of ground water is an important as its quantity. The most extensive use of ground water is for irrigation of crops and a part of the potential is for domestic and industrial uses. With the advent of industrialization and inadequate attention paid to protect the environment degradation in water quality one of the challenges of modern time.

To study the chemical quality of ground water for domestic, irrigation and industrial uses representative ground water samples from 44 locations (4 samples from each block) were collected for basic analysis & from same locations were collected for trace element analysis. These samples represented the ground water from shallow aquifer.

All the samples were analyzed for basic constituents as per standard methods, for the determination of pH, EC, Bicarbonate, Chloride, Fluoride, Nitrate, Sulphate, Total Hardness, Calcium, Magnesium, Sodium, Potassium, Silicate, Iron, Manganese, Zinc, Arsenic, Uranium and Chromium.

2.3.1 pH VALUE:

pH is one of the most important parameter in water chemistry and is defined as log[H+]. The pH concentration determines the alkaline/acidic nature of water on a scale ranges from 0-14. The pH concentration determines the alkaline/acidic nature of water. The BIS, (10500- 2012) has indicated a maximum range of 6.5 to 8.5 but allows a range of 6.5 to 9.2 for domestic uses. In the study area, the pH range of 7.6 to 8.2 with average values of 7.91 as shown in table 2.6; which is quite safe and water is free from all corrosive & sealing action.

2.3.2 ELECTRICAL CONDUCTIVITY (EC):

Electrical conductivity is a measure of the total mineralization in water and thus indicates its degree of salinity. EC has been arrived at after dividing TDS values by a factor of 0.67. Thus EC values of the area indicate that conductivity in ground water generally varies from 449 to 1832 μ/cm at 25^0C. The maximum EC of 1832 micromhos/cm at 25^oC has been

observed in Malwan block with average values of 766 as shown in table 2.6;. Thus salinity of ground water is well within permissible limits.

2.3.3 TOTAL HARDNESS AS CACO3:

Hardness in water is caused by a variety of dissolved polyvalent metallic ions, predominantly calcium and magnesium cations. It is usually expressed as milligrams of calcium carbonate per liter. The degree of hardness of drinking water is important for aesthetic acceptability by consumers. Hardness is the property of water which prevents the lather (foam) formation with the soap and increased the boiling point of the water. Hardness is classified in four categories as soft water, hard water, moderately hard water and very hard water as given in table below.

WATER CLASS AS PER HARDNESS

HARDNESS (mg/l)	WATER CLASS
0-75	SOFT
75-150	MODERATELY HARD
150-300	HARD
> 300	VERY HARD

The BIS, (10500- 2012) shows desirable limit up to 300 mg/l maximum permissible limit of 600 mg/l. Higher concentration may cause urinary diseases of kidney, bladder and stomach disorder. Total hardness of the groundwater samples of the area varies between 150 and 400 mg/l. The average hardness of the analyzed samples was found as 257mg/l as shown in table 2.6. About12 samples (about 92.33%) fall in the **hard** category according to the hardness class while one sample from the Teliyani Block is in the category of Moderate Hard.

Table 2.6: Water Quality of Fatehpur District-2019

Block	pH	EC µS/cm at 25°C	HCO_3	Cl	F	NO_3	SO_4	TH	Ca	Mg	Na	K	SiO_2	Fe	Mn	Zn	As	U	Cr
			(mg/l)											(µg/l)					
Deomai	7.84	689	281	57	0.54	BDL	57	260	32	43	57	1.4	22	0.30	0.00	0.08	0.00	3.00	3.00
Khajuha	7.87	507	256	43	1.35	BDL	6	230	32	36	25	4.7	26	0.18	0.01	0.34	0.00	9.00	2.00
Amauli	7.79	719	232	64	2.1	43	53	290	40	46	41	4.4	35	0.03	0.00	0.02	0.00	10.00	2.00
Bahuwa	7.60	811	244	99	1.79	33	48	330	56	46	43	4.9	32	0.36	0.01	1.05	0.00	10.00	2.00
Asother	7.90	620	354	21	1.84	BDL	25	240	28	41	51	4.5	33	0.22	0.00	0.02	0.00	7.00	2.00
Dhata	8.00	609	268	71	0.73	BDL	48	300	48	43	31	7.4	25	0.06	0.00	0.07	0.00	12.00	6.00
Vijayeepur	7.80	491	244	21	0.43	13	25	240	32	38	17	2.8	30	0.12	0.00	0.17	1.00	7.00	5.00
Airayan	7.82	1199	329	156	0.60	37	53	400	36	74	81	11	35	0.00	0.15	0.24	0.00	19.00	2.00
Haswa	8.15	449	244	21	0.66	BDL	6	160	16	29	36	6.8	29	0.45	0.09	0.12	0.00	8.00	2.00
Hathgaon	7.72	613	305	28	0.73	16	23	270	36	43	17	20	28	0.63	0.02	0.55	0.00	16.00	3.00
Bhitaura	7.99	517	293	21	0.65	BDL	7	220	24	38	29	3.0	30	0.04	0.02	0.21	0.00	16.00	3.00
Teliyani	8.20	903	549	21	1.04	BDL	6	150	12	29	155	7.0	25	0.04	0.01	0.40	0.00	18.00	4.00
Malwan	8.15	1832	537	213	1.50	15	171	250	24	46	315	6.1	20	0.08	0.01	0.05	0.00	43.00	2.00

2.3.4 SODIUM & CHLORIDE:

The concentration of Sodium controls the taste of the water and its maximum permissible limit is 200 mg/l by BIS, (10500- 2012). The concentration of Sodium Varies from the 17 to 315 mg/l as shown in table 2.6; in the district while the average concentration of the district is 69 mg/l which is in the permissible limit as shown in figure 2.9.

The concentration of chloride (Cl) controls the taste of the water and its maximum permissible limit is 250 mg/l by BIS, (10500- 2012). However the permissible limit in the absence of alternate sources is relatable up to 1000 mg/l. The chloride concentration in water samples varies between 21 and 213 mg/l (Avg. 64 mg/l) as shown in figure 2.9. All the samples are below 250 mg/l, hence the quality of ground in the area with reference to chloride concentration is fit for human consumption.

2.3.5 NITRATE:

Nitrate and nitrite are highly soluble in water. Nitrate ($NO3^{-}$) is found naturally in the environment and is an important plant nutrient. Nitrate can reach both surface water and groundwater as a consequence of agricultural activity (including excess application of inorganic nitrogenous fertilizers and manures), from wastewater disposal and from oxidation of nitrogenous waste products in human and animal excreta, including septic tanks. According to the Indian Standard for drinking water (BIS 10500:2012), the maximum allowable nitrate concentration in drinking water is 45 mg/l as NO3& WHO standards (1963) indicates the maximum permissible limit of (NO3) nitrate is up to 45 mg/l, whereas 100 mg/l is the upper limit of concentration allowed by European drinking water standards (1970).

The nitrate concentration in water samples varies between below detection limit to 43 mg/l (Avg. 26 mg/l) as shown in table 2.6.

2.3.6 SULPHATE

Sulphate in drinking water can cause noticeable taste, and very high levels might cause a laxative effect in unaccustomed consumers. Taste impairment varies with the nature of the associated cation taste thresholds have been found to range from 250 mg/l for sodium sulphate to 1000 mg/l for calcium sulphate. High sulfate levelsin drinking water results in gastro-intestinal disorders, and hence, it is recommended that health authorities be notified of sources of drinking water that contain sulfate concentrations in excess of 500 mg/l (WHO, 2011). BIS (2012) has prescribed 200 mg/l as acceptable limit and 400 mg/l as permissible limit for sulphate in absence of alternate source for drinking and other domestic usage. The Sulphate concentration in water samples vary from 6 to 171 mg/l and hence well within permissible limit of 400 mg/l as shown in table 2.6. It shows that Sulphate concentration is well within permissible limit and is good for drinking as well as irrigational purposes.

2.3.7 FLUORIDE:

Fluoride is found in all natural waters at some concentration. Seawater typically contains about 1 mg/l while rivers and lakes generally exhibit concentrations of less than 0.5 mg/L. In groundwater, however, low or high concentrations of fluoride can occur, depending on the nature of the rocks and the occurrence of fluoride-bearing minerals. Fluoride occurs as fluorspar (fluoride), rock phosphate, florite, phosphorite minerals etc in nature. The WHO (2011) and BIS (10500- 2012) estimates the maximum allowable limit for fluoride uptake to human's in drinking water as 1.5 mg/L. Excess fluoride intake causes different types of fluorosis, primarily dental and skeletal fluorosis. White line striations followed by brown patches and, in severe cases, brittling of the enamel are common symptoms of dental fluorosis. Skeletal fluorosis first causes pain in the different joints, then limits joint movement and finally causes skeletal deformities, which become particularly acute if fluoride uptake occurs during growth. Since these ailments are incurable, fluorosis can only be mitigated by preventing intake of excess fluoride. Fluoride concentration in the area ranges from 0.43 to 2.1 mg/l as shown in table 2.6; which is well within desirable

limit. Only in Khajuha, Bahuwa and Asothar block's water sample has higher concentration than permissible limit as shown in figure 2.9.

2.3.8 CALCIUM & MAGNESIUM:

The dissolved solids like Calcium (Ca^{+2}) and Magnesium (Mg^{+}) in ground water are essential to human nutrition and beneficial to the heart and nervous system of human beings respectively.

But the deficiency of calcium may cause adverse physiological effects. Excess of Magnesium contributes to hardness of water. BIS, (10500- 2012) have laid down the acceptable/maximum permissible limits for Calcium and Magnesium in drinking water as 75/200 mg/l and 30/100 mg/l respectively. In the ground water samples the concentration of Calcium ranges between 12 and 56 mg/l, as shown in table 2.6; which is well within permissible limit.

The concentration of magnesium ranges from 29 to 74 mg/l as shown in table 2.6;. Overall the concentrations of Mg is within permissible limit in the area.

2.3.9 SILICA & PHOSPHATE:

The Silica concentration in water samples varies between 20 and 35 mg/l (Avg. 28 mg/l) as shown in table 2.6.

2.3.10 ARSENIC:

The permissible limit of arsenic in drinking water is 0.001mg/l as shown in table 2.6;.The arsenic concentration more than permissible limit in ground water causes mainly skin diseases and disorder in blood circulation system. The concentration of Arsenic has been found in water sample well within <5µg/l.

2.3.11 Heavy Metal:

The heavy metals (Manganese, Iron, Copper, Cadmium, Zinc, Lead, Silver) analysis shows that concentration of Iron and Manganese in ground are more than the permissible limit (>0.3 mg/l as per BIS). The high concentration of Iron and Manganeses in the water may be due to geogenic contamination.

In all the collected water samples from the district, the concentration of heavy metals are within the permissible limit while the concentration of Uranium is out of the permissible limit 0.043mg/l as shown in figure 2.9.

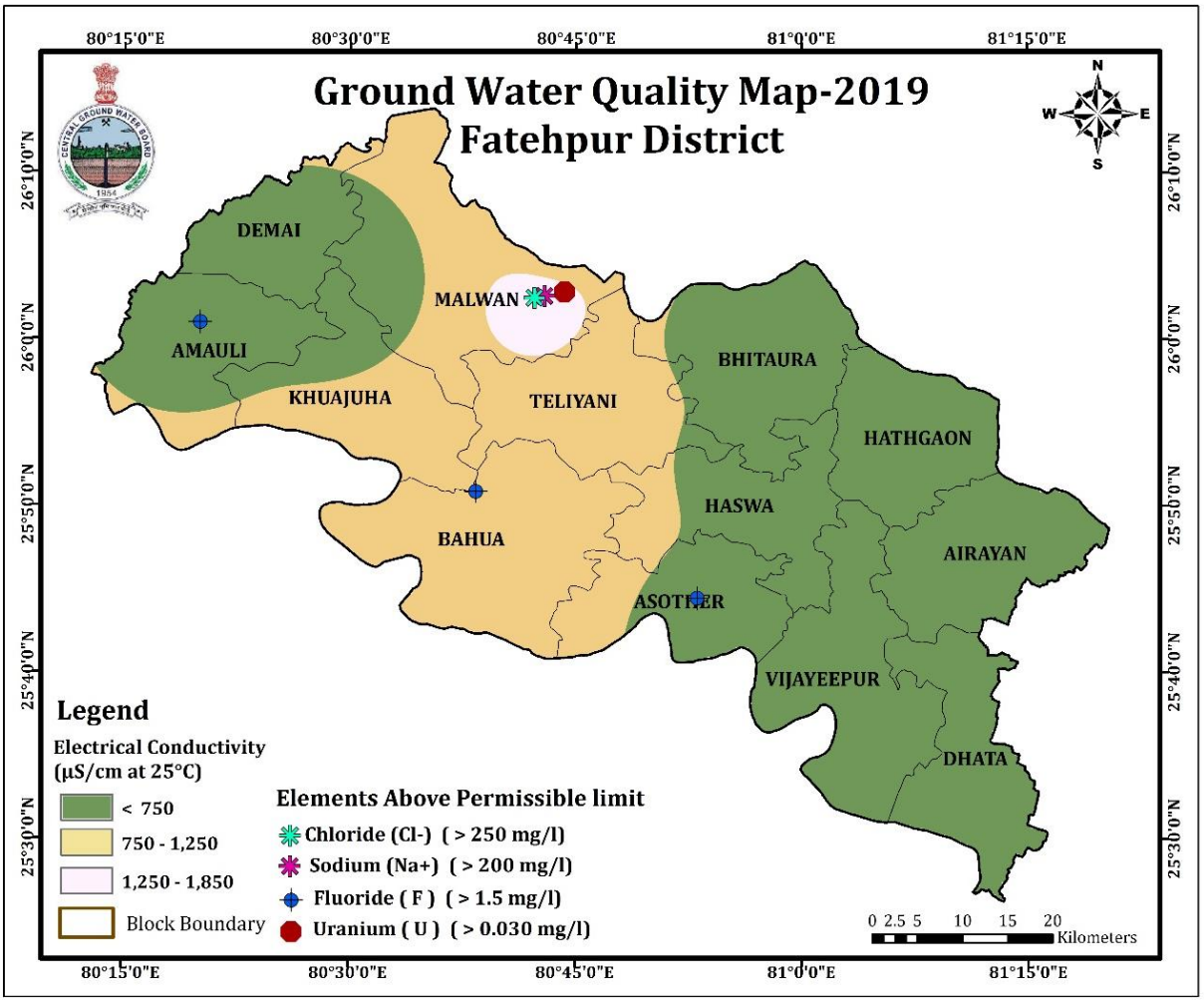


Figure 2.11: Water Quality of Fatehpur District

CHAPTER-3
GROUND WATER RESOURCES

Ground water resources have been computed jointly by Central Ground Water Board and Ground Water Department, Govt. of U.P. as on 31st March 2017 according to the methodology recommended by the Ground Water Estimation Committee constituted by Government of India (GEC 1997).

3.1 DYNAMIC GROUND WATER RESOURCES

Dynamic Ground Water Resource Estimation as on 31.3.2017 has been carried out with administrative blocks as ground water assessment units by GWD & CGWB. Due to lack of data on command, non-command and poor ground water quality areas, the resources could not be estimated separately and the administrative unit (block) as a whole without sub-dividing it into sub-units has been considered. The precise estimation of ground water reserves and irrigation potential is prerequisite for proper planning and execution for socio-economic development in the area. The ground water recharge has been estimated on the basis of water level fluctuation method which has been evaluated by significant change in water level during pre and post monsoon periods. Since the area is alluvium, the specific yield has been considered 16 % and of rainfall infiltration is 25 % for all blocks.

3.1.1 GROUND WATER DRAFT:

The ground water draft is the quantity of water withdrawn from ground water reservoirs. The principal ground water development structures for utilization of ground water in the district are open wells, dug cum borewells, private tubewells / government tubewells / government tubewells constructed under minor irrigation works and by other state government departments. On the basis of statistical data available on the number of various ground water structures, the block wise annual gross draft has been computed by multiplying its average discharge and annual working hours. The total draft from the

district is 104182.87 ham. From the Table 3.1, it is seen that maximum ground water drawl for all uses is 13783 ham in Bithaura block and minimum draft of ground water for all uses is 5122 ham in Asothar block.

