केंद्रीय भूमि जल बोर्ड

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भारत सरकार

Central Ground Water Board

Department of Water Resources, River Development and Ganga Rejuvenation,

Ministry of Jal Shakti

Government of India

AQUIFER MAPPING AND MANAGEMENT OF GROUND WATER RESOURCES

SHEOPUR DISTRICT, MADHYA PRADESH

उत्तर मध्य क्षेत्र, भोपाल

North Central Region, Bhopal

CONTENTS

By

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1. INTRODUCTION

National Aquifer Mapping (NAQUIM) has been taken up in XII five-year plan by CGWB to carry out detailed hydrogeological investigation on 1:50,000 scale. The NAQUIM has been prioritized to study Over-exploited, Critical and Semi-Critical blocks as well as the other stress areas recommended by the State Govt. Aquifer mapping is a process wherein a combination of geologic, geophysical, hydrologic and chemical analyses is applied to characterize the quantity, quality and sustainability of ground water in aquifers.

The vagaries of rainfall, inherent heterogeneity & poor sustainability of hard rock aquifers, over exploitation of once copious alluvial aquifers, lack of regulatory mechanism has a detrimental effect on ground water scenario of the Country in last decade or so. Thus, prompting the paradigm shift from "**traditional groundwater development concept**" to "**modern groundwater management concept**".

Varied and diverse hydrogeological settings demand precise and comprehensive mapping of aquifers down to the optimum possible depth at appropriate scale to arrive at the robust and implementable ground water management plans. The proposed management plans will provide the **"Road Map"** for ensuring sustainable management and equitable distribution of ground water resources, thereby primarily improving drinking water security and irrigation coverage. Thus, the crux of NAQUIM is not merely mapping, but reaching the goal-that of ground water management through community participation. The aquifer maps and management plans will be shared with the administration of Sheopur district, Madhya Pradesh for its effective implementation.

The activities under NAQUIM are aimed at:

- Identifying the aquifer geometry
- Aquifer characteristics and their yield potential
- Quality of water occurring at various depths
- Aquifer wise assessment of ground water resources
- Preparation of aquifer maps and
- Formulate ground water management plan

1.1 Background of Aquifer Mapping

'Aquifer mapping' is a holistic approach for aquifer-based groundwater management. It may not be construed as aquifer geometry mapping only. In a broader perspective it can be defined as understanding the aquifers, ascertaining and establishing their quantity and quality sustainability through multi-disciplinary scientific approach integrating the techniques of geology, remote sensing, hydrogeology, geophysics, borehole drilling, hydrochemistry, hydrology, hydrometeorology, mathematical modelling, agriculture and soil science, water treatment and remediation, economics and social and environmental sciences. Out of these the Geophysical technique will help as a strong tool to identify the aquifer geometry precisely.

1.2 Scope of Study

At present a generalized picture of aquifer-dispositions and their characteristics are known from the existing hydrogeological and surface geophysical data, the borehole lithological and geophysical logs and the aquifer performance tests conducted by CGWB and other central and state agencies. But it is not enough to prepare aquifer maps because of the inadequate density of data vis-à-vis geological heterogeneities. The extrapolation and interpolation within the existing boreholes may not yield accurate information on aquifer disposition unless they are tied up further by close-grid geophysical measurements conducted in between. This has necessitated in a systematic mapping of aquifers. Further hydro- geological investigation either by geophysical technique or by exploration is proposed for the aquifer mapping. It is to provide adequate and precise subsurface information in terms of aquifer lithology and geometry leading to 3-dimensional

aquifer dispositions. Also, it is to establish the most appropriate technique or combination of techniques for identifying the aquifers in different hydrogeological terrains.

1.3 Objectives

The objective of applying the hydrogeological and geophysical techniques is to provide more adequate and more precise (reduced uncertainty and ambiguity) information on aquifers – shallow and deep including dry and saturated zones with their geometry at reasonable scale (1: 50,000) in the area. The tentative depth of the hydrogeological and geophysical exploration will be 200 m in hard rock area. However, the depth of exploration may vary depending on the geological conditions and requirements. Additional exploratory wells shall be drilled for validations of aquifer parameter estimations where borehole data are not available.

The information thus generated through additional drilling of boreholes shall be used for refinement of hydrogeological data base in terms of aquifer characterization, yield capacity, chemical quality, selecting areas for artificial recharge and sustainability under varied future demand scenario leading to preparations of aquifer-management plans and recommendations to mitigate mining of aquifer.

1.4 Approach and Methodology

National Aquifer Mapping Programme basically aims at characterizing the geometry, parameters, behavior of ground water levels and status of ground water development in various aquifer systems to facilitate Major Aquifers planning of their sustainable management. The major activities involved in this process include compilation of existing data, identification of data gaps and generation of data for filling data gaps and preparation of aquifer maps. The overall methodology of aquifer mapping is presented **(Fig-1.1)** once the maps are prepared, plans for sustainable management of ground water resources in the aquifers mapped shall be formulated and implemented through participatory approach involving all stakeholders.

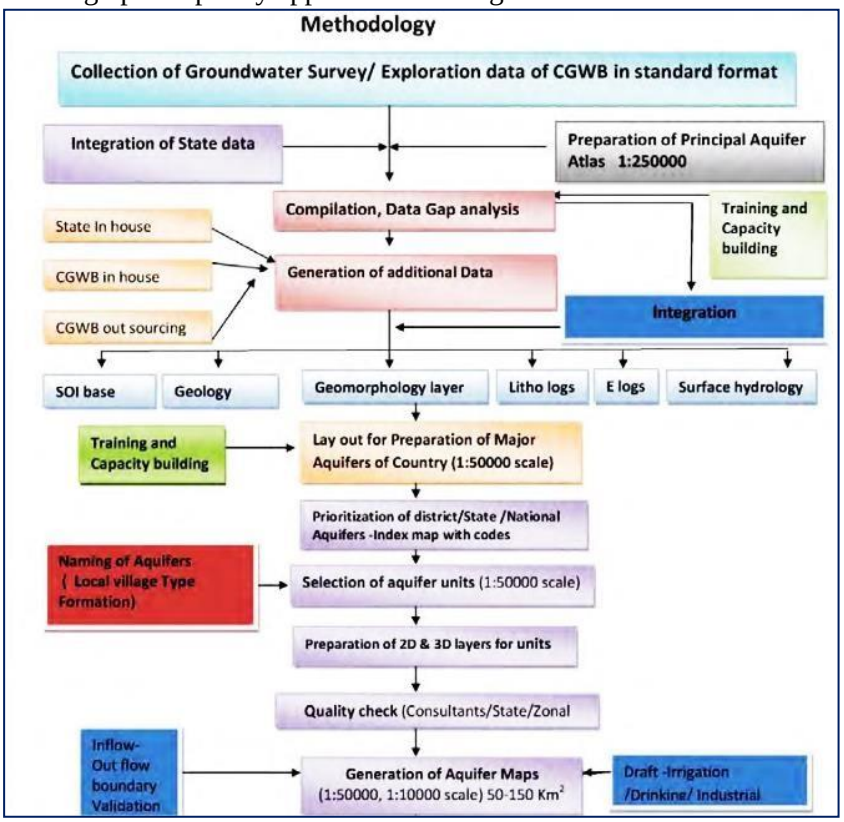


Fig: 1.1 Flow Chart of Methodology

1.5 Study Area

The Sheopur district lies in North Western corner of the state of Madhya Pradesh **(Fig-1.2),** covering an area of 6606 Sq Km **(As per GWRA-2020)**. The Sheopur Kalan district in bordered by Rajasthan on the west and Uttar Pradesh on the north. The adjacent districts are Morena, Gwalior and Bhind in the east and Shivpuri in the south. The district lies between North Longitude 760 30' to 770 40' and east latitude 250 15' to 260 15' falling in survey of India toposheet No's 54 C/10, 11, 14, 9, 13, 54 F/4 & 8 and 54 G/2, 3 & 9. Sheopur town is the district head quarter for administrative purposes. The district is sub divided into 5 Tehsils and 3 blocks. There are 586 Villages, 225 Panchayats and 5 Tehsils in the District and as per census 2011, the total population of the district 5,80,509. **(Table-1.1 & 1.2)**