3.1.2 Stage of Ground Water Development and Categorization of Blocks

The level of ground water development in Fatehpur district has been worked out for each block as the ratio of gross annual draft to net ground water availability.

$$\textbf{Level of Ground Water Development} = \frac{\textbf{Gross Annual Draft} * \textbf{100}}{\textbf{Net Ground Water Availability}}$$

The distributions of various categorized blocks are shown in the Figure3.1. One block namely Bithaura is in the Over-Exploited Category and one block Amauli is in the Critical Category. There are seven blocks are in Semi-critical as Airayan, Bahua, Dhata, Haswa, Hathgaon Malwan and Teliyani. Rest four blocks are in safe category as shown in the Figure3.1.

Table 3.1: Dynamic Ground Water Resource-2017 of Fatehpur District

S. No	Block	Net Annual Ground Water Availability (ham)	Existing Gross Ground Water Draft for Irrigation (ham)	Existing Gross Ground Water Draft for Domestic & Industrial Water Supply (ham)	Existing Gross Ground Water Draft for All Uses (ham)	Provision for Domestic and Industrial Requirement Supply for 2025 (ham)	Net Ground Water Availability for future Irrigation development	Stage of Development (%)	Category
1	Airayan	9660.23	6709.2	528.69	7237.89	612.02	2339.02	74.92	Semi-Critical
2	Amauli	9505.81	8812.1	405.47	9217.57	490.52	203.19	96.97	Critical
3	Asother	12340.24	4696	426.86	5122.86	489.83	7154.41	41.51	Safe
4	Bahua	10905	7334.8	451.23	7786.03	528.7	3041.51	71.4	Semi-Critical
5	Bhitaura	13169.82	13266.4	516.62	13783.02	516.62	0	104.66	Over Exploited
6	Deomai	10065.45	5552.8	392.25	5945.05	448.74	4063.92	59.06	Safe
7	Dhata	10670.8	7180	448.55	7628.55	534.49	2956.31	71.49	Semi-Critical
8	Haswa	11729.67	8291.6	501.15	8792.75	587.06	2851.01	74.96	Semi-Critical
9	Hathgaon	13661.43	9022.6	1000.71	10023.31	1208.13	3430.7	73.37	Semi-Critical
10	Khajuha	11260.73	5288	451.58	5739.58	529.29	5443.44	50.97	Safe
11	Malwan	14949.69	10297.4	634.85	10932.25	759.89	3892.4	73.13	Semi-Critical
12	Teliyani	8477.62	5780.2	368.83	6149.03	444.19	2253.22	72.53	Semi-Critical
13	Vijayeepur	12108.25	5336.4	488.58	5824.98	577.5	6194.35	48.11	Safe
Total		**148504.76**	**97567.5**	**6615.37**	**104182.87**	**7726.98**	**43210.28**	**70.15**	

Static water resources were also calculated for the Fatehpur District as shown in table 3.2.

Table 3.2: Static Ground Water Resource-2017 of Fatehpur District

Sl No	Block	Area (Hectare)	Avg. Pre-Monsoon DTW (mbgl)	Avg. Thickness of Aquifer Gr-I (m)	Thickness below WL (m)	Aquifer %	Thickness of Granular Zone below WL(m)	Static Resource (upto 50m Depth) in Ham	Static Resource (50m - bottom of Aquifer Gr-I) in Ham	Total Static Resource in Aquifer Group-I in Ham
1	Airayan	31731	15.45	103.55	88.10	66.57	58.65	36490.547	130.1	36620.6
2	Amauli	34161	16.39	106.77	90.38	50.13	45.31	28778.41	106.9	28885.3
3	Asother	41391	11.08	108.88	97.80	47.43	46.39	38203.388	132.9	38336.3
4	Bahua	27942	17.04	117.08	100.04	44.38	44.40	20436.287	168.9	20605.1
5	Bhitaura	34418	10.18	114.69	104.51	55.20	57.69	37826.483	141.3	37967.8
6	Deomai	23573	14.33	110.68	96.35	50.84	48.98	21374.379	123.6	21498.0
7	Dhata	28980	21.14	86.21	65.07	61.32	39.90	25642.883	74.0	25716.9
8	Haswa	32487	15.55	106.82	91.27	50.02	45.65	27990.621	29.4	28020.0
9	Hathgaon	27499	17.23	92.26	75.03	53.47	40.12	24092.038	124.3	24216.3
10	Khajuha	33048	19.27	115.06	95.79	43.71	41.87	22195.174	108.1	22303.3
11	Malwan	38675	11.68	115.45	103.77	53.74	55.77	39822.039	156.4	39978.5
12	Teliyani	23770	12.68	122.18	109.50	61.88	67.76	27446.763	122.1	27568.9
13	Vijayeepur	36111	16.32	95.78	79.46	55.00	43.70	33446.008	104.6	33550.6
	District Total	**413786**	**15.25**	**107.34**	**92.08**	**53.36**	**48.94**	**383745.02**	**1522.59**	**385267.61**

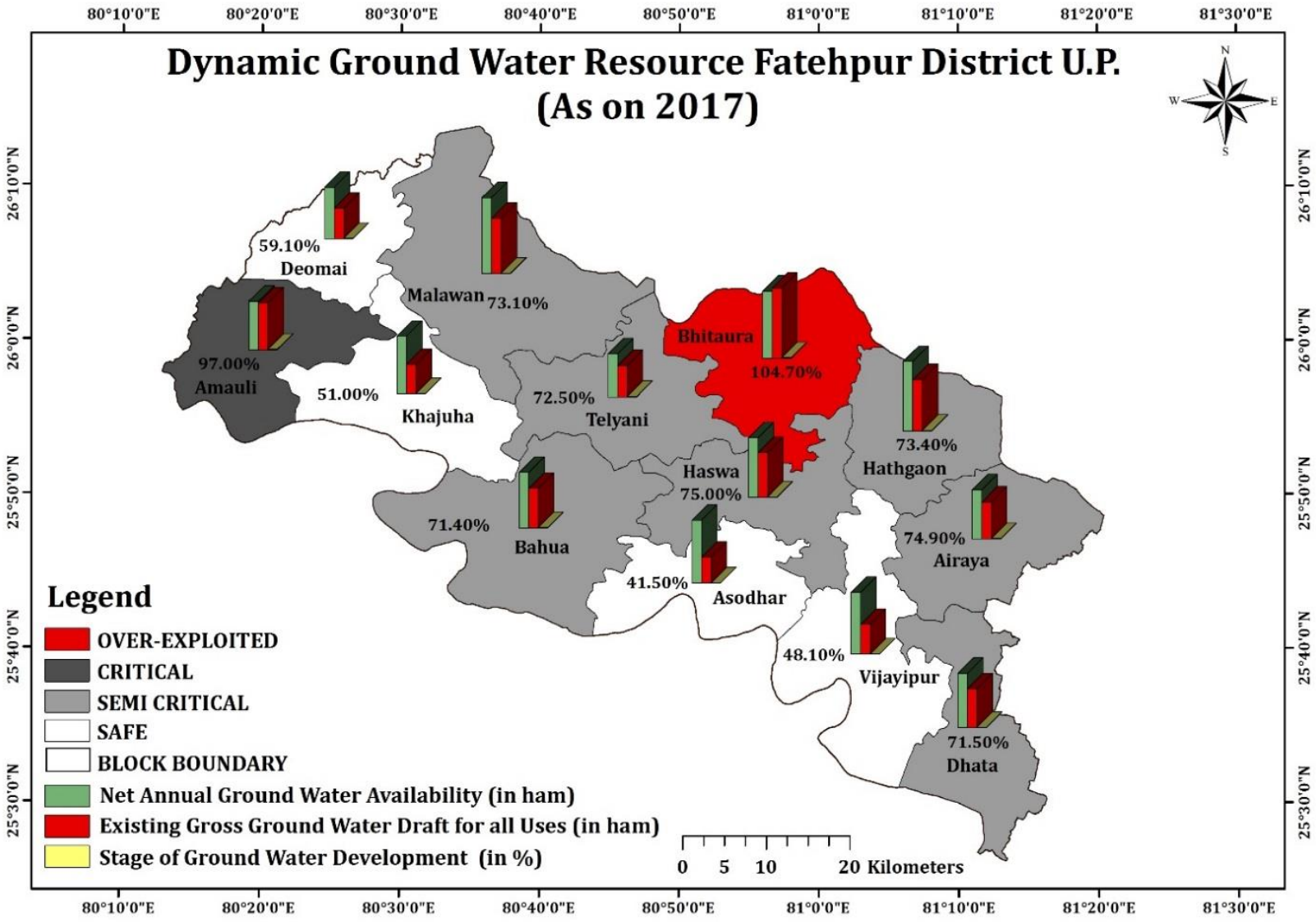


Figure 3.1: Dynamic Ground Water Resource-2017

CHAPTER-4
GROUND WATER RELATED ISSUES

The development of ground water is 70.15% in district. The trend analysis of historical ground water level data indicates long term fall in most of the wells in the district.

4.1 GROUND WATER RESOURCES

AREA OF INTENSIVE GROUND WATER DEVELOPMENT:

The stage of ground water development of the district is 70.15 %. One block namely Bithaura is in the Over-Exploited Category and one block Amauli is in the Critical Category. There are seven blocks are in Semi-critical as Airayan, Bahua, Dhata, Haswa, Hathgaon Malwan and Teliyani. Rest four blocks are in safe category as shown in the Figure3.1.

The block wise areas under agriculture activities vary from 77-88% with average of 93 % of area of the district. The over exploited block where ground water draft has increased many folds during past decades, is a biggest challenge because these are the blocks where in storage ground water resources is depleting very fast. There is a probability for adjacent block which may also be comes in water stressed category in future if proper effective intervention is not taken by stack holder. The change in climatic pattern is also exerting withdrawal pressure on groundwater resource creating imbalance in groundwater resources.

4.2 WATER TABLE DEPLETED AREA:

A perusal of the table show that there is a rising trend of 0.176 to 0.840 m/year and the falling trend is 0.050 to 1.916 m/year during the pre-monsoon period while in the post-monsoon period there is a rising trend of 0.111 to 0.794 m/year and the falling trend is 0.032 to 0.988 m/year as shown in table 2.

4.3 DEPENDENCY OF GROUND WATER IRRIGATION:

In the district, about 81% of the area irrigated by the ground water (as shown in figure 1.4 and table 1.6; 1.7) and rest out of 19 %, 18 % of the area irrigated by the canals. This much

of dependency on the ground water is leading the ground water stress. Amouli and Airayan blocks are using more than 99% of the ground water as shown in figure 1.5.

In the district no of ground water extraction sources have also increased very much. In some blocks it has been increased by up to 900% as in Bithaura, Amauli and Malwan block of the district as shown in figure 1.6.

4.4 GROUND WATER QUALITY ISSUES:

The Quality of Ground water in shallow Aquifer of Aquifer Group I, are good. However, Chloride, Sodium, Fluoride and Uranium concentration is high is in Malwan Block while Asothar and Mahua Block has aslo the high concentration of Flouride.

4.5 EFFICIENT IRRIGATION PRACTICES:

The flooding irrigation practices are in vogue. As per the prevailing flooding irrigation practices the actual water applied is more than the optimum crop water requirement. As per the prevailing flood irrigation practices the actual water applied is 100 to 200% more than the optimum crop water requirement. Proper and efficient irrigation practices and water saving techniques are not being adopted by the majority of farmers in the state for a variety of reasons. By adoption of micro irrigation practices such as sprinkler and drip irrigation method water can be saved between 30 to 40%. When properly maintained, application of water by drip irrigation can be as much as 60 percent efficient, which means there is very little loss due to evaporation, surface runoff or from percolation. Drip irrigation, wherever it has been implemented has dramatically increased crop yield by 20 to 40% higher than flood irrigation method. Consumption of fertilizers also gets reduced in such irrigation practices.

CHAPTER- 5

GROUND WATER DEVELOPMENT AND MANAGEMENT STRATEGIES

5.1 GROUND WATER DEVELOPMENT

The development of groundwater resources is increasing over the years in order to meet drinking water, industrial and irrigation requirements. The stage of ground water development had been changed to 84.03 % in 2004, 80.02 % in 2009, 82.13% in2011 and 84.28 in 2013. As on 31.03.2013, it shows that block wise level of development of ground water potential in Fatehpur district varies from 59% in Akrabad to 121% in 'Lodha' block. This increase in ground water utilization, for agriculture activity through adaptation of bore wells/tube wells, has increased the ground water. The area irrigated by Ground water is seen in Fig 5.1 since 1994-95. It is observed that it was 2,41,253 ha in 1994-95 and steadily increase to 2,78,196 ha in 2013-14.The Fig 5.2 shows block wise irrigation from 1994-95 to 2013-14. It is observed that it is has been steadily increased over the period. The number ground water structures are 43,909 in 1994-45, 48,283 in 1999-2000, 54,250 in 2004-5, 60,519 in 2009-10 and 65,695 2013-14. It is seen from Fig 5.3, in recent years the number of ground water structures is increased at slower rate, Keeping in view the level of ground water development, growing needs, there is an urgent need for scientific approach for proper management of the available ground water resources for sustainability of this precious natural resource without having any adverse effect on the environment. At those places where water level is gradually going down we should restrict or minimized the ground water for irrigation needs. Planned ground water development is possible only when the availability of the ground water potential is precisely quantified and also the demand for various uses is properly estimated for the projected development scenario of urban as well as rural area for next 25 years.

5.2 GROUND WATER MANAGEMENT STRATEGIES

Block wise management plan is prepared considering the present water level, water level trend category of the block and further prioritized the blocks for interventions (Table 5.1).

Two blocks namely Iglas and Chandaus are over exploited and declining trend of water level is recoded over the last ten years. Thus there is urgent need for taking up suitable water management interventions based on integrated approach, which on one hand includes augmentation of ground water resources through appropriate techniques, and on the other hand requires the adoption of suitable water conservation measures, such as ensuring water use efficiency through creation of additional water storage facility, maintenance/ renovation of existing water bodies etc. Water awareness and capacity building of the stakeholders are also the important attributes of water management interventions as envisaged in the National Water Policy.

5.3 GROUND WATER MANAGEMENT OPTIONS

Ground water issues can be addressed by focusing on measures to increase recharge and reducing the draft. It can be managed by a mix of measures such as:

5.3.1 Supply Side Management

- Water conservation and Artificial Recharge to ground water
- On Farm Activities

5.3.2 Demand Side Management

- Adoption of techniques to enhance water Use Efficiency
- Adoption of new irrigation practices in sugarcane cultivation area to save 35-40 % irrigation water

5.3.1 Supply Side Management

5.3.1.1 Water conservation and Artificial Recharge to ground water

Water conservation structures such as check dams, farm, ponds, and nala-bunds etc. result are the main artificial sources of ground water recharge. Maximum amount of rainfall runoff to the rivers and oceans only very few percentage of water, recharged to the ground water as it is calculated in the table 15.1 with the runoff factor of 10 percentage.

Table 5.1: Recharge through runoff to the subsurface in Fatehpur District

Sl. No.	Block	Total area (sq.km.)	Average Monsoon Rainfall (mm)	Runoff Generated During Monsoon (ham)	Runoff factor 10% (ham)	Non-committed Runoff (50 %) (ham)
1	Airayan	317.31	568.85	27075.27	2707.527	1353.763
2	Amauli	341.61	568.85	29148.73	2914.873	1457.436
3	Asother	413.91	568.85	35317.91	3531.791	1765.895
4	Bahua	279.42	568.85	23842.21	2384.221	1192.111
5	Bhitaura	344.18	568.85	29368.02	2936.802	1468.401
6	Deomai	235.73	568.85	20114.25	2011.425	1005.713
7	Dhata	289.8	568.85	24727.91	2472.791	1236.395
8	Haswa	324.87	568.85	27720.34	2772.034	1386.017
9	Hathgaon	274.99	568.85	23464.21	2346.421	1173.21
10	Khajuha	330.48	568.85	28199.03	2819.903	1409.952
11	Malwan	386.75	568.85	33000.41	3300.041	1650.021
12	Teliyani	237.7	568.85	20282.35	2028.235	1014.117
13	Vijayeepur	361.11	568.85	30812.61	3081.261	1540.631
	Total	**4137.86**		**353073.2**	**35307.32**	**17653.66**

There are some artificial recharge structures and some have been proposed block-wise, then total expected recharge to the ground water is about 472 ham by check dam and and 1497 ham by ponds in three times in a year to fill these structure as shown in table 5.2 and table 5.3.

Table 5.2: Proposed/Constructed Artificial Recharge from Check Dam, Fatehpur District

Sl. No.	Block	Check Dams of 45000 cum Capacity (1500m*10m*3m)	Unit Recharge consider 50% filling for 3 times (ham/year)	Expected Total Recharge (in ham)
1	Airayan	4	6.75	27
2	Amauli	10	6.75	67.5
3	Asother	2	6.75	13.5
4	Bahua	4	6.75	27
5	Bhitaura	4	6.75	27
6	Deomai	4	6.75	27
7	Dhata	12	6.75	81
8	Haswa	7	6.75	47.25
9	Hathgaon	4	6.75	27
10	Khajuha	4	6.75	27
11	Malwan	8	6.75	54
12	Teliyani	4	6.75	27
13	Vijayeepur	3	6.75	20.25
	Total	**70**		**472.5**

Table 5.3: Proposed/Constructed Artificial Recharge from Ponds, Fatehpur District

Sl. No.	Block	Construction of new ponds / renovation of old ponds (100mx100mx3m)	Unit Recharge considered 17% filling for 3 times (ham/year)	Expected Total Recharge (in ham)
1	Airayan	65	1.53	99.45
2	Amauli	47	1.53	71.91
3	Asother	40	1.53	61.2
4	Bahua	102	1.53	156.06
5	Bhitaura	100	1.53	153
6	Deomai	40	1.53	61.2
7	Dhata	105	1.53	160.65
8	Haswa	75	1.53	114.75
9	Hathgaon	60	1.53	91.8
10	Khajuha	40	1.53	61.2
11	Malwan	140	1.53	214.2
12	Teliyani	125	1.53	191.25
13	Vijayeepur	40	1.53	61.2
	Total	**979**		**1497.87**

The existing ponds and tanks lose their storage capacity as well as the natural ground water recharge due to siltation and encroachment by farmers for agriculture purposes. Through de-siltation, and removal of encroachments, the village tanks can also be converted into recharge structure.

5.3.1.2: On Farm Practices

Leveling of crop field is essential for uniform distribution of water. Laser leveling has been found very effective ensuring saving of 10 to 30% of applied irrigation as calculated in table 5.4.

The in-situ farm activities such as contour bunding, land leveling, bench terracing, water harvesting structures, afforestation and diversification of cropping pattern are other measures to increase recharge in the block.

Table 5.4: Artificial Recharge from On-Farm Activities, Fatehpur District

Sl. No.	Block	Net Sown Area (ha)	On-farm Activities (Area in ha) 30%=OE & 25%=Critical 20%=Semi-critical 10%=Safe of Net Area	Current Annual Ground Water Extraction (Ham) Irrigation Use	Unit Draft (ham/ha)	Total Draft (ham)	Saving 30%
1	Airayan	18382	3676.40	6709.2	0.36	1341.84	402.55
2	Amauli	27254	6813.50	8812.1	0.32	2203.03	660.91
3	Asother	26632	2663.20	4696	0.18	469.60	140.88
4	Bahua	18895	3779.00	7334.8	0.39	1466.96	440.09
5	Bhitaura	22443	6732.90	13266.4	0.59	3979.92	1193.98
6	Deomai	17669	1766.90	5552.8	0.31	555.28	166.58
7	Dhata	20523	4104.60	7180	0.35	1436.00	430.80
8	Haswa	22185	4437.00	8291.6	0.37	1658.32	497.50
9	Hathgaon	19571	3914.20	9022.6	0.46	1804.52	541.36
10	Khajuha	24542	2454.20	5288	0.22	528.80	158.64
11	Malwan	24140	4828.00	10297.4	0.43	2059.48	617.84
12	Teliyani	16452	3290.40	5780.2	0.35	1156.04	346.81
13	Vijayeepur	26195	2619.50	5336.4	0.20	533.64	160.09
	Total	**284883**	**51079.80**	**97567.5**	**0.35**	**19193.43**	**5758.03**

5.3.3 Demand Side Management

5.3.2.1 Enhancing Water Use Efficiency

Efficient irrigation

- In flood/furrow irrigation method more than 50% of applied water is wasted through seepage to deeper level, localized inundation causes loss through evaporation and it leaches out the nutrients from the plant.
- Adoption of new irrigation practices in sugarcane cultivation area to save 35-40 % irrigation water
- Agriculture department should promote to conserve the soil moisture by reducing ET losses through cultivation of 'Green Manure'
- While through drip & sprinkler irrigation wastage of irrigational water could be minimized. The conveyance losses (mainly seepage & evaporation) can be saved upto 25 to 40% through utilization of HDPE pipes as shown in table 5.4.

Table 5.5 Saving from WUE Activities, Fatehpur District

S. No.	Water Use Efficiency Measures (Drip & Sprinkler + HDPE Pipes) (Area in ha) 10% of agriculture land						
	Block	Area in ha	Current Annual Ground Water Extraction (Ham) Irrigation Use	Unit Draft (ham/ha)	WUE Activities (Area in ha) 30%=OE 20%=Critical 10%=Safe & Semi-critical of Net Area	Total Draft (ham)	Saving 30%
1	Airayan	18382	6709.2	0.36	3676.40	1341.84	402.55
2	Amauli	27254	8812.1	0.32	6813.50	2203.03	660.91
3	Asother	26632	4696	0.18	2663.20	469.60	140.88
4	Bahua	18895	7334.8	0.39	3779.00	1466.96	440.09
5	Bhitaura	22443	13266.4	0.59	6732.90	3979.92	1193.98
6	Deomai	17669	5552.8	0.31	1766.90	555.28	166.58
7	Dhata	20523	7180	0.35	4104.60	1436.00	430.80
8	Haswa	22185	8291.6	0.37	4437.00	1658.32	497.50
9	Hathgaon	19571	9022.6	0.46	3914.20	1804.52	541.36
10	Khajuha	24542	5288	0.22	2454.20	528.80	158.64
11	Malwan	24140	10297.4	0.43	4828.00	2059.48	617.84
12	Teliyani	16452	5780.2	0.35	3290.40	1156.04	346.81
13	Vijayeepur	26195	5336.4	0.20	2619.50	533.64	160.09
	Total	**284883**	**97567.5**	**0.35**	**51079.80**	**19193.43**	**5758.03**

Diversification of cropping pattern

- Horticulture department should promote Baghwani in the area. This will bring in money without high use of water. These will also help conserve soil moisture.
- Alternate cropping system having lower requirement of water are better option.
- Summer paddy and maize need to be avoided which are grown over substantial area in the block.
- Large scale adoption of rice-wheat rotation system is the main reason of over exploitation of groundwater. Late sown wheat/peas are replaced by spring maize which consumes more water. Suggested cropping pattern are as under.
- **Kharif-** Maize, cotton, sorghum, pulses, groundnut
- **Rabi-** Mustard, gram, pulses, vegetable
- By adopting suggested cropping pattern 20 to 30% of irrigation water saving is possible

5.3.2.2 Agricultural Practices for Saving Irrigation Water in Sugarcane Cultivation

Irrigation Scheduling At Critical Growth Stages of Sugarcane

The initial crop growth stages coincide with hot summer due to which crop requires frequent irrigations. Experimental results have indicated that sugar cane has certain growth stages in its entire crop cycle on which if the crop is not irrigated growth and yields are affected adversely. These stages have been termed **Critical Stages**. Ensuring irrigation at its critical growth stages improves water use efficiency without any loss of yield.

Advantages

- Water Use Efficiency is increased by 35-40%.
- Water saving: Irrigation water is saved up to 30-40 %
- Normal Cane Yield and Quality is obtained.
- Weed infestation is reduced considerably.

Ring Pit Method of Sugarcane Planting

Sugarcane crop comprise mother shoots & tillers. Since tillers start emerging about 45-60 days after emergence of mother shoots, so these are comparatively weak and result in milliable cane of lesser length, girth & weight. Therefore to accommodate more numbers of mother shoots in the same space, tillers of sugarcane need to be suppressed. To achieve this more number of sets are planted in circular pits at relatively greater depths. Thus mother shoots at large are allowed to grow with very less or no tillers. That is why this technology is also called "No Tiller Technology"

Advantages

- **Higher Input Use Efficiency:** Water Use Efficiency is increased by 30-40%& nutrient use efficiency by 30-35 % due to their localized application in pits only.
- **Water saving:** Irrigation water is saved up to 30-40 % as only pits are irrigated and inter row spaces are not irrigated.

Ring Pit Method of Sugarcane Planting

Skip Furrow Method of Irrigation

Normally farmers irrigate sugar cane by flooding entire field with water. Considerable amount of waste thus goes waste due to evaporation from wet soil surface. In Skip Furrow method efforts have been made to reduce wet surface area in field. In this technique furrows are made in alternate inter-row space & the crop is irrigated through these furrows. Thus the soil surface of inter-row space remains almost dry, thereby evaporation losses are reduced to the extent of 30-40 %.

Advantages

- **Water Use Efficiency is increased by 60-65%.**
- **Water saving:**Irrigation water is saved up to 35-40 %
- Normal Cane Yield and Quality is obtained.
- Weed infestation is reduced considerably.

Skip Furrow Method of Irrigation

Trash Mulching

Sugarcane trash i.e. dry leaves available after harvesting of the crop is a valuable source of organic matter & water saving. In general farmers burn trash or utilize it for other purposes such as thatching, fuel litter etc. If it is recycled in the cane field itself it contributes not only in saving precious irrigation water but also adds organic matter as well as other plant nutrients in soil. So it is important to recycle trash by mulching in sugarcane field.

Advantages

- Irrigation water is saved up to 40% as it conserves the soil moisture & reduces evaporation from soil surface.
- Increased availability of nutrients especially Nitrogen and Phosphorus to the plants.
- Mulch also adds large quantity of organic matter thus improves soil health of the soil.

Micro Irrigation (Sprinkler/ Drip Irrigation)

Micro irrigation is the frequent application of small quantities of water on, above or through water directly at the root zone of the plant in a uniform and effective way.

Advantages

- **Water Use Efficiency can be improved from 50-60 % to 90-95%.**
- The consumption of fertilizers can be reduced by 30 %.
- Weed infestation is reduced considerably.
- Can be used on undulating topography & on soils having low infiltration rates.

Less water consuming varieties of sugarcane

- CoLK 94184
- CoPK 05191

The two varieties need water 25 days after germination whereas others after 10 to 15 days.

Table 5.6: Saving of Irrigation water in Sugarcane on adoption of new agricultural practices

S. No.	Block	Net Irrigated Area (Ha)	Sugarcane Irrigated Area (Ha)	% of Sugarcane Irrigated Area to Net Irrigated Area (Ha)	Area irrigated under other crops (Ha)	Gross Draft from irrigation (Ham)	Ratio of Sugarcane Vs Other Crops	Annual Sugarcane Draft (Ham)	35% Saving of water with new irrigation practices (ham)	Net GW draft after Interventions (ham)	Final Projected stage of G.W. Dev. after adoption new irrigation practices in sugarcane area + AR & WUE Intervention
1	Airayan	14841	76	0.51	14765	7237.89	0.01	42.86	15.00	7195.03	7180.02
2	Amauli	14599	1654	11.33	12945	9217.57	0.13	932.86	326.50	8284.71	7958.21
3	Asother	13308	75	0.56	13233	5122.86	0.01	42.30	14.81	5080.56	5065.76
4	Bahua	15451	371	2.40	15080	7786.03	0.02	209.24	73.24	7576.79	7503.55
5	Bhitaura	20495	268	1.31	20227	13783.02	0.01	151.15	52.90	13631.87	13578.96
6	Deomai	15279	816	5.34	14463	5945.05	0.06	460.22	161.08	5484.83	5323.75
7	Dhata	13070	1186	9.07	11884	7628.55	0.10	668.90	234.12	6959.65	6725.53
8	Haswa	17716	159	0.90	17557	8792.75	0.01	89.68	31.39	8703.07	8671.69
9	Hathgaon	17427	200	1.15	17227	10023.31	0.01	112.80	39.48	9910.51	9871.03
10	Khajuha	15481	1402	9.06	14079	5739.58	0.10	790.73	276.75	4948.85	4672.10
11	Malwan	21752	376	1.73	21376	10932.25	0.02	212.06	74.22	10720.19	10645.96
12	Teliyani	15419	292	1.89	15127	6149.03	0.02	164.69	57.64	5984.34	5926.70
13	Vijayeepur	13030	579	4.44	12451	5824.98	0.05	326.56	114.29	5498.42	5384.13
	Total	**207868**	**7484**	**3.60**	**200384**	**104182.87**	**0.04**	**4220.98**	**1477.34**	**99961.89**	**98484.55**

Table 5.7: After the interventions in both supply side and demand side net recharge

Recharge from Supply Side (ham)				Saving from Demand Side (ham)			
Blocks	**Check Dam**	**Pond**	**Total Recharge**	**On-Farm**	**WUE**	**Sugarcane**	**Total Saving**
Airayan	27	99.45	126.45	402.55	402.55	15	820.1
Amauli	67.5	71.91	139.41	660.91	660.91	326.5	1648.32
Asother	13.5	61.2	74.7	140.88	140.88	14.81	296.57
Bahua	27	156.06	183.06	440.09	440.09	73.24	953.42
Bhitaura	27	153	180	1193.98	1194	52.9	2440.86
Deomai	27	61.2	88.2	166.58	166.58	161.08	494.24
Dhata	81	160.65	241.65	430.8	430.8	234.12	1095.72
Haswa	47.25	114.75	162	497.5	497.5	31.39	1026.39
Hathgaon	27	91.8	118.8	541.36	541.36	39.48	1122.2
Khajuha	27	61.2	88.2	158.64	158.64	276.75	594.03
Malwan	54	214.2	268.2	617.84	617.84	74.22	1309.9
Teliyani	27	191.25	218.25	346.81	346.81	57.64	751.26
Vijayeepur	20.25	61.2	81.45	160.09	160.09	114.29	434.47
Total	472.5	1497.9	1970.37	5758.03	5758.03	1477.34	12993.4

If the interventions are applied in the district then the stage of ground water development will be near to at the stage of Safe Category as shown in table 5.7.