Table-1.1 Blocks in Sheopur district

Sl No.	Blocks	Male	Female	Total	SC	ST	GEN/OBC
1	Vijaypur	1,15,353	99,688	2,15,041	38,005	44514	1,32,522
2	Sheopur	1,22,548	1,13,036	2,35,584	46,059	30787	1,58,738
3	Karahal	67,459	62,425	1,29,884	7,736	81926	40,222
Total		3,05,360	2,75,149	5,80,509	91,800	157227	3,31,482

Source- Census handbook- 2011

Table-1.2: Administrative setup of Sheopur district, MP

S. No.	Blocks	Area Sq. Km
1	Karahal	2287
2	Vijaypur	1426
3	Sheopur	2893
Total		6606

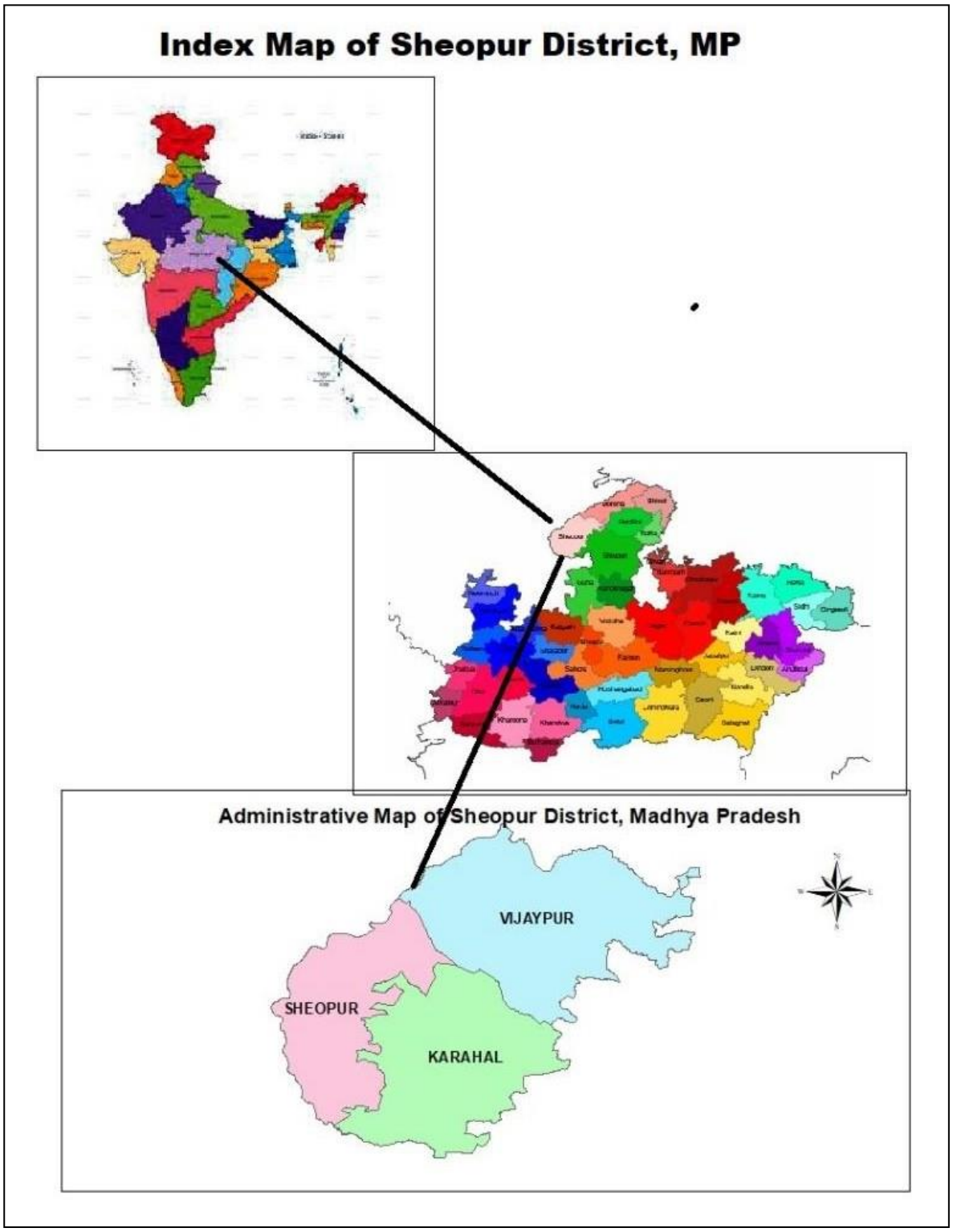


Fig-1.2 Administrative Map of Sheopur district

2. DATA COLLECTION AND GENERATION

The data collection and compilation for various components was carried out as given below.

- Hydrogeological Data – Current and historical water levels along with water level trend data of monitoring wells representing Aquifer-I (Shallow aquifer) of CGWB. The weathered zone thickness (aquifer-I), lithological details of deeper aquifers (aquifer- II) of exploratory wells were also collected and compiled.

- Hydro chemical Data - Ground water quality data of monitoring wells of CGWB representing shallow aquifer and data from exploratory wells representing deeper aquifer.

- Exploratory Drilling – Ground water exploration data of exploratory wells of CGWB.

- Hydro meteorological Data - Long term rainfall data for the whole district and for each block from Indian meteorological Department and Water Resource Department.

- Cropping Pattern Data – Data on prevailing cropping pattern from District Irrigation Plan, Sheopur district.

- For data generation 27 no’s of key wells have been established throughout the district and collected Pre-monsoon water sample.

- Again, for data generation 27 no’s of VES has been performed through out the district

2.1 DATA AVAILABILITY

The compiled data were plotted on a 1:50000 scale map, and analysis of the data gap was carried out. The summarized table comprising the data requirement, data availability, and data gap analysis is presented in the following **table-2.1**

Table-2.1various data for NAQUIM study

S. No	Items	Data Requirement	Data Availability
1	Rainfall Data	Meteorological stations spread over the project area.	India-Wris
2	Soil	Soil map	Prepared
3	Land Use	Latest Land UsePattern	Prepared from Land Sat 8 Imagery in GIS.
4	Geomorphology	Digitized Geomorphological Map	Bhukosh.
5	Geophysics	Geophysical data in each Quadrant	27 VES done till date
6	Exploration Data	EW in each Quadrant with Aquifer Parameters	24 exploratory wells drilled till now
7	Aquifer Parameters	Aquifer parameters for all the quadrants	Available
8	Groundwater Level	Decadal water level data	CGWB monitoring well data

2.2 DATA COLLECTION AND GENERATION

Data on all the attributes of Aquifer Mapping has been generated based on the data availability and data gap analysis. The data generated and data collected from various state governments agencies are summarized in the following **table-2.2**

Table 2.2. Data Generated and Data collected for Aquifer Mapping Area.

S.No	Items	Data Generated	Data Collected
1	GW Regime Monitoring	27 Key observation wells established	Pre-monsoon depth to water level
2	Chemical Quality	27 Samples collected during June, 2022 for Basic element analysis & 11 samples for Heavy metal analysis	GW Samples submitted for chemical analysis to generate the quality data.
3	Exploration	24 Exploratory wells drilled	Lithologs, Aquifer geometry and aquifer parameters measured.