Table-5.8: Projected Impact on Status of Groundwater Resource & Development in Fatehpur District

S. No.	Block	Net G.W. Availability (Ham)	Additional Recharge from RWH & Recharge (ham)	Total Net G.W. Availability after intervention (Ham)	Existing G.W Draft for all purpose (ham)	Saving of Ground water through projects (ham)	Net GW draft after interventions (ham)	Present stage of G.W. development (%)	Projected stage of G.W. Dev. (in %)
1	Airayan	9660.23	126.45	9786.68	7237.89	820.1	6417.79	74.92	65.58
2	Amauli	9505.81	139.41	9645.22	9217.57	1648.32	7569.25	96.97	78.48
3	Asother	12340.24	74.7	12414.94	5122.86	296.57	4826.29	41.51	38.87
4	Bahua	10905	183.06	11088.06	7786.03	953.42	6832.61	71.40	61.62
5	Bhitaura	13169.82	180	13349.82	13783.02	2440.86	11342.16	104.66	84.96
6	Deomai	10065.45	88.2	10153.65	5945.05	494.24	5450.81	59.06	53.68
7	Dhata	10670.8	241.65	10912.45	7628.55	1095.72	6532.83	71.49	59.87
8	Haswa	11729.67	162	11891.67	8792.75	1026.39	7766.36	74.96	65.31
9	Hathgaon	13661.43	118.8	13780.23	10023.31	1122.2	8901.11	73.37	64.59
10	Khajuha	11260.73	88.2	11348.93	5739.58	594.03	5145.55	50.97	45.34
11	Malwan	14949.69	268.2	15217.89	10932.25	1309.9	9622.35	73.13	63.23
12	Teliyani	8477.62	218.25	8695.87	6149.03	751.26	5397.77	72.53	62.07
13	Vijayeepur	12108.25	81.45	12189.7	5824.98	434.47	5390.51	48.11	44.22
	Total	**148504.8**	**1970.37**	**150475.1**	**104182.9**	**12993.4**	**91189.47**	**70.15**	**60.60**

6. CONCLUSION

1. District Fatehpur is covering an area of 422126 sq. km lies in doab of River Ganga and Yamuna.
2. The area is a part of the flat Yamuna alluvial plain and slopes gently from northwest to southeast. The gradient following the drainage lines of the principal rivers (Non River, Rind River).
3. The drainage pattern of the district is strictly governed by the major river Yamuna, which forms western boundary of the district. The river in his respective course flow more or less north to south. Major tributary of Yamuna is Non and Rind rivers.
4. The loamy soils of the area are very fertile. About 80% of the total geographical area of the district is cultivated area. The main rabi crops are wheat and oil seeds while paddy and pulses are the main kharif crops.
5. Net Area Sown in the district is 27254 ha, Net irrigated area is 207868 and Gross irrigated area is 316502 ha. Tube well irrigation accounts for about 99% in the area.
6. The average annual rainfall (2011-2020) is 609.5 mm. About 85% of rainfall takes places from June to September.
7. District Fatehpur, is underlain by Quaternary alluvium deposited by Yamuna river system. Lithologically the alluvial sediments comprise of sand, silt, clay and kankars in varying proportions.
8. The depth to water level ranges from 1.9 to 36.41 mbgl during pre-monsoon where as it ranges from 0.1 to 34.41 mbgl in post-monsoon. The pre & post-monsoon water level fluctuation varies from 0.3 to 6.5 m.
9. Relatively deeper water levels are observed in the southern as well as central part of the block whereas relatively shallower water levels are present in the north-eastern and in northern part of the district.

On the basis of Litholog of exploratory wells three aquifer system have been identified which ranges down to 205 mbgl (first aquifer). Second Aquifer observed from 23 to 377 mbgl and third aquifer from 276 to 427mbgl. At the depth of 334, 247, 448, 273,162,258 the Vindhyan quartzites as basement encountered at Airaya Mushayak, Jahanpur Majre Digh, Amoli, Damanpur, ITI Fatehur, Mahakherra and Umar Gahna locations respectively.

10. Transmissivity of aquifer varies from 1267 to 6338 m^2/day and Storativity 9.6×10^{-5}. Discharge varies from 500 to 2728lpm.
11. The total ground water draft is 104183 ham, which is being used in present for domestic, irrigation & industrial purposes against the ground water availability of 43210 ham. One block namely Bithaura is in the Over-Exploited Category and one block Amauli is in the Critical Category. There are seven blocks are in Semi-critical as Airayan, Bahua, Dhata, Haswa, Hathgaon Malwan and Teliyani. The stage of ground water development of the district is about 70.15%.
12. The total runoff created about 17653 ham for artificial recharge through supply side management structures.
13. The stage of ground water development after intervention is 60.60%.

7. RECOMMENDATION

1. To arrest the further decline in ground water levels and depletion of ground water resources, there is urgent need to implement both Supply side and Demand side measures which includes artificial recharge and water conservation, On-farm activities and adoption of water use efficiency measures.
2. It is proposed to adopt supply side management options as; one block namely Bithaura is in the Over-Exploited Category and one block Amauli is in the Critical Category. There are seven blocks are in Semi-critical as Airayan, Bahua, Dhata, Haswa, Hathgaon Malwan and Teliyani. There is considerable scope for implementation of Roof Top Rain Water Harvesting in the urban areas of the block. Check dams, cement plugs, renovation of ponds are ideal structures for rain water harvesting in rural areas. Water conservation structures such as check dams, farm ponds, nala bunds etc. result in ground water recharge to the tune of about 40% of the storage capacity considering 3 annual fillings.
3. It is also proposed to adopt On Farm practices such as laser leveling, bench terracing, construction of farm ponds, afforestation, diversification of crops etc.
4. It is proposed to construct 70 Check dams and renovate 979 pond under supply side management.
5. In demand side management there is urgent need to promote piped and pressurized irrigation practices which can save 25 to 70% of water use in the agriculture. On-farm Activities in 51080 ha, Water Use Efficiency Measures (Drip & Sprinkler + HDPE Pipes) in 51080 ha. It is proposed to initiate these measures initially in 30% of area. The measures adopted for supply side and demand side management in district will substantially bring down stage of ground water development.
6. It is also proposed to adopt new water saving agricultural practices in about 7484 ha in areas of sugarcane cultivation. Such practices have the potential of saving 35-40% irrigation water thereby drastically reducing the draft for irrigation leading the change of category of the district from semi-critical to safe.
7. Agriculture department should promote to conserve the soil moisture by reducing ET losses through cultivation of 'Green Manure'.

8. Alternate cropping pattern system having lower requirement of water should be encouraged in accordance to the irrigation water availability.
9. Furrow irrigation with raised bed planting in wide row crops should be practiced.
10. Irrigation in checks in close row crops should be practiced.
11. Drip irrigation in sugarcane and other wide row crops should be practiced with mulch in the area.
12. Multiuse of water through integrated farming system.
13. Conjunctive use of surface and groundwater should be encouraged in the block.
14. Besides the above, there is urgent need for participatory ground water management in the area which will further help in bringing more awareness among the common farmers which will reduce the ground water drawl and bring down the stage of ground water development.
15. All efforts should be taken to ensure treatment of waste disposal both solid and liquid from industries and urban areas to prevent pollution of ground water and surface water.

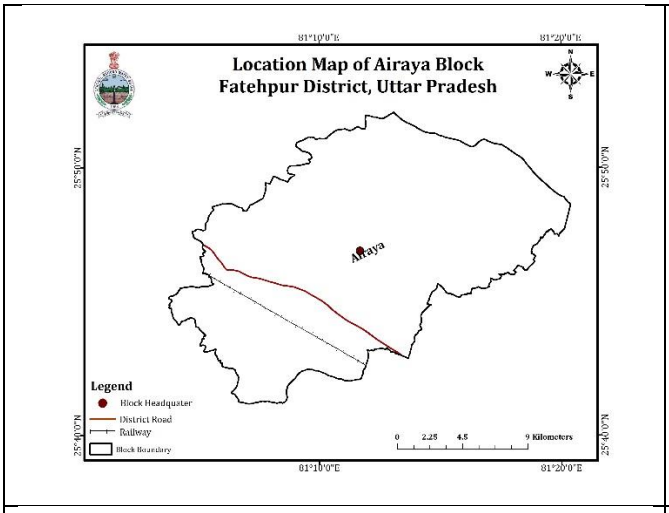
8.0 REFERENCES:

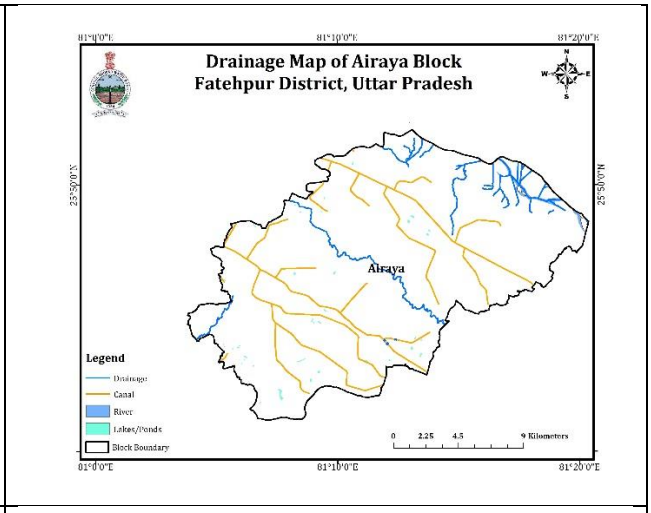
- Report on Status of Ground Water Exploration, Uttar Pradesh 2012.
- Dynamic Ground Water Resources of Uttar Pradesh (As on March, 2004).
- Dynamic Ground Water Resources of Uttar Pradesh (As on March, 2009).
- Dynamic Ground Water Resources of Uttar Pradesh (As on March, 2011).
- Dynamic Ground Water Resources of Uttar Pradesh (As on March, 2013, excel sheet).
- Gautam J.P. Ground Water Management Studies (Reappraisal Hydrogeological Studies) of Aligarh District, U.P 2005
- Jal Nigam, U.P. Construction division U.P. Jal Nigam Kumar Arun & Bhargava A.K., Ground water Recourse & Development Potential of Aligarh , U.P.,2002
- Mahmood Kamal & Bharthawal Hydrogeology And Ground Water Potential of Aligarh District Uttar Pradesh ,1996
- Nigam Neelam et al., 2016; A Report On Ground Water Quality Of Some Industrial Clusters of Uttar Pradesh June 2016.
- Nigam Neelam et al., 2017; Hydrochemical chemical report of Uttar Pradesh Jan 2017.
- Trivedi B.B. & Chandra P.C., Inland Ground Water Salinity in Uttar Pradesh 2010.
- Trivedi B.B. & Chandra P.C., Inland Ground Water Salinity in Uttar Pradesh 2010.
- Trivedi B.B. & Srivastava,M M & Bhowmic M.K U.P. State Geophysical Report ,2010.
- Trivedi B.B. & Srivastava,M M & Bhowmic M.K U.P. State Geophysical Report ,2010. www.updes.nic.in/

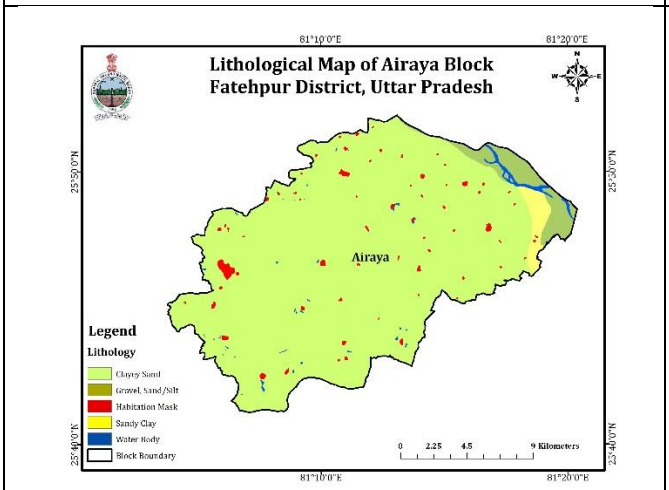
Chapater-9.0

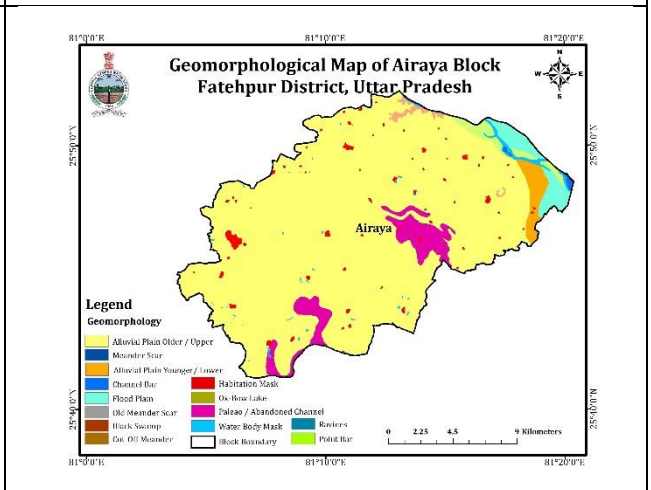
Aquifer Maps and Management plan of District Fatehpur Blocks, U.P.

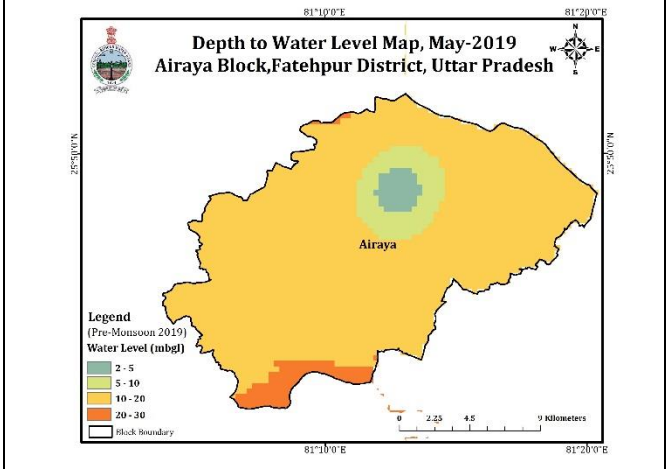
Aquifer Map and Management plan of Airaya Block Fatehpur District U.P.

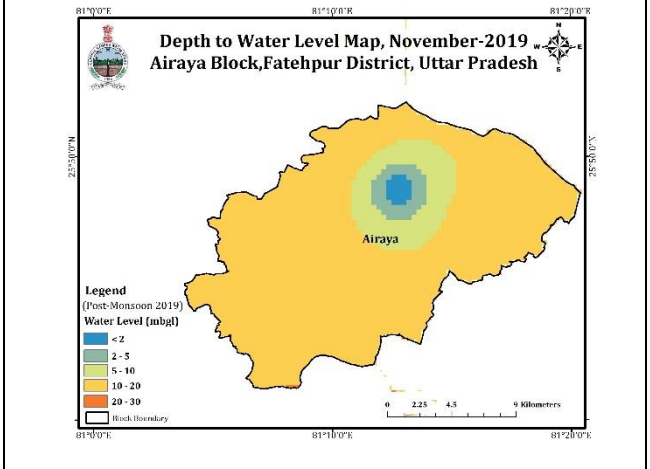










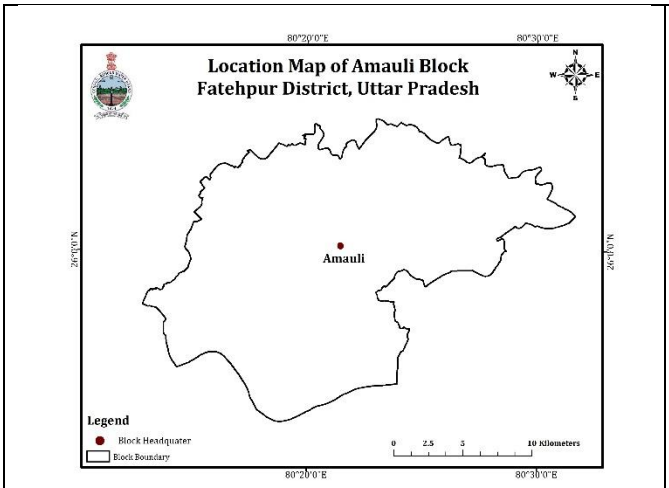


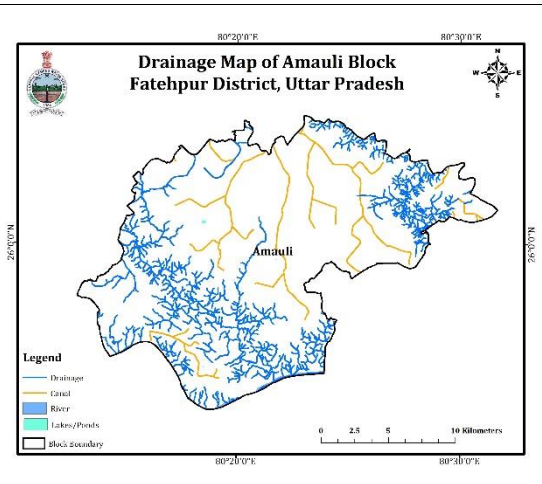
9.1 AIRAYAN BLOCK AT A GLANCE

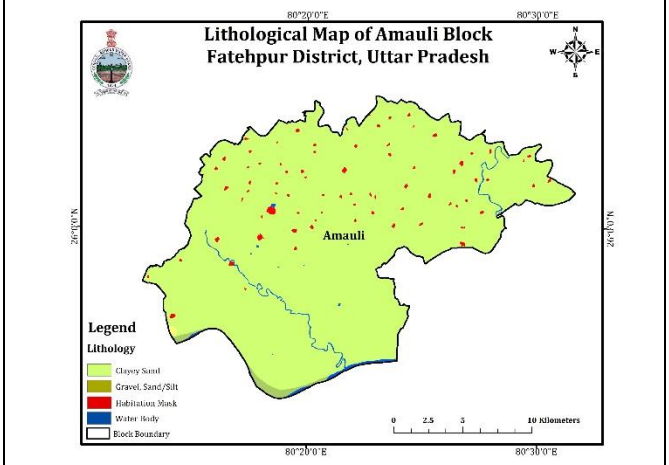
Block	(Unit)	Airayan
Area Irrigated by Surface Water	(ha)	13
Area Irrigated by Ground Water	(ha)	15194
Contribution of GW	(%)	99.91
Canal Length	**(km)**	96
Govt Tube Wells	(No.)	32
Well		0
(Shallow Tube Wells) in No.	**Electric Pumps**	131
	Diesel Pumps	1636
	Others	16
Medium Tube Wells	(No.)	303
Deep Tube wells		101
Rainfall	(mm)	609.5
pH		7.82
EC µS/cm at 25°C		1199
HCO_3	**(mg/l)**	329
Cl		156
F		0.6
NO_3		37
SO_4		53
TH		400
Ca		36
Mg		74
Na		81
K		11
SiO_2		35
Fe	**(µg/l)**	0
Mn		0.15
Zn		0.24
As		0
U		19
Cr		2
Net Annual Ground Water Availability	(ham)	9660.2
Existing Gross Ground Water Draft for Irrigation		6709.2
Existing Gross Ground Water Draft for Domestic & Industrial Water Supply		528.69
Existing Gross Ground Water Draft for All Uses		7237.9
Provision for Domestic and Industrial Requirement Supply for 2025		612.02
Net Ground Water Availability for future Irrigation development		2339
Stage of Development	(%)	74.92