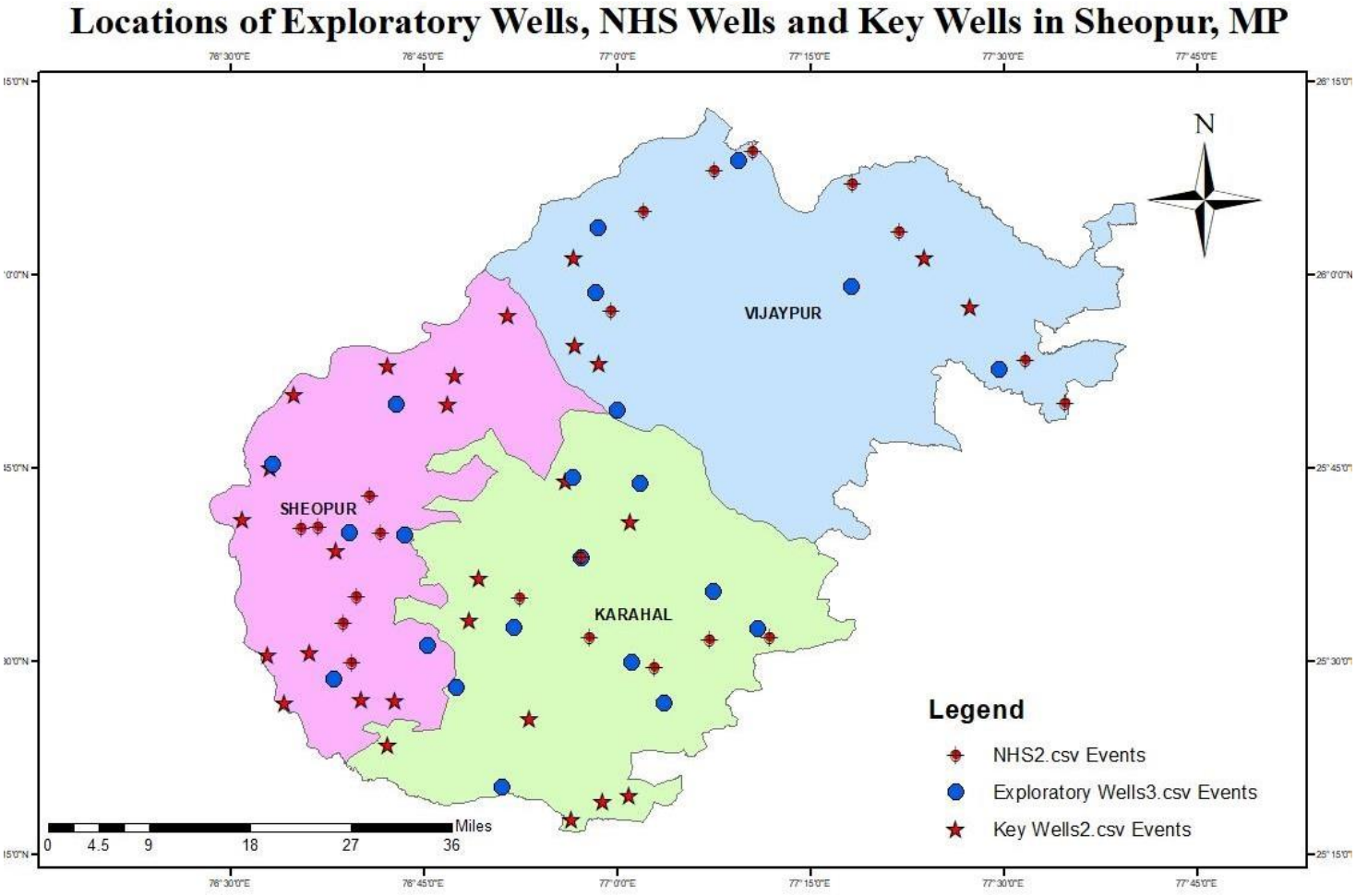


Fig.1.3 Map showing all the Key wells established during June 2022, NHS wells & Exploratory Wells in Sheopur district

2.3 IRRIGATION

The district is covered with hard and compact rocks. So, the water bearing formations are limited and varied from place to place in their thickness and discharge. However, the structures like large water harvesting Ponds, dug wells, borewells etc. are used for ground water withdrawal. Agriculture is the backbone of the district as there are no industries to provide rural as well as urban employment. The majority of the population is engaged in agriculture. The major crop of district is kharif season soybean paddy and other crops are sesamum, bajra, maize jowar. major crops Rabi season wheat, mustard and others crops are gram. The introduction of the modem varieties of mustard/wheat and Bajra, in 1960s and 70s changed the agriculture land scenario of the district. The district considerably with diversified cropping system in 60s to predominantly Bajara, Mustard -wheat system now. The use of fertilizers and improved irrigation facilities improved the cropping intensity to almost 154.72 % (Table-) the increase in the use fertilizer, irrigation and now pesticides have led increased cost of cultivation. There are 259762 ha. are under cultivation of different crops. The percentage of net sown area to total cultivable 65%.

Table-2.3- Cropping intensity, Sheopur district, MP

Sl No	Block	Cropping Intensity(%)
1	Sheopur	167.35
2	Karahal	143.22
3	Vijaypur	132.03
Total		154.72

Sl No		Blocks	Irrigated Area(Ha)		Rainfed Area(Ha)
		Gross Irrigated Area (Ha)	Net Irrigated Area (Ha)	Partially Irrigated/Protective Irrigation (Ha)	Unirrigated/ Totally Rainfed Area(Ha)
1	Sheopur	110166	91973	-	49478
2	Karahal	28322	28233	-	30378
3	Vijaypur	27190	22031	-	13958
		165678	**142237**	-	**93814**

(*Source-DIP,Sheopur)

2.4 CLIMATE AND RAINFALL

2.4.1 Climate

The climate of Sheopur- Kalan District, M.P. is characterized by a hot summer and general dryness except during the south – west monsoon season. The year may be divided into four seasons. The cold season, December to February is followed by the hot season from march to about the middle of June. The period from middle of June to Sept. is the south west monsoon season. October and November forms the post-monsoon or transition period. The normal annual rainfall of the district is 730.2 mm in the year 2021 **(Table-2.4).** The district receives maximum rainfall during south-west monsoon period i.e. June to Sept. Thus, surplus water for ground water recharge is available only during the monsoon period. The normal maximum temperature recorded during the month of may in 47^0C and minimum during January is 2^0C. The wind velocity is higher during pre-Manson period as compared to post monsoon period. The max. wind velocity (11.3 Km/hr) observed during the month of June. The rainfall comparison is shown in **fig-1.4**.

Table-2.4, Rainfall data of Sheopur district, MP

YEAR	Monsoon(mm)	Non-Monsoon(mm)	Total(mm)
2016	698.9	29	727.9
2017	404.6	31.4	436
2018	795.7	3.5	799.2
2019	849.3	61.1	910.4
2020	579.6	63.8	643.4
2021	670.7	59.5	730.2

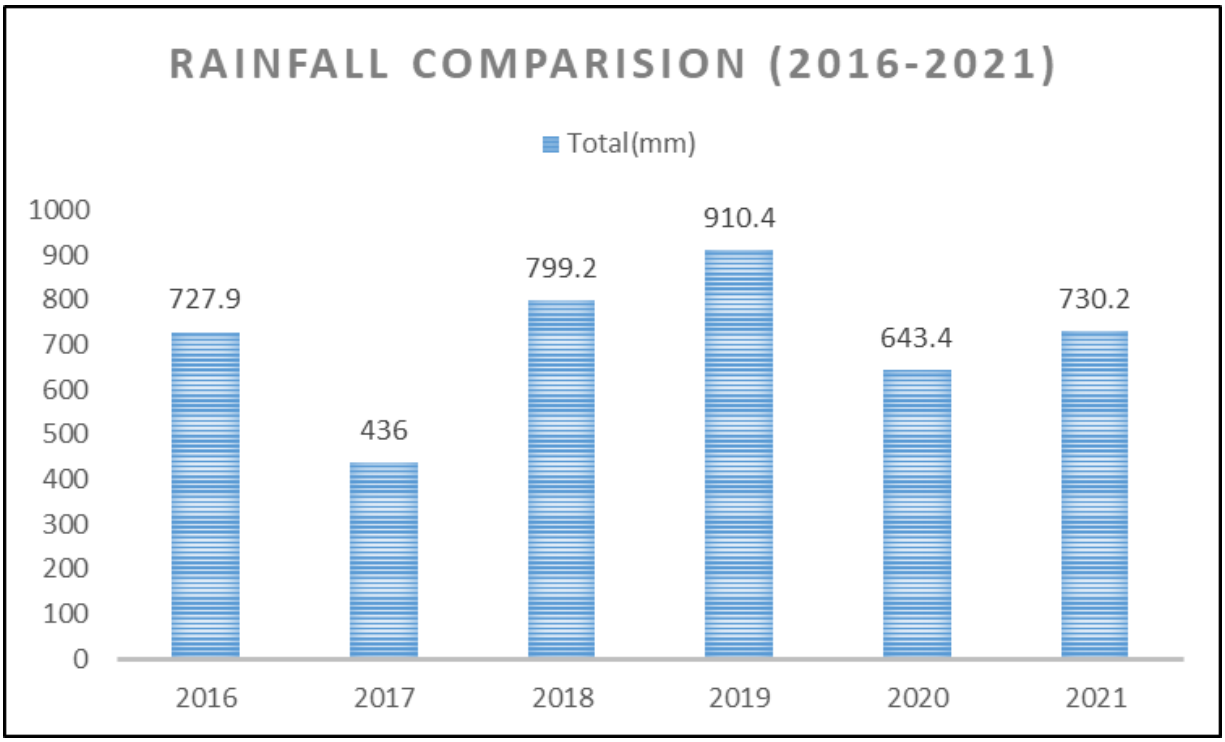


Fig.1.4 Rain Fall Comparison of Sheopur District, MP

2.5 DRAINAGE

In geomorphology, a drainage system is the pattern formed by the streams, rivers, and lakes in a particular drainage basin. The Chambal & its tributaries forms the major drainage pattern **(Fig-1.5).** The Chambal River flows along the northern periphery of the district whereas the Parbati, the biggest tributary of Chambal forms the western boundary of the district. The length of the Chambal River is about 250 km. All other rivers which are tributaries of the Chambal are generally flowing from south to north. Another major tributary is Kunnu, Sip Nadi & Kadwal Nadi. They are governed by the topographyof the land, whether a particular region is dominated by hard or soft rocks and the gradient of the land. Geomorphologists and hydrologists often view streams as being part of drainage basins. A drainage basin is the topographic region from which a stream receives runoff, through flow, and groundwater flow. Drainage basins are divided from each other by topographic barriers called a watershed. A watershed represents all of the stream tributaries that flow to some location along the stream channel. The number, size, and shape of the drainage basins found vary from one place to another.

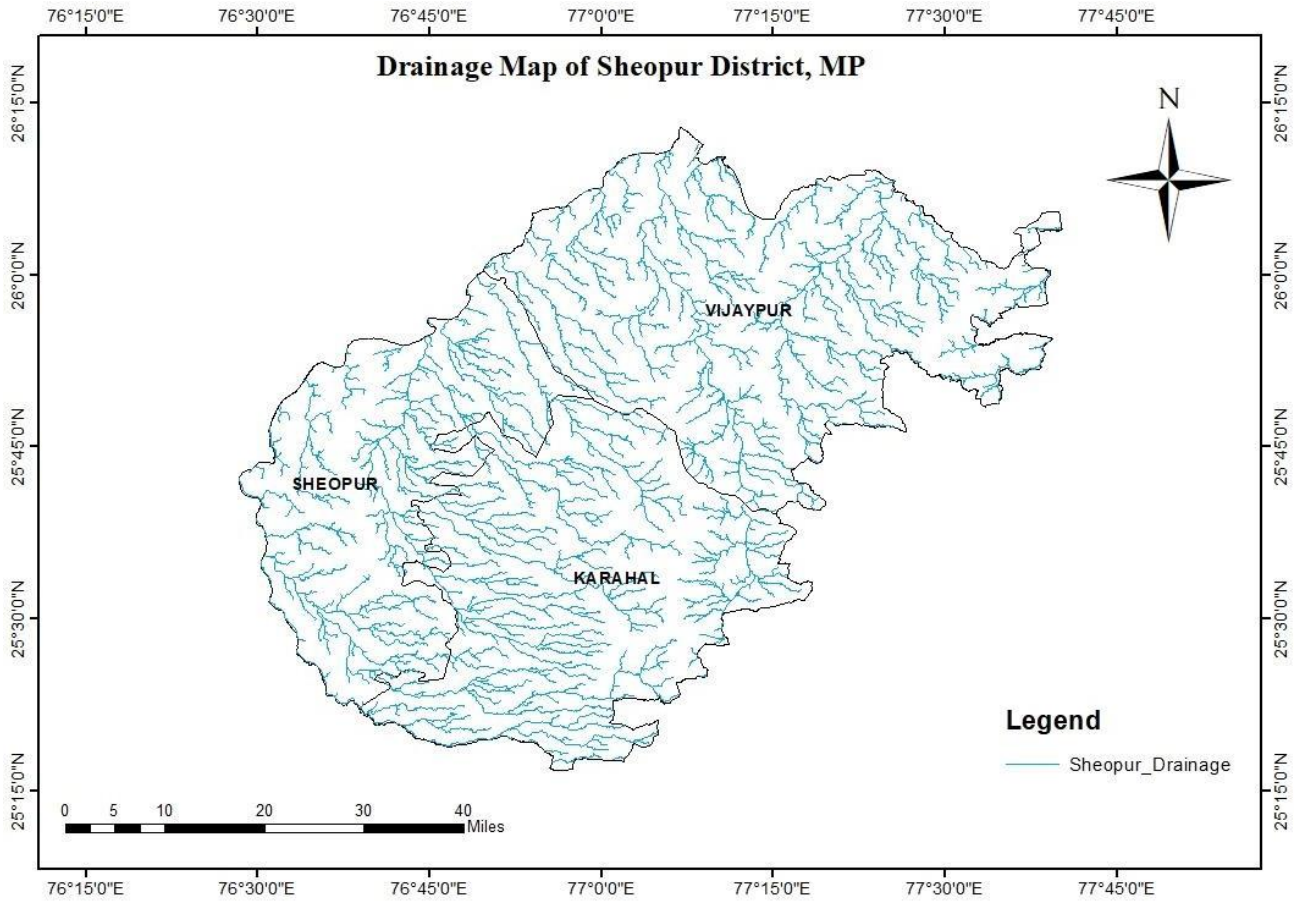


Fig-1.5 Drainage in Sheopur District, MP

2.6 Physiography:

Physiographically, Sheopur district is covered by Vindhyan Group of rocks and in some parts by Recent Alluvium **(Fig-1.6).** The Vindhyachal range has maimum elevation of 512 m above mean sea level and minimum elevation of 145m above Mean Sea Level. These are governed by geological formations and their lithological and structural configurations. Sandstone form the hilly areas with prominent scarps and spurs, while shale normally, because of their inherent proclivities for denudation from plain and low lying areas.