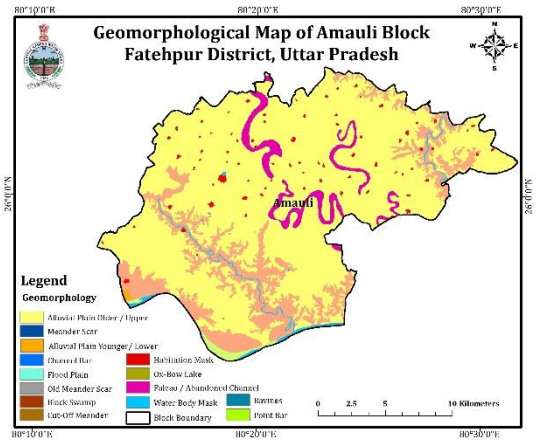
Category		Semi-Critical
Check Dams of 45000 cum Capacity (1500m*10m*3m)	(No.)	4
Unit Recharge consider 50% filling for 3 times	(ham/year)	6.75
Expected Total Recharge	(in ham)	27
Construction of new ponds / renovation of old ponds (100mx100mx3m)	(No.)	140
Unit Recharge considered 17% filling for 3 times	(ham/year)	1.53
Expected Total Recharge	(in ham)	214.2
Net Irrigated Area	**(Ha)**	14841
Sugarcane Irrigated Area		76
% of Sugarcane Irrigated Area to Net Irrigated Area	(%)	0.51
Area irrigated under other crops	**(Ha)**	14765
Gross Draft from irrigation	**(Ham)**	7237.9
Ratio of Sugarcane Vs Other Crops		0.01
Annual Sugarcane Draft	**(Ham)**	42.86
35% Saving of water with new irrigation practices	(%)	15
Net GW draft after Interventions	**(ham)**	7195
Final Projected stage of G.W. Dev. after adoption new irrigation practices in sugarcane area + AR & WUE Intervention		7180

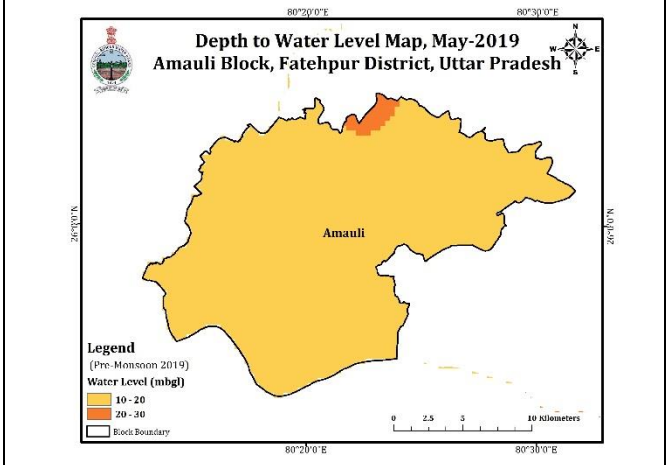
Aquifer Map and Management plan of Amauli Block Fatehpur District U.P.

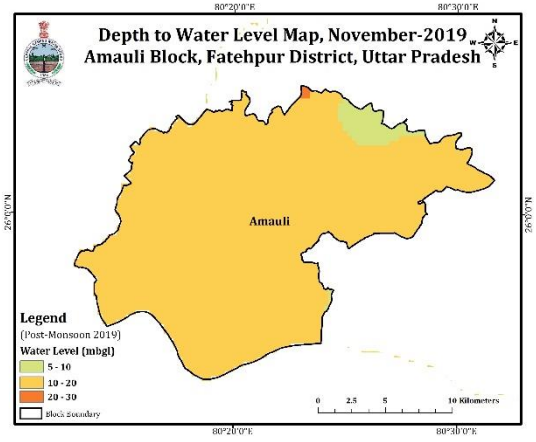










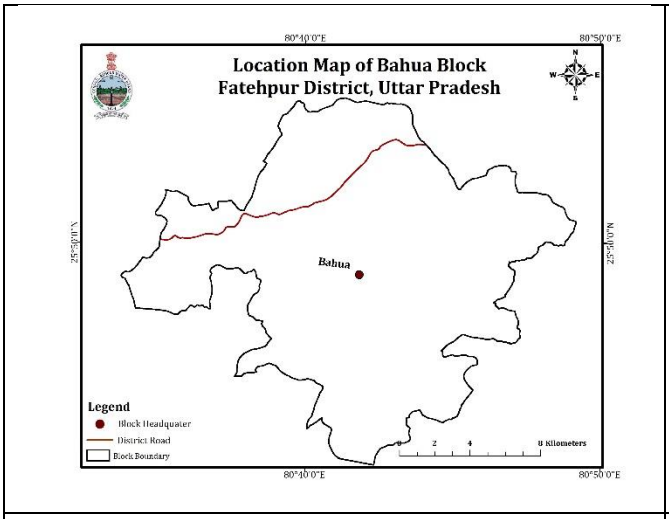


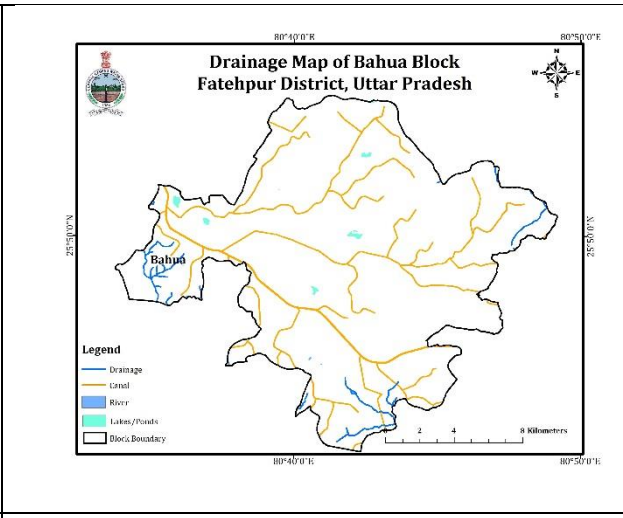
9.2 AMAULI BLOCK AT A GLANCE

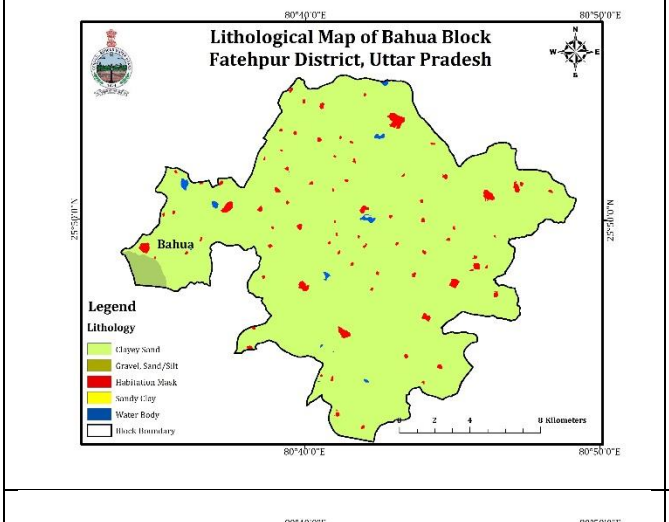
Block	(Unit)	Amauli
Area Irrigated by Surface Water	(ha)	53
Area Irrigated by Ground Water	(ha)	14950
Contribution of GW	(%)	99.65
Canal Length	**(km)**	11
Govt Tube Wells	(No.)	97
Well		14
(Shallow Tube Wells) in No.	**Electric Pumps**	820
	Diesel Pumps	1049
	Others	12
Medium Tube Wells	(No.)	105
Deep Tube wells		369
Rainfall	(mm)	609.5
pH		
EC µS/cm at 25°C		
HCO_3	**(mg/l)**	232
Cl		64
F		2.1
NO_3		43
SO_4		53
TH		290
Ca		40
Mg		46
Na		41
K		4.4
SiO_2		35
Fe	**(µg/l)**	0.03
Mn		0
Zn		0.02
As		0
U		10
Cr		2
Net Annual Ground Water Availability	(ham)	9505.81
Existing Gross Ground Water Draft for Irrigation		8812.1
Existing Gross Ground Water Draft for Domestic & Industrial Water Supply		405.47
Existing Gross Ground Water Draft for All Uses		9217.57

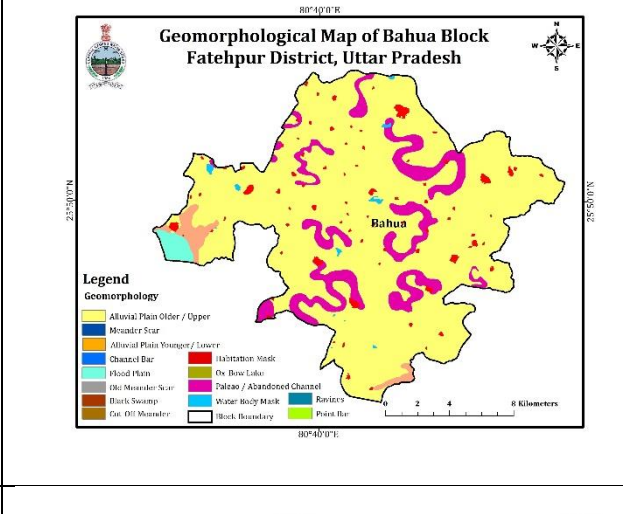
Provision for Domestic and Industrial Requirement Supply for 2025		490.52
Net Ground Water Availability for future Irrigation development		203.19
Stage of Development	(%)	96.97
Category		
Check Dams of 45000 cum Capacity (1500m*10m*3m)	(No.)	10
Unit Recharge consider 50% filling for 3 times	(ham/year)	6.75
Expected Total Recharge	(in ham)	67.5
Construction of new ponds / renovation of old ponds (100mx100mx3m)	(No.)	40
Unit Recharge considered 17% filling for 3 times	(ham/year)	1.53
Expected Total Recharge	(in ham)	61.2
Net Irrigated Area	**(Ha)**	14599
Sugarcane Irrigated Area		1654
% of Sugarcane Irrigated Area to Net Irrigated Area	(%)	11.33
Area irrigated under other crops	**(Ha)**	12945
Gross Draft from irrigation	**(Ham)**	9217.57
Ratio of Sugarcane Vs Other Crops		
Annual Sugarcane Draft	**(Ham)**	932.86
35% Saving of water with new irrigation practices	(%)	326.5
Net GW draft after Interventions	**(ham)**	8284.71
Final Projected stage of G.W. Dev. after adoption new irrigation practices in sugarcane area + AR & WUE Intervention		7958.21

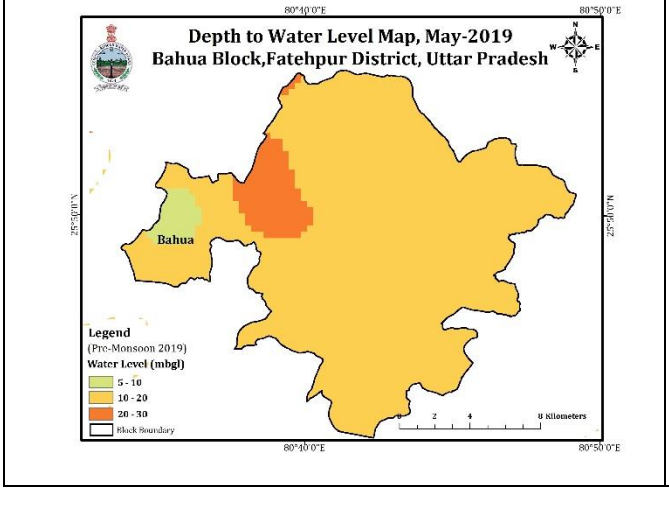
Aquifer Map and Management plan of Bahua Block Fatehpur District U.P.