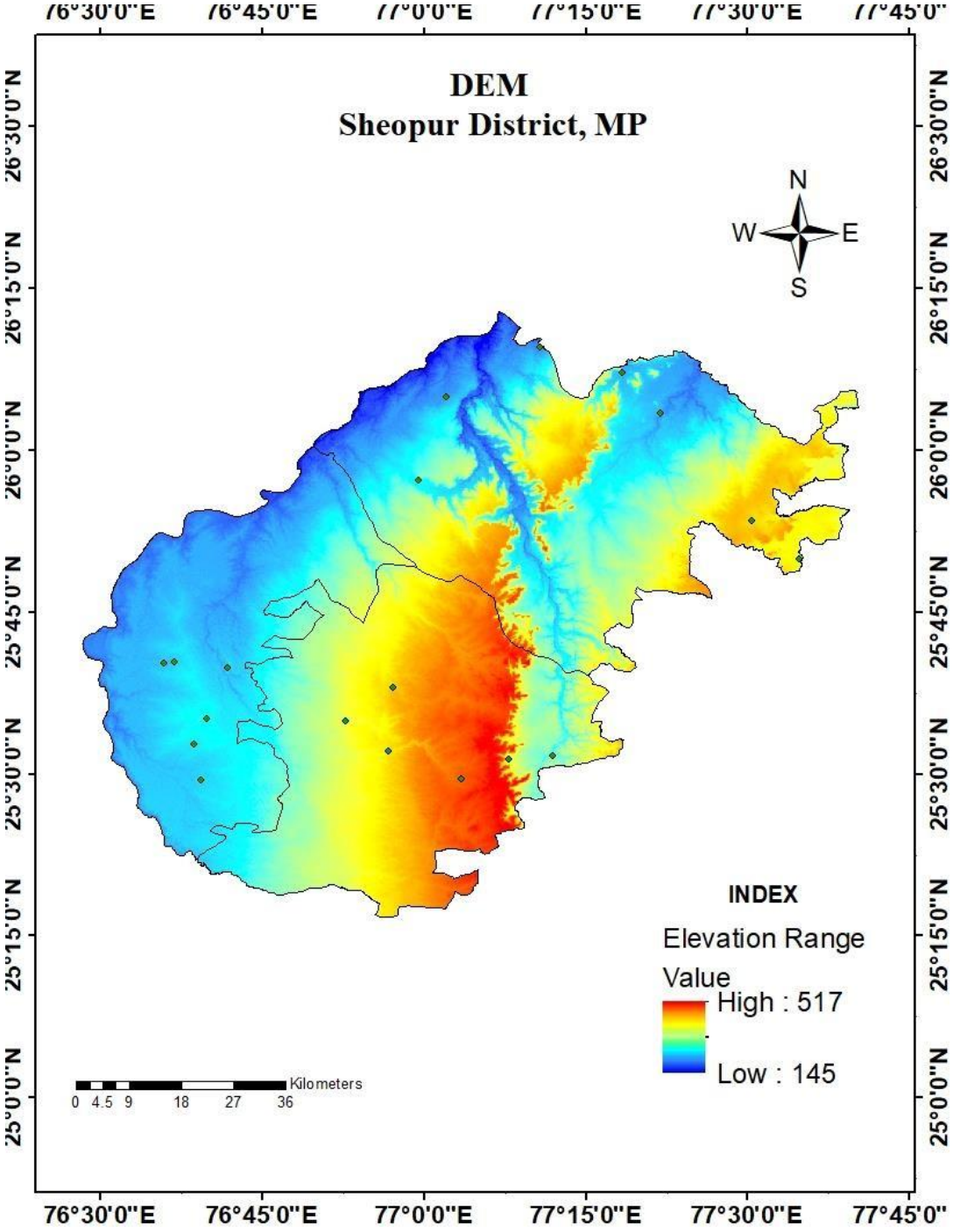


Fig-1.6 DEM, Sheopur District, MP

2.7 Geomorphology

The Geomorphological map explains the geo-environment, geo-engineering, geohazards, mineral and ground water exploration and also interdisciplinary themes like soil, land use / land cover and forest, etc. Geomorphology plays an important role in various fields of planning. One of the major themes is the irrigation development wherein the geomorphological guides are used as one of the indicator zones for site selection. The understanding of subsurface geology is a primary requirement for planning exploration and exploitation strategies. The basement structure highs manifest itself on the surface as geomorphic anomaly like annular drainage pattern, radial pattern, sudden change in the river course etc.

The southern hilly and upland area constituting Vindhyan sandstone, shales and limestone occupies 6640 Sq km are of the district. The maximum elevation is 517m above MSL and the surface gradient is generally from South to North. The Geomorphological map of Sheopur district is shown in the **fig-1.7**