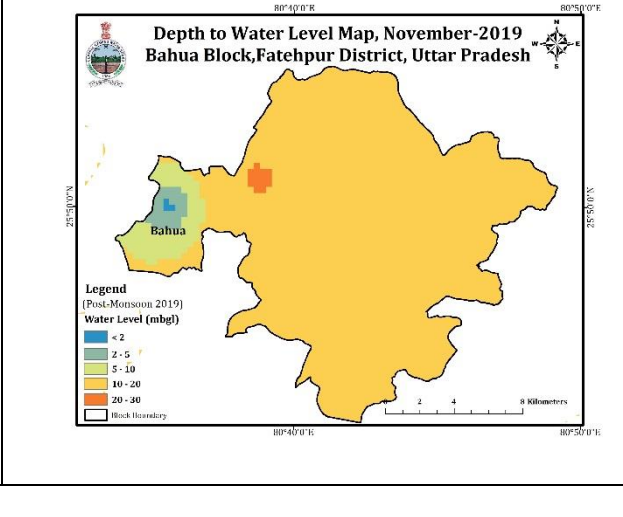










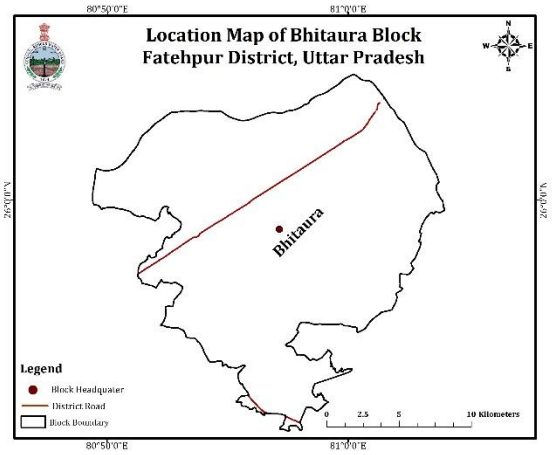


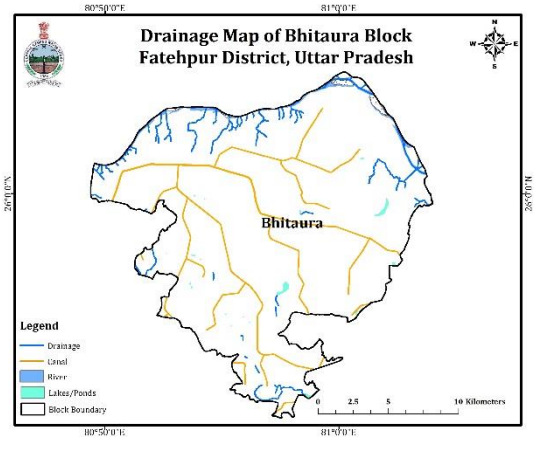
9.3 BAHUA BLOCK AT A GLANCE

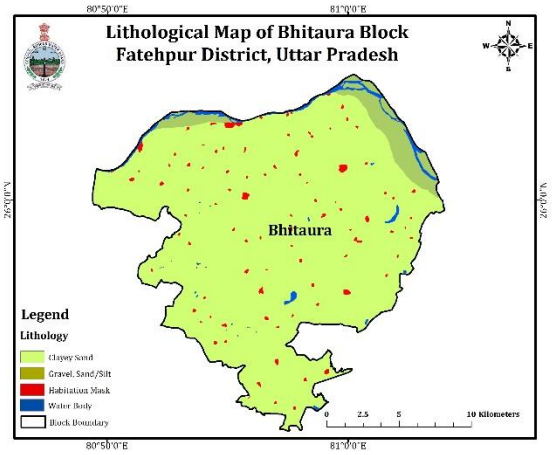
Block	(Unit)	Bahua
Area Irrigated by Surface Water	(ha)	4617
Area Irrigated by Ground Water	(ha)	11118
Contribution of GW	(%)	70.66
Canal Length	**(km)**	180
Govt Tube Wells	(No.)	31
Well		300
(Shallow Tube Wells) in No.	**Electric Pumps**	229
	Diesel Pumps	2631
	Others	123
Medium Tube Wells	(No.)	263
Deep Tube wells		137
Rainfall	(mm)	609.5
pH		
EC µS/cm at 25°C		
HCO_3	**(mg/l)**	244
Cl		99
F		1.79
NO_3		33
SO_4		48
TH		330
Ca		56
Mg		46
Na		43
K		4.9
SiO_2		32
Fe	**(µg/l)**	0.36
Mn		0.01
Zn		1.05
As		0
U		10
Cr		2
Net Annual Ground Water Availability	(ham)	10905
Existing Gross Ground Water Draft for Irrigation		7334.8
Existing Gross Ground Water Draft for Domestic &		451.23

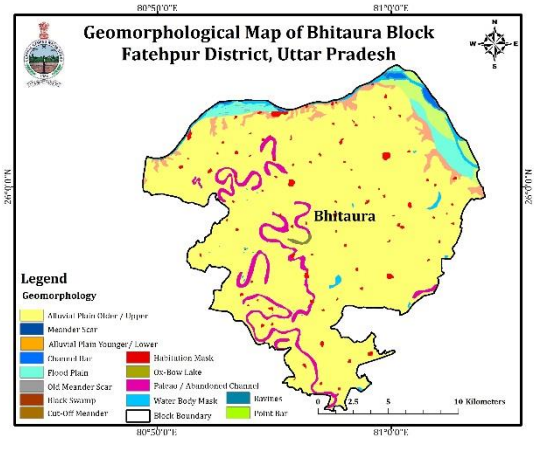
Industrial Water Supply		
Existing Gross Ground Water Draft for All Uses		7786
Provision for Domestic and Industrial Requirement Supply for 2025		528.7
Net Ground Water Availability for future Irrigation development		3041.5
Stage of Development	(%)	71.4
Category		
Check Dams of 45000 cum Capacity (1500m*10m*3m)	(No.)	4
Unit Recharge consider 50% filling for 3 times	(ham/year)	6.75
Expected Total Recharge	(in ham)	27
Construction of new ponds / renovation of old ponds (100mx100mx3m)	(No.)	75
Unit Recharge considered 17% filling for 3 times	(ham/year)	1.53
Expected Total Recharge	(in ham)	114.75
Net Irrigated Area	**(Ha)**	15451
Sugarcane Irrigated Area		371
% of Sugarcane Irrigated Area to Net Irrigated Area	(%)	2.4
Area irrigated under other crops	**(Ha)**	15080
Gross Draft from irrigation	**(Ham)**	7786
Ratio of Sugarcane Vs Other Crops		
Annual Sugarcane Draft	**(Ham)**	209.24
35% Saving of water with new irrigation practices	(%)	73.24
Net GW draft after Interventions	**(ham)**	7576.8
Final Projected stage of G.W. Dev. after adoption new irrigation practices in sugarcane area + AR & WUE Intervention		7503.6

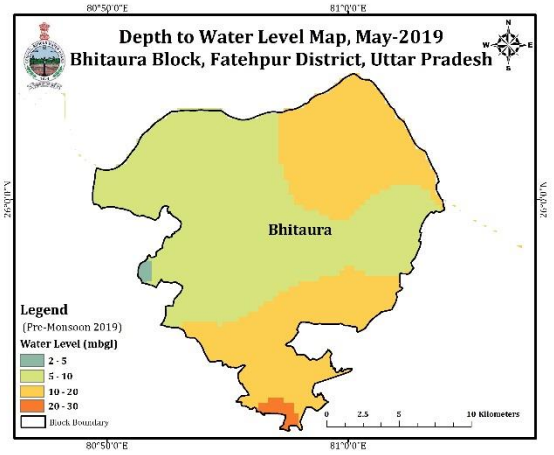
Aquifer Map and Management plan of Bhitaura Block Fatehpur District U.P.

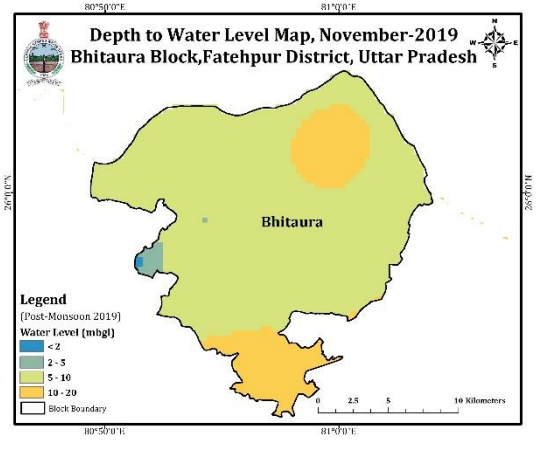










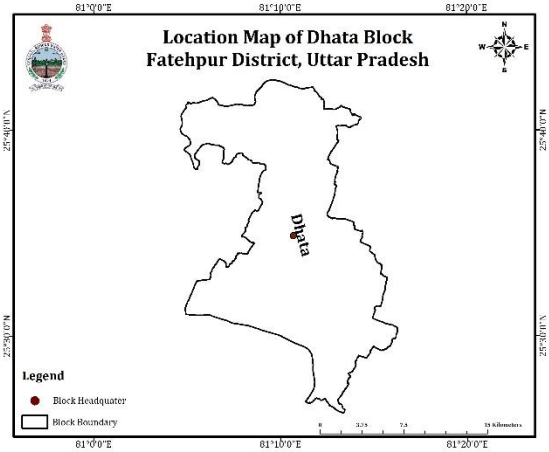


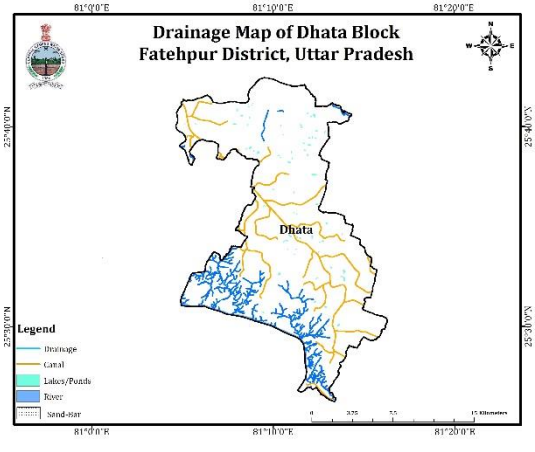
9.4 BITHAURA BLOCK AT A GLANCE

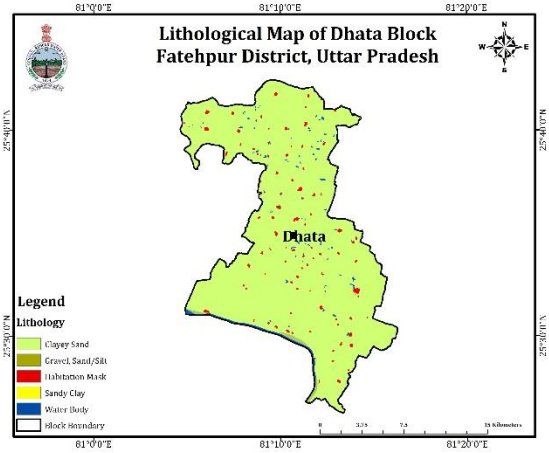
Block	(Unit)	Bhitaura
Area Irrigated by Surface Water	(ha)	4157
Area Irrigated by Ground Water	(ha)	16725
Contribution of GW	(%)	80.09
Canal Length	**(km)**	121
Govt Tube Wells	(No.)	13
Well		207
(Shallow Tube Wells) in No.	**Electric Pumps**	513
	Diesel Pumps	5316
	Others	18
Medium Tube Wells	(No.)	133
Deep Tube wells		33
Rainfall	(mm)	609.5
pH		
EC µS/cm at 25°C		
HCO_3	**(mg/l)**	293
Cl		21
F		0.65
NO_3		BDL
SO_4		7
TH		220
Ca		24
Mg		38
Na		29
K		3
SiO_2		30
Fe	**(µg/l)**	0.04
Mn		0.02
Zn		0.21
As		0
U		16
Cr		3
Net Annual Ground Water Availability	(ham)	13169.82
Existing Gross Ground Water Draft for Irrigation		13266.4
Existing Gross Ground Water Draft for Domestic & Industrial Water Supply		516.62
Existing Gross Ground Water Draft for All Uses		13783.02

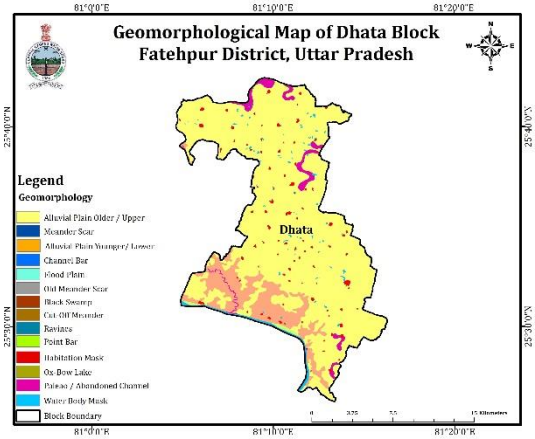
Provision for Domestic and Industrial Requirement Supply for 2025		516.62
Net Ground Water Availability for future Irrigation development		0
Stage of Development	(%)	104.66
Category		
Check Dams of 45000 cum Capacity (1500m*10m*3m)	(No.)	4
Unit Recharge consider 50% filling for 3 times	(ham/year)	6.75
Expected Total Recharge	(in ham)	27
Construction of new ponds / renovation of old ponds (100mx100mx3m)	(No.)	40
Unit Recharge considered 17% filling for 3 times	(ham/year)	1.53
Expected Total Recharge	(in ham)	61.2
Net Irrigated Area	**(Ha)**	20495
Sugarcane Irrigated Area		268
% of Sugarcane Irrigated Area to Net Irrigated Area	(%)	1.31
Area irrigated under other crops	**(Ha)**	20227
Gross Draft from irrigation	**(Ham)**	13783.02
Ratio of Sugarcane Vs Other Crops		
Annual Sugarcane Draft	**(Ham)**	151.15
35% Saving of water with new irrigation practices	(%)	52.9
Net GW draft after Interventions	**(ham)**	13631.87
Final Projected stage of G.W. Dev. after adoption new irrigation practices in sugarcane area + AR & WUE Intervention		13578.96

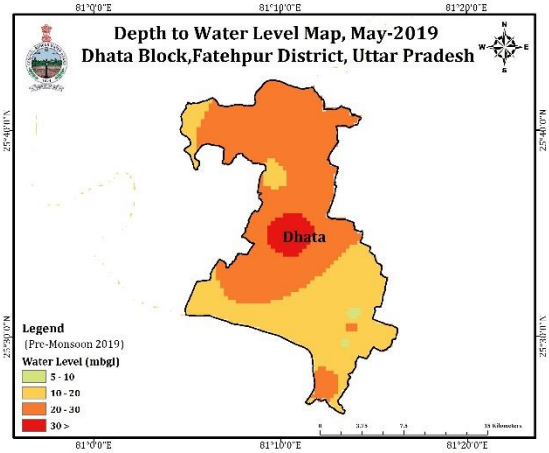
Aquifer Map and Management plan of Dhata Block Fatehpur District U.P.

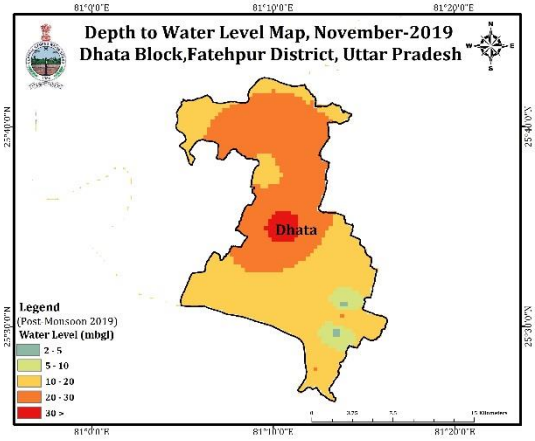










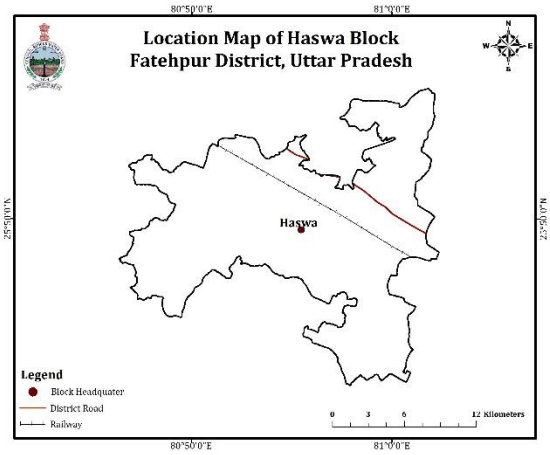


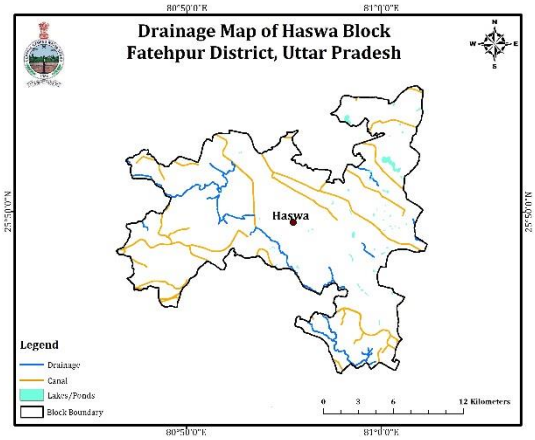
9.5 DHATA BLOCK AT A GLANCE

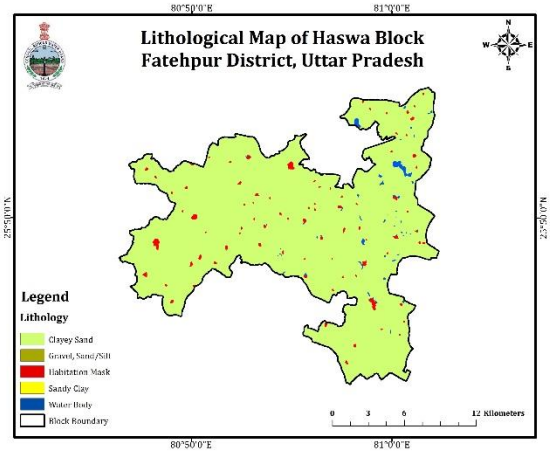
Block	(Unit)	Dhata
Area Irrigated by Surface Water	(ha)	894
Area Irrigated by Ground Water	(ha)	12491
Contribution of GW	(%)	93.32
Canal Length	**(km)**	115
Govt Tube Wells	(No.)	62
Well		15
(Shallow Tube Wells) in No.	**Electric Pumps**	386
	Diesel Pumps	2215
	Others	56
Medium Tube Wells	(No.)	779
Deep Tube wells		252
Rainfall	(mm)	609.5
pH		
EC µS/cm at 25°C		
HCO_3	**(mg/l)**	268
Cl		71
F		0.73
NO_3		BDL
SO_4		48
TH		300
Ca		48
Mg		43
Na		31
K		7.4
SiO_2		25
Fe	**(µg/l)**	0.06
Mn		0
Zn		0.07
As		0
U		12
Cr		6
Net Annual Ground Water Availability	(ham)	10671
Existing Gross Ground Water Draft for Irrigation		7180
Existing Gross Ground Water Draft for Domestic &		448.55

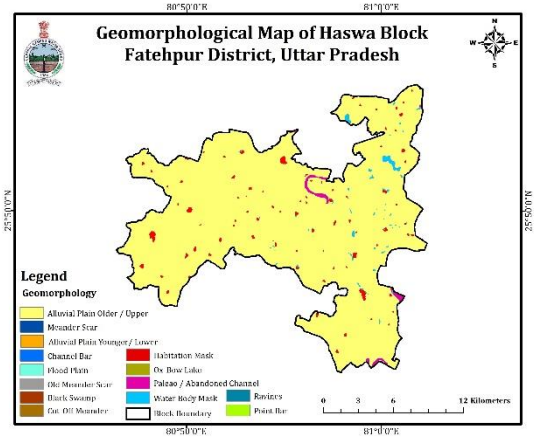
Industrial Water Supply		
Existing Gross Ground Water Draft for All Uses		7628.6
Provision for Domestic and Industrial Requirement Supply for 2025		534.49
Net Ground Water Availability for future Irrigation development		2956.3
Stage of Development	(%)	71.49
Category		
Check Dams of 45000 cum Capacity (1500m*10m*3m)	(No.)	12
Unit Recharge consider 50% filling for 3 times	(ham/year)	6.75
Expected Total Recharge	(in ham)	81
Construction of new ponds / renovation of old ponds (100mx100mx3m)	(No.)	40
Unit Recharge considered 17% filling for 3 times	(ham/year)	1.53
Expected Total Recharge	(in ham)	61.2
Net Irrigated Area	**(Ha)**	13070
Sugarcane Irrigated Area		1186
% of Sugarcane Irrigated Area to Net Irrigated Area	(%)	9.07
Area irrigated under other crops	**(Ha)**	11884
Gross Draft from irrigation	**(Ham)**	7628.6
Ratio of Sugarcane Vs Other Crops		
Annual Sugarcane Draft	**(Ham)**	668.9
35% Saving of water with new irrigation practices	(%)	234.12
Net GW draft after Interventions	**(ham)**	6959.7
Final Projected stage of G.W. Dev. after adoption new irrigation practices in sugarcane area + AR & WUE Intervention		6725.5

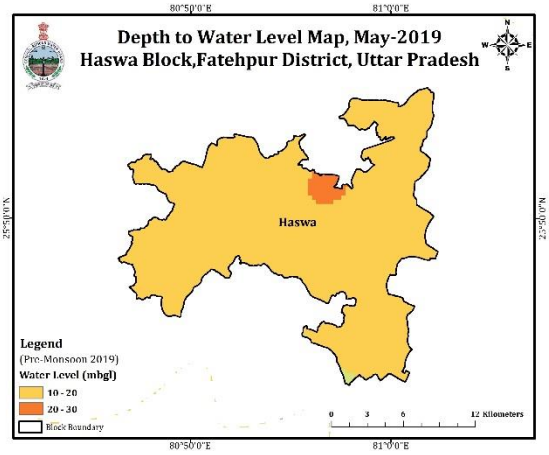
Aquifer Map and Management plan of Haswa Block Fatehpur District U.P.

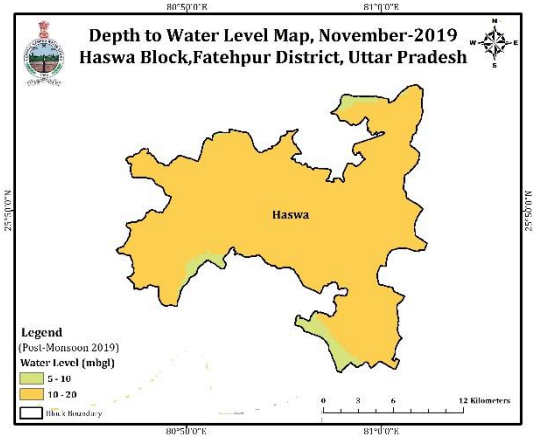










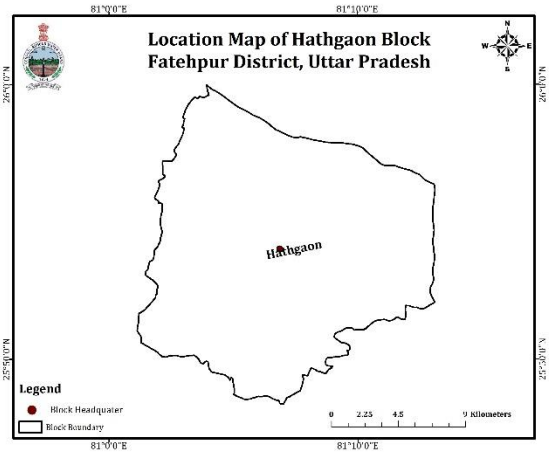


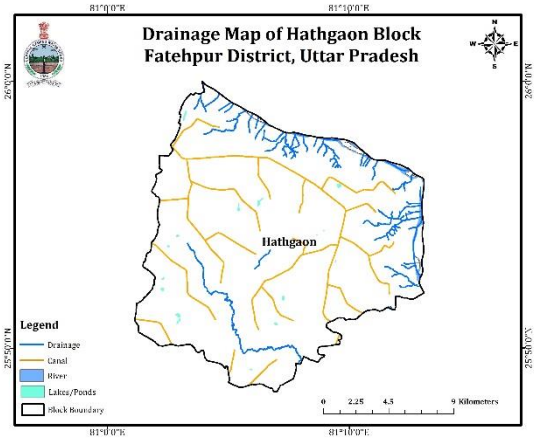
9.6 HASWA BLOCK AT A GLANCE

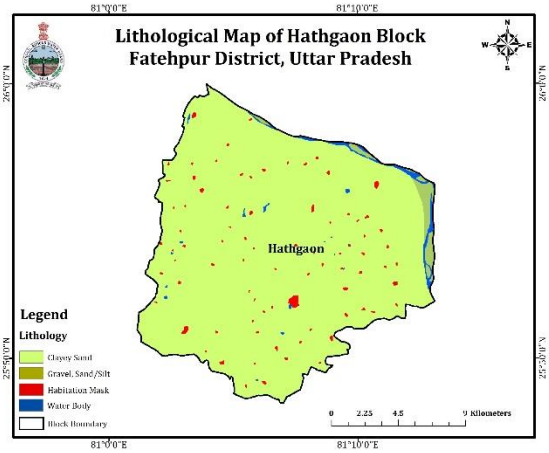
Block	(Unit)	Haswa
Area Irrigated by Surface Water	(ha)	2271
Area Irrigated by Ground Water	(ha)	15801
Contribution of GW	(%)	87.43
Canal Length	**(km)**	182
Govt Tube Wells	(No.)	25
Well		224
(Shallow Tube Wells) in No.	**Electric Pumps**	361
	Diesel Pumps	4118
	Others	27
Medium Tube Wells	(No.)	253
Deep Tube wells		59
Rainfall	(mm)	609.5
pH		
EC µS/cm at 25°C		
HCO_3	**(mg/l)**	244
Cl		21
F		0.66
NO_3		BDL
SO_4		6
TH		160
Ca		16
Mg		29
Na		36
K		6.8
SiO_2		29
Fe	**(µg/l)**	0.45
Mn		0.09
Zn		0.12
As		0
U		8
Cr		2
Net Annual Ground Water Availability	(ham)	11730
Existing Gross Ground Water Draft for Irrigation		8291.6
Existing Gross Ground Water Draft for Domestic &		501.15

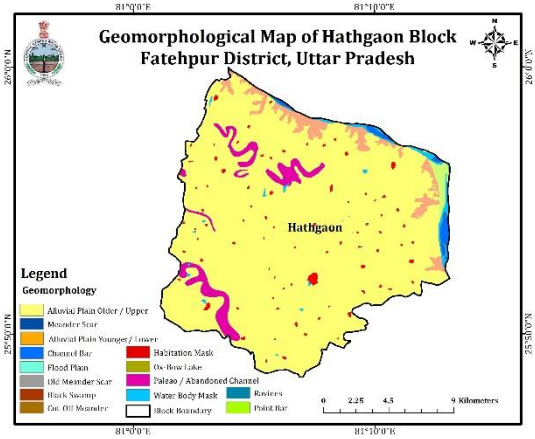
Industrial Water Supply		
Existing Gross Ground Water Draft for All Uses		8792.8
Provision for Domestic and Industrial Requirement Supply for 2025		587.06
Net Ground Water Availability for future Irrigation development		2851
Stage of Development	(%)	74.96
Category		
Check Dams of 45000 cum Capacity (1500m*10m*3m)	(No.)	7
Unit Recharge consider 50% filling for 3 times	(ham/year)	6.75
Expected Total Recharge	(in ham)	47.25
Construction of new ponds / renovation of old ponds (100mx100mx3m)	(No.)	105
Unit Recharge considered 17% filling for 3 times	(ham/year)	1.53
Expected Total Recharge	(in ham)	160.65
Net Irrigated Area	**(Ha)**	17716
Sugarcane Irrigated Area		159
% of Sugarcane Irrigated Area to Net Irrigated Area	(%)	0.9
Area irrigated under other crops	**(Ha)**	17557
Gross Draft from irrigation	**(Ham)**	8792.8
Ratio of Sugarcane Vs Other Crops		
Annual Sugarcane Draft	**(Ham)**	89.68
35% Saving of water with new irrigation practices	(%)	31.39
Net GW draft after Interventions	**(ham)**	8703.1
Final Projected stage of G.W. Dev. after adoption new irrigation practices in sugarcane area + AR & WUE Intervention		8671.7

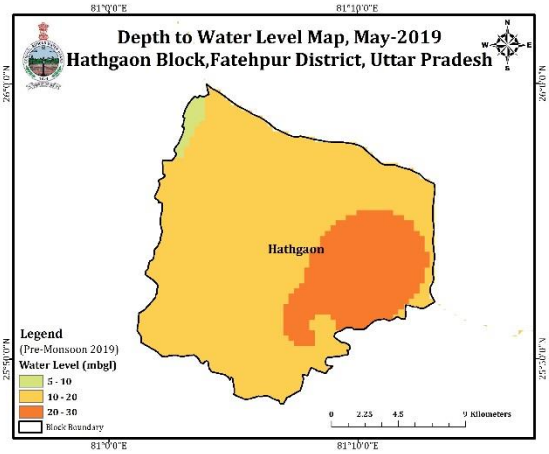
Aquifer Map and Management plan of Hathgaon Block Fatehpur District U.P.

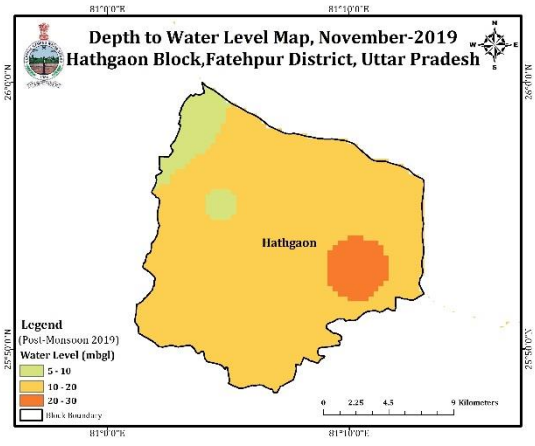










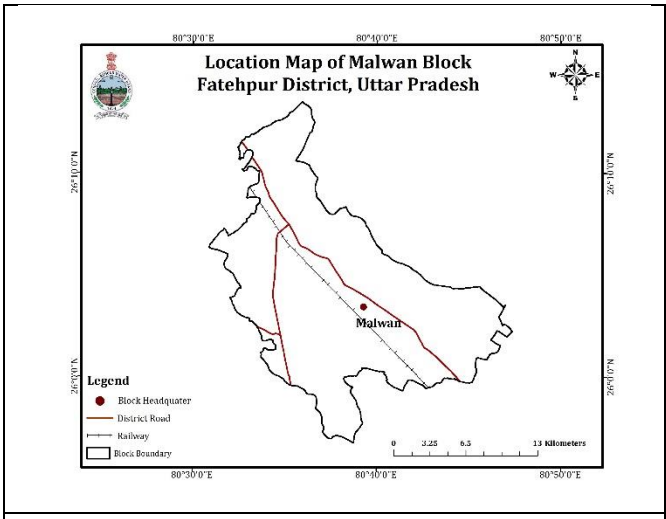


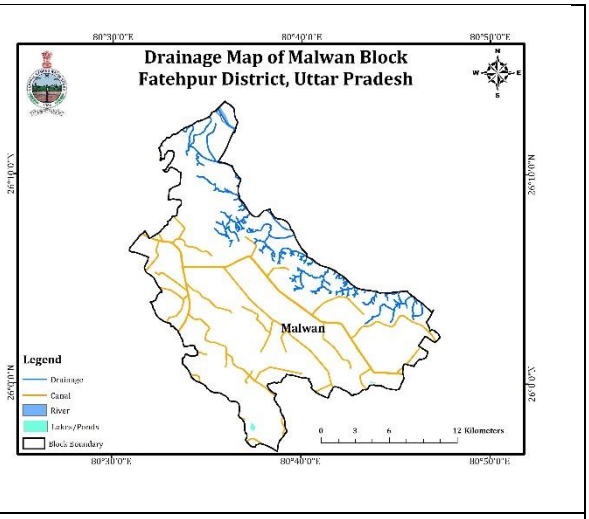
9.7 HATHGAON BLOCK AT A GLANCE

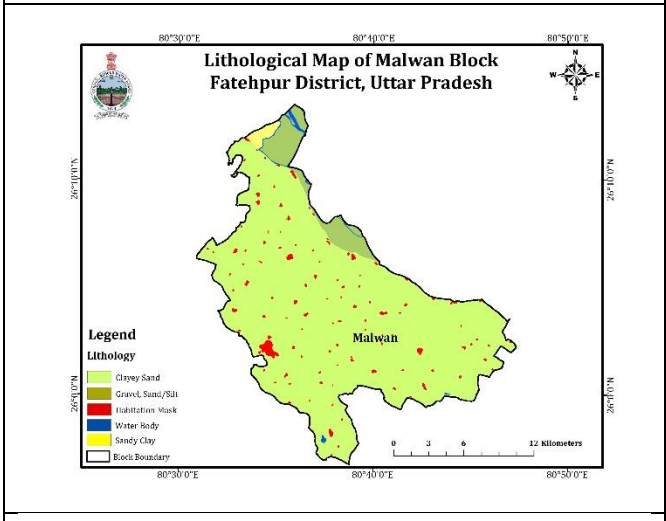
Block	(Unit)	Hathgaon
Area Irrigated by Surface Water	(ha)	1834
Area Irrigated by Ground Water	(ha)	15859
Contribution of GW	(%)	89.63
Canal Length	**(km)**	126
Govt Tube Wells	(No.)	3
Well		0
(Shallow Tube Wells) in No.	**Electric Pumps**	387
	Diesel Pumps	3694
	Others	36
Medium Tube Wells	(No.)	246
Deep Tube wells		37
Rainfall	(mm)	609.5
pH		
EC µS/cm at 25°C		
HCO_3	**(mg/l)**	305
Cl		28
F		0.73
NO_3		16
SO_4		23
TH		270
Ca		36
Mg		43
Na		17
K		20
SiO_2		28
Fe	**(µg/l)**	0.63
Mn		0.02
Zn		0.55
As		0
U		16
Cr		3
Net Annual Ground Water Availability	(ham)	13661.43
Existing Gross Ground Water Draft for Irrigation		9022.6
Existing Gross Ground Water Draft for Domestic & Industrial Water Supply		1000.71
Existing Gross Ground Water Draft for All Uses		10023.31