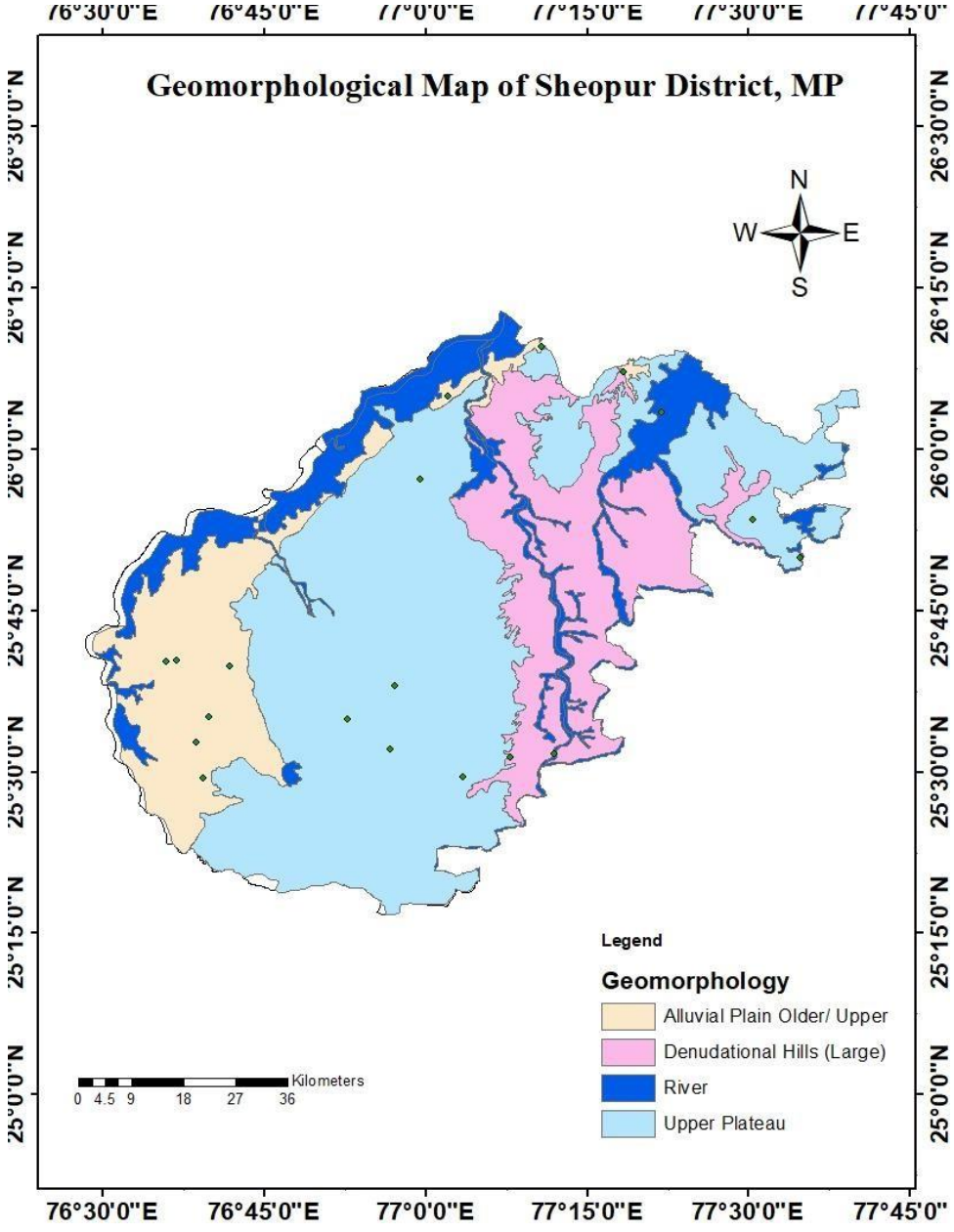


Fig-1.7 Geomorphological map of Sheopur District, MP

2.8 Land Uses

Land use denotes how humans use the biophysical or ecological properties of land. Land use include the modification and/or management of land for agriculture, settlements, forestry and other uses including those that exclude humans from land, as in the designation of nature reserves for conservation.

The major Land use in this district is forest land covers more than 50% of the geographical area. This is followed by net sown area of the geographical area,Waste land and others including water bodies and built up area. The landuse / landcover map of Sheopur district is shown in the **fig-1.8**.

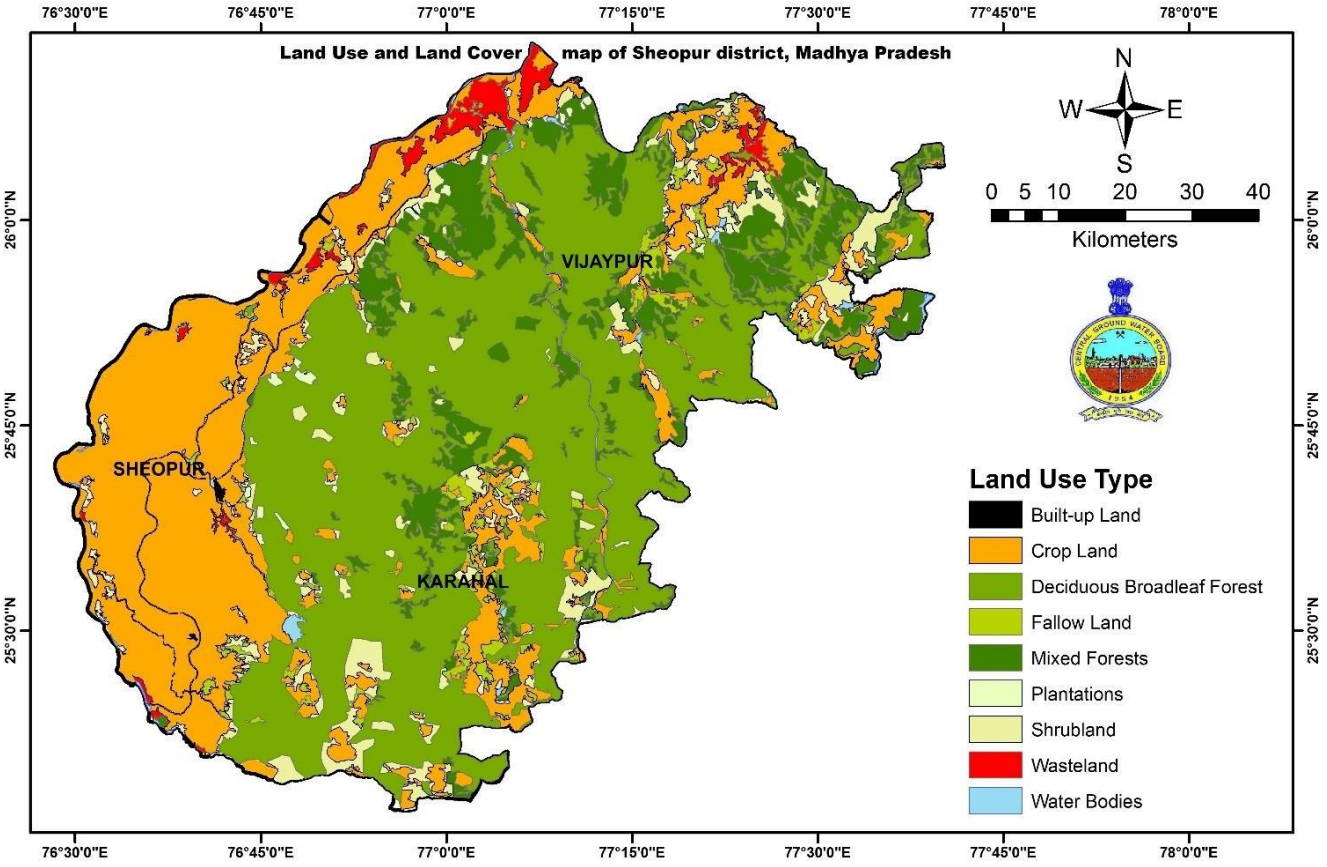


Fig.1.8 Land use and Land Cover Map of Sheopur district, MP

2.9 Soil

Mainly two types of soils are found in the area namely Loamy soil & calcareous soil formed from erosion/ degradation of Vindhyan sandstone/shale/limestone found near the foot hills of high hilly area/ forested area. The Soil map of the district is shown in the **figure-1.9**