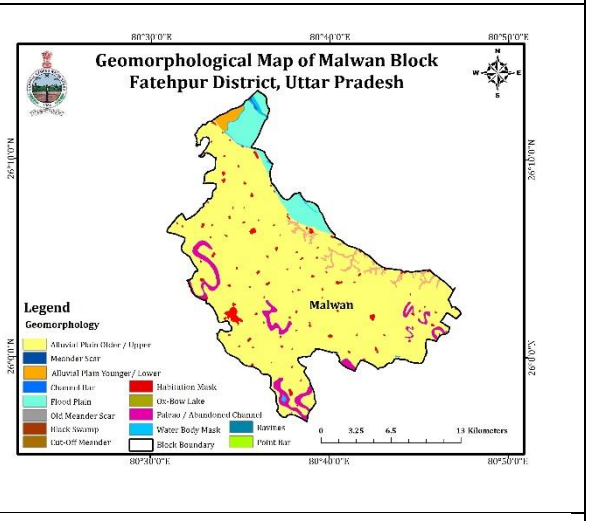
Provision for Domestic and Industrial Requirement Supply for 2025		1208.13
Net Ground Water Availability for future Irrigation development		3430.7
Stage of Development	(%)	73.37
Category		
Check Dams of 45000 cum Capacity (1500m*10m*3m)	(No.)	4
Unit Recharge consider 50% filling for 3 times	(ham/year)	6.75
Expected Total Recharge	(in ham)	27
Construction of new ponds / renovation of old ponds (100mx100mx3m)	(No.)	40
Unit Recharge considered 17% filling for 3 times	(ham/year)	1.53
Expected Total Recharge	(in ham)	61.2
Net Irrigated Area	**(Ha)**	17427
Sugarcane Irrigated Area		200
% of Sugarcane Irrigated Area to Net Irrigated Area	(%)	1.15
Area irrigated under other crops	**(Ha)**	17227
Gross Draft from irrigation	**(Ham)**	10023.31
Ratio of Sugarcane Vs Other Crops		
Annual Sugarcane Draft	**(Ham)**	112.8
35% Saving of water with new irrigation practices	(%)	39.48
Net GW draft after Interventions	**(ham)**	9910.51
Final Projected stage of G.W. Dev. after adoption new irrigation practices in sugarcane area + AR & WUE Intervention		9871.03

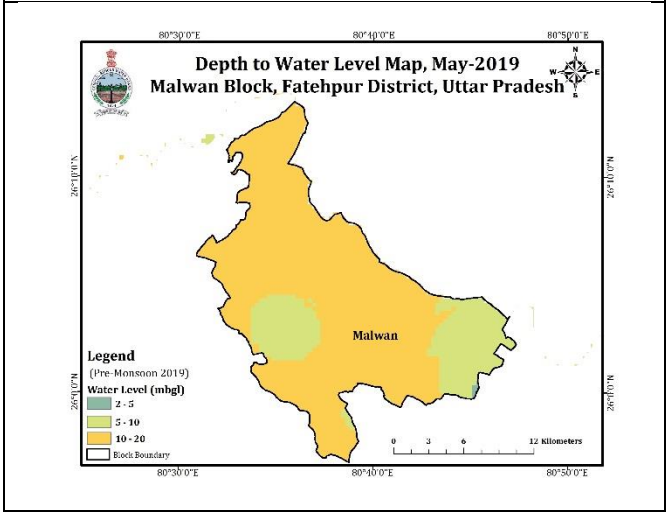
Aquifer Map and Management plan of Malwan Block Fatehpur District U.P.

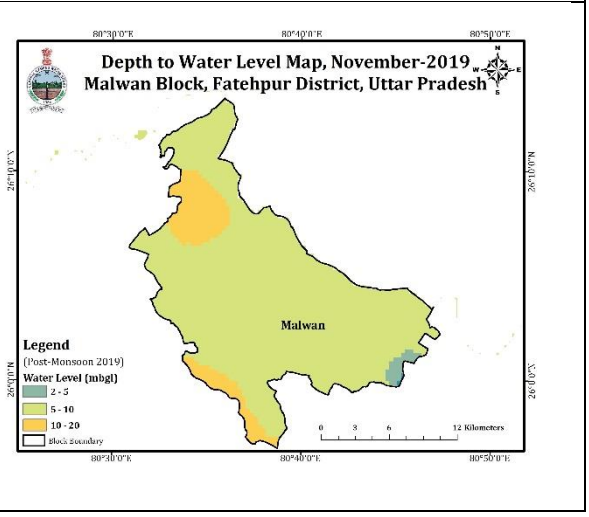










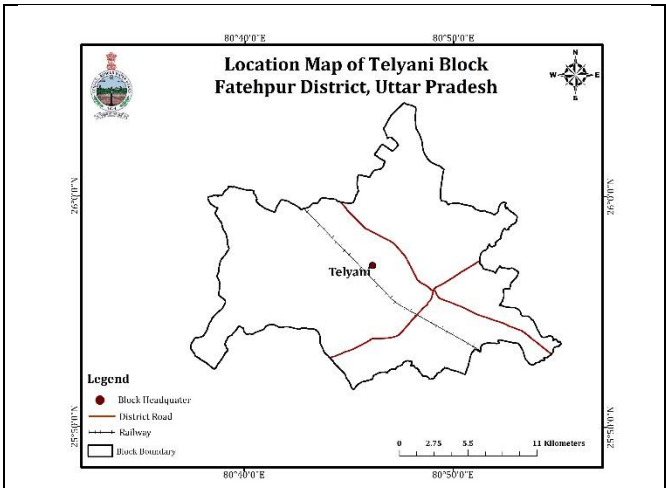


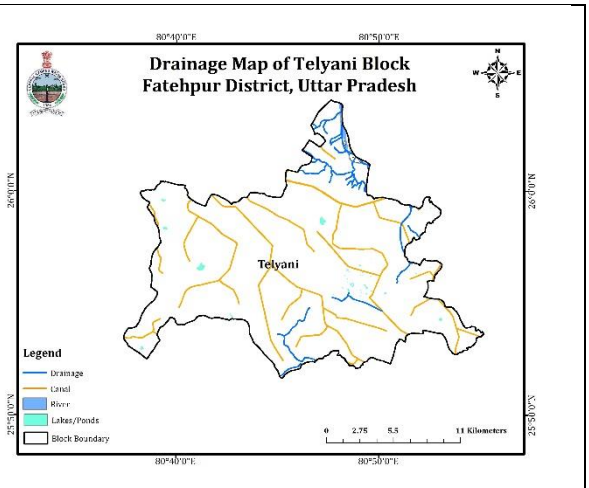
9.8 MALWAN BLOCK AT A GLANCE

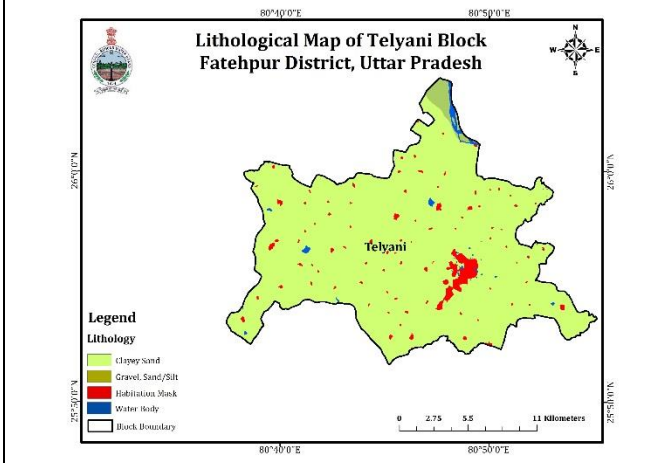
Block	(Unit)	Malwan
Area Irrigated by Surface Water	(ha)	4658
Area Irrigated by Ground Water	(ha)	17473
Contribution of GW	(%)	78.95
Canal Length	**(km)**	123
Govt Tube Wells	(No.)	26
Well		4
(Shallow Tube Wells) in No.	**Electric Pumps**	1026
	Diesel Pumps	3515
	Others	46
Medium Tube Wells	(No.)	89
Deep Tube wells		62
Rainfall	(mm)	609.5
pH		
EC µS/cm at 25°C		
HCO_3	**(mg/l)**	537
Cl		213
F		1.5
NO_3		15
SO_4		171
TH		250
Ca		24
Mg		46
Na		315
K		6.1
SiO_2		20
Fe	**(µg/l)**	0.08
Mn		0.01
Zn		0.05
As		0
U		43
Cr		2
Net Annual Ground Water Availability	(ham)	14949.7
Existing Gross Ground Water Draft for Irrigation		10297.4
Existing Gross Ground Water Draft for Domestic &		634.85

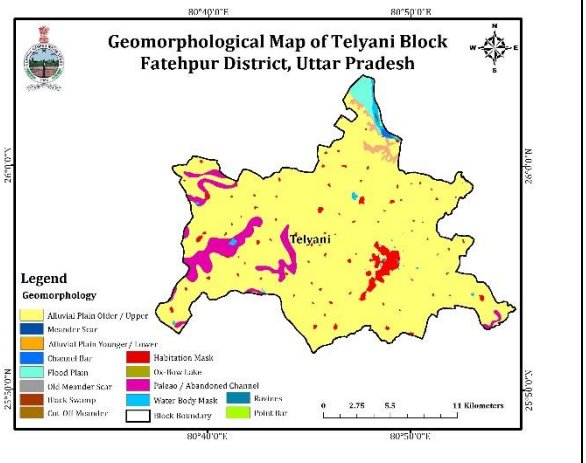
Industrial Water Supply		
Existing Gross Ground Water Draft for All Uses		10932.3
Provision for Domestic and Industrial Requirement Supply for 2025		759.89
Net Ground Water Availability for future Irrigation development		3892.4
Stage of Development	(%)	73.13
Category		
Check Dams of 45000 cum Capacity (1500m*10m*3m)	(No.)	8
Unit Recharge consider 50% filling for 3 times	(ham/year)	6.75
Expected Total Recharge	(in ham)	54
Construction of new ponds / renovation of old ponds (100mx100mx3m)	(No.)	47
Unit Recharge considered 17% filling for 3 times	(ham/year)	1.53
Expected Total Recharge	(in ham)	71.91
Net Irrigated Area	**(Ha)**	21752
Sugarcane Irrigated Area		376
% of Sugarcane Irrigated Area to Net Irrigated Area	(%)	1.73
Area irrigated under other crops	**(Ha)**	21376
Gross Draft from irrigation	**(Ham)**	10932.3
Ratio of Sugarcane Vs Other Crops		
Annual Sugarcane Draft	**(Ham)**	212.06
35% Saving of water with new irrigation practices	(%)	74.22
Net GW draft after Interventions	**(ham)**	10720.2
Final Projected stage of G.W. Dev. after adoption new irrigation practices in sugarcane area + AR & WUE Intervention		10646

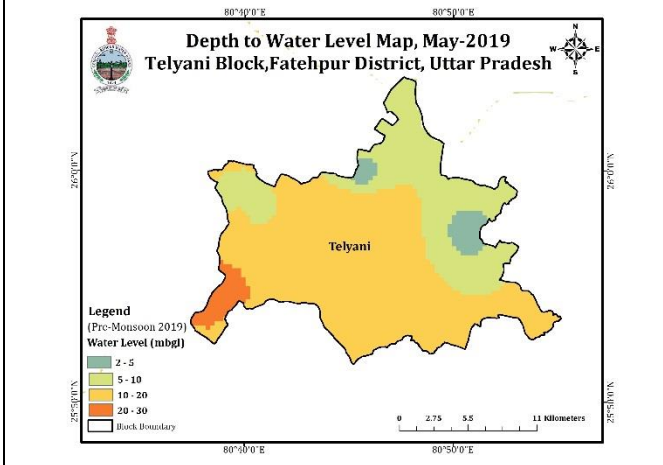
Aquifer Map and Management plan of Telyani Block Fatehpur District U.P.

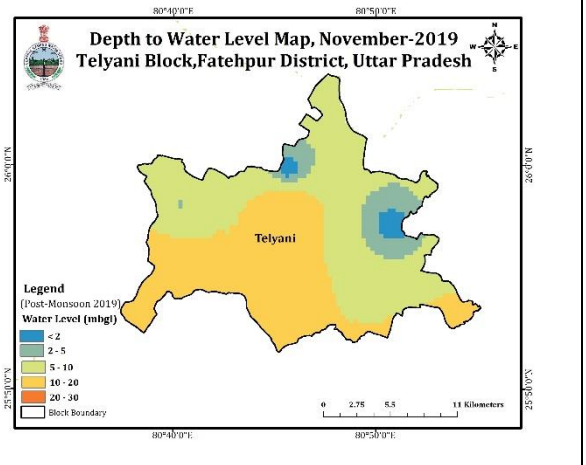












9.9 TELIYANI BLOCK AT A GLANCE

Block	(Unit)	Teliyani
Area Irrigated by Surface Water	(ha)	3292
Area Irrigated by Ground Water	(ha)	12403
Contribution of GW	(%)	79.03
Canal Length	**(km)**	104
Govt Tube Wells	(No.)	12
Well		7
(Shallow Tube Wells) in No.	**Electric Pumps**	432
	Diesel Pumps	3619
	Others	16
Medium Tube Wells	(No.)	233
Deep Tube wells		49
Rainfall	(mm)	609.5
pH		
EC µS/cm at 25°C		
HCO_3	**(mg/l)**	549
Cl		21
F		1.04
NO_3		BDL
SO_4		6
TH		150
Ca		12
Mg		29
Na		155
K		7
SiO_2		25
Fe	**(µg/l)**	0.04
Mn		0.01
Zn		0.4
As		0
U		18
Cr		4
Net Annual Ground Water Availability	(ham)	8477.62
Existing Gross Ground Water Draft for Irrigation		5780.2
Existing Gross Ground Water Draft for Domestic &		368.83

Industrial Water Supply		
Existing Gross Ground Water Draft for All Uses		6149.03
Provision for Domestic and Industrial Requirement Supply for 2025		444.19
Net Ground Water Availability for future Irrigation development		2253.22
Stage of Development	(%)	72.53
Category		
Check Dams of 45000 cum Capacity (1500m*10m*3m)	(No.)	4
Unit Recharge consider 50% filling for 3 times	(ham/year)	6.75
Expected Total Recharge	(in ham)	27
Construction of new ponds / renovation of old ponds (100mx100mx3m)	(No.)	100
Unit Recharge considered 17% filling for 3 times	(ham/year)	1.53
Expected Total Recharge	(in ham)	153
Net Irrigated Area	**(Ha)**	15419
Sugarcane Irrigated Area		292
% of Sugarcane Irrigated Area to Net Irrigated Area	(%)	1.89
Area irrigated under other crops	**(Ha)**	15127
Gross Draft from irrigation	**(Ham)**	6149.03
Ratio of Sugarcane Vs Other Crops		
Annual Sugarcane Draft	**(Ham)**	164.69
35% Saving of water with new irrigation practices	(%)	57.64
Net GW draft after Interventions	**(ham)**	5984.34
Final Projected stage of G.W. Dev. after adoption new irrigation practices in sugarcane area + AR & WUE Intervention		5926.7