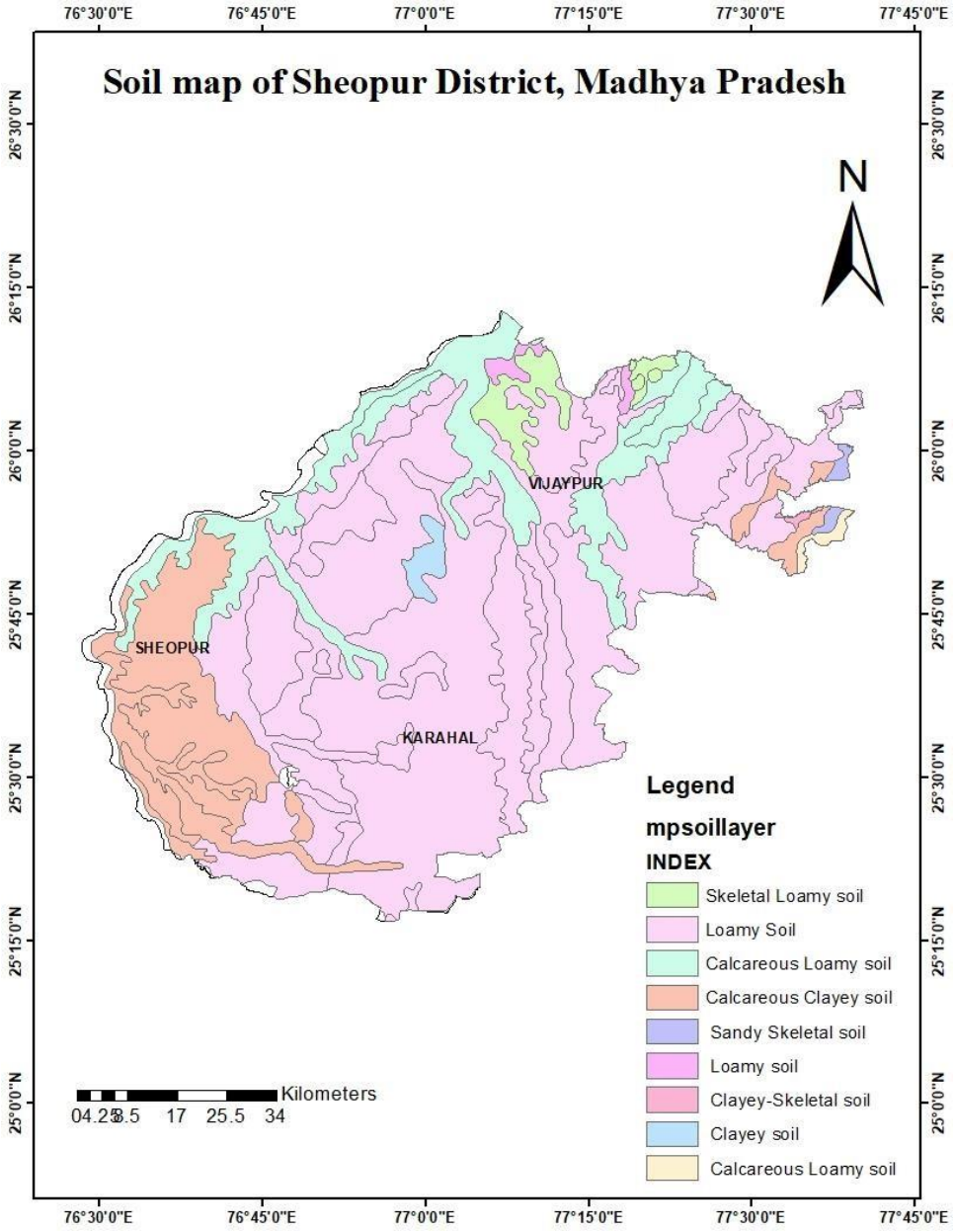


Fig-1.9 Soil map of Sheopur district, MP

2.10 GEOLOGY

The major geological formation in the district is upper Vindhyan which are overlain by Alluvial deposits belonging to Pleistocene to Recent age. Occurrence & movement of ground water is mainly controlled by secondary porosity through joints & fractures. Ground water in general occurs under unconfined to semi-confined conditions. The Geological map of the district is shown in the **fig-2.1**. The occurrence and movement of ground water in different geological formations is described below –

Vindhyan Formation

The sandstones are hard compact with siliceous matrix and as such are completely devoid of primary porosity and permeability. But whenever they are jointed and weathered, secondary porosity and permeability are developed in them and such areas are water bearing. The water bearing capacity largely depends upon the intensity of jointing and degree & thickness of weathering which varies from 2 to 4m in thickness. The shales are fine grained and compact in nature. These are porous but not permeable. The water bearing capacity in shale depends upon degree of weathering and jointing along and across the bedding planes. In general, these shales are not rich in ground water potential. The limestone generally is compact and massive and occurs at the hill top and as such do not possess water bearing capacity. In Vindhyan rock, ground water occurs under water table condition.

Alluvium

The alluvium consisting of clay and silt with intercalated bands of sand, gravel & pebbles and having vary good water bearing capacities. The thickness of these layers ranges from half a meter to more than a meter. The thickness of the alluvium deposits is more towards the Northern periphery of the district. In alluvium, ground water is found under phreatic as well as semi-confined to confined conditions.

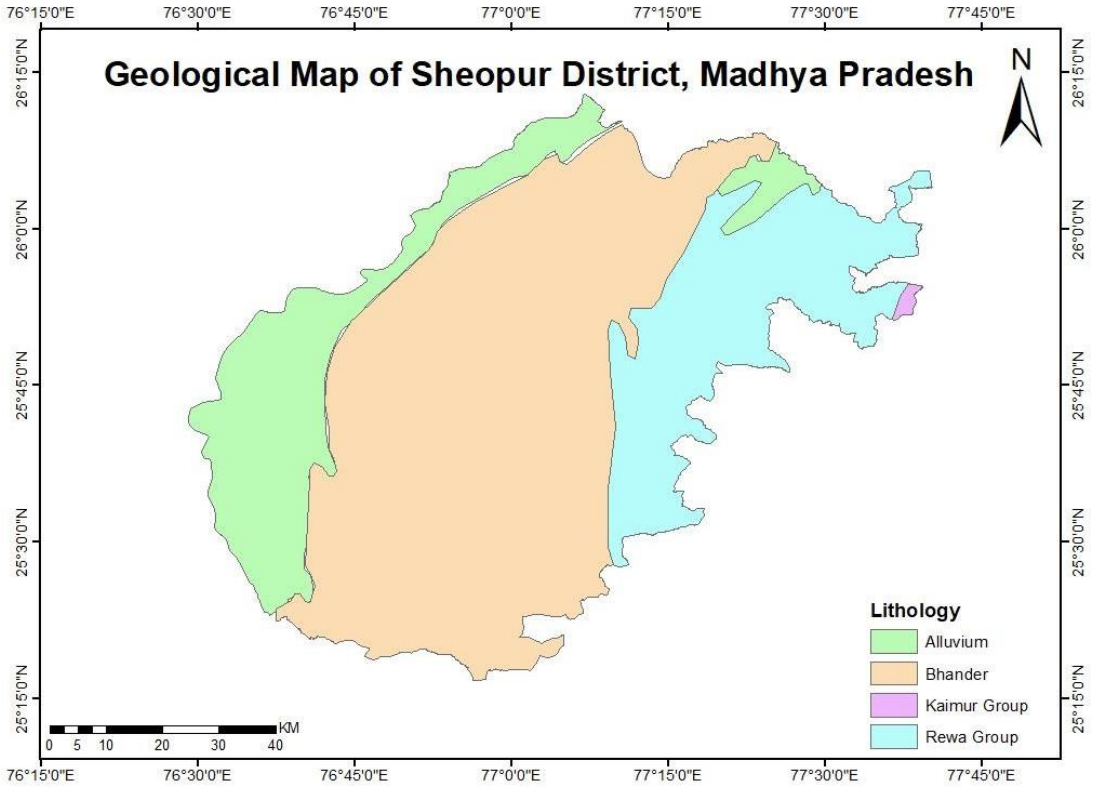


Fig-2.1 Geological map of Sheopur district, MP

2.11 HYDROGEOLOGY

The occurrence and movement of ground water in hard rock areas is widely controlled by the secondary porosity present in them like joints, fractures, weathering etc. The district is mainly occupied by Vindhyan Super Group of rocks & alluvium. The weathering of Precambrian rocks ranges from 0.50 mbgl to 20.00 mbgl. The water bearing properties of these formations varied widely depending upon their lithological properties and structural control. The hydrogeological map of Sheopur district is shown in the **fig-2.2.**

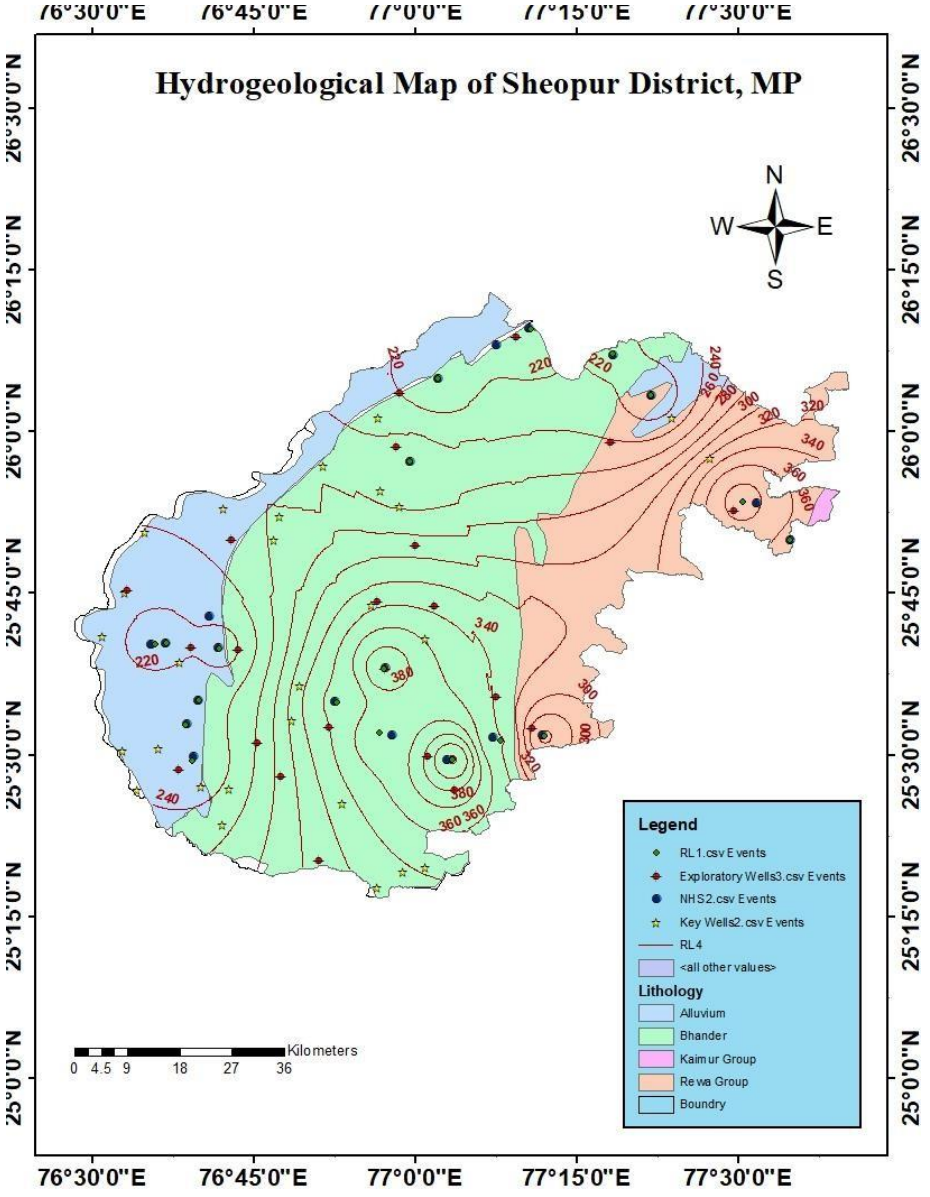


Fig-2.2 Hydrogeology Map of Sheopur district

2.11.1 Occurrence of Ground Water

The Ground Water occurs under water table and semi confined to confined conditions in all formations of the area. Topographic depressions, nature and extent of weathering, presence of joints and fractures play an important role in the occurrence and movement of ground water. The area occupied by Precambrian rocks is mostly undulating. The ground water in these rocks occurs under confined to semi-confined conditions, which is widely controlled by the presence of joints, fracture in them.

The area occupied by the Vindhyan Super Group of rocks, where ground water occurs in the weaker zones of weathered fractured and jointed parts of the rocks. The inter-connection of joints and fractures controls the horizontal as well as vertical movement of ground water.

2.11.2 Ground Water Scenario

Depth to water level Pre-monsoon (June 2022)

The pre-monsoon depth to water level in the district ranges between 2.64 m bgl and 29.6m bgl. Major part of the district has water level in the range of 5-10 m bgl during the pre-monsoon. The Pre-monsoon groundwater level details for June-2022 is presented in Annexure-.

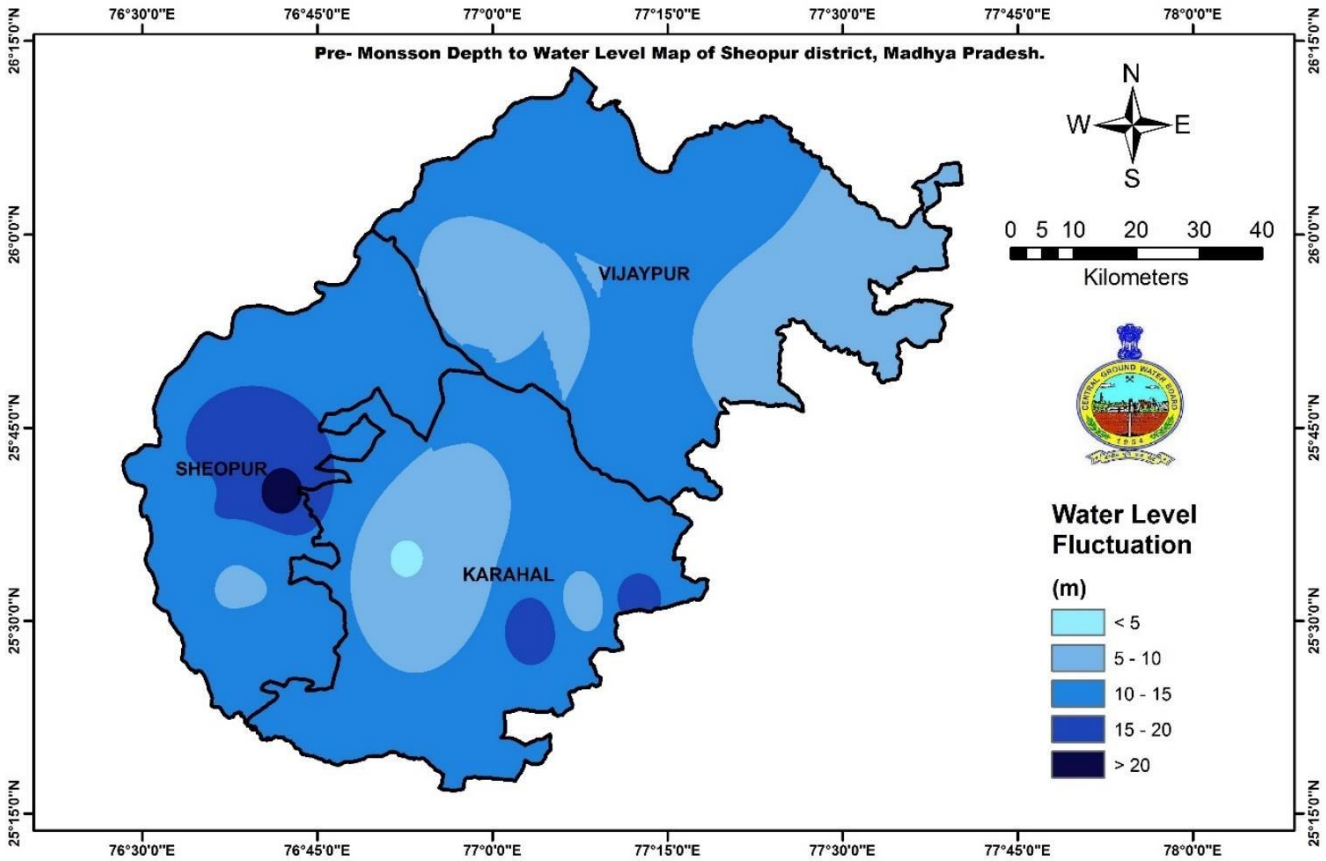


Fig-2.3 Pre- Monsoon Depth of Water Level map of Sheopur District, MP

Depth to Water Level Post –monsoon

The post-monsoon depth to water level in the district ranges between 2.64 m bgl and 29.6m bgl. Major part of the district has water level in the range of 5-10 m bgl during the pre-monsoon. The Pre-monsoon groundwater level details for June-2022 is presented in Annexure-.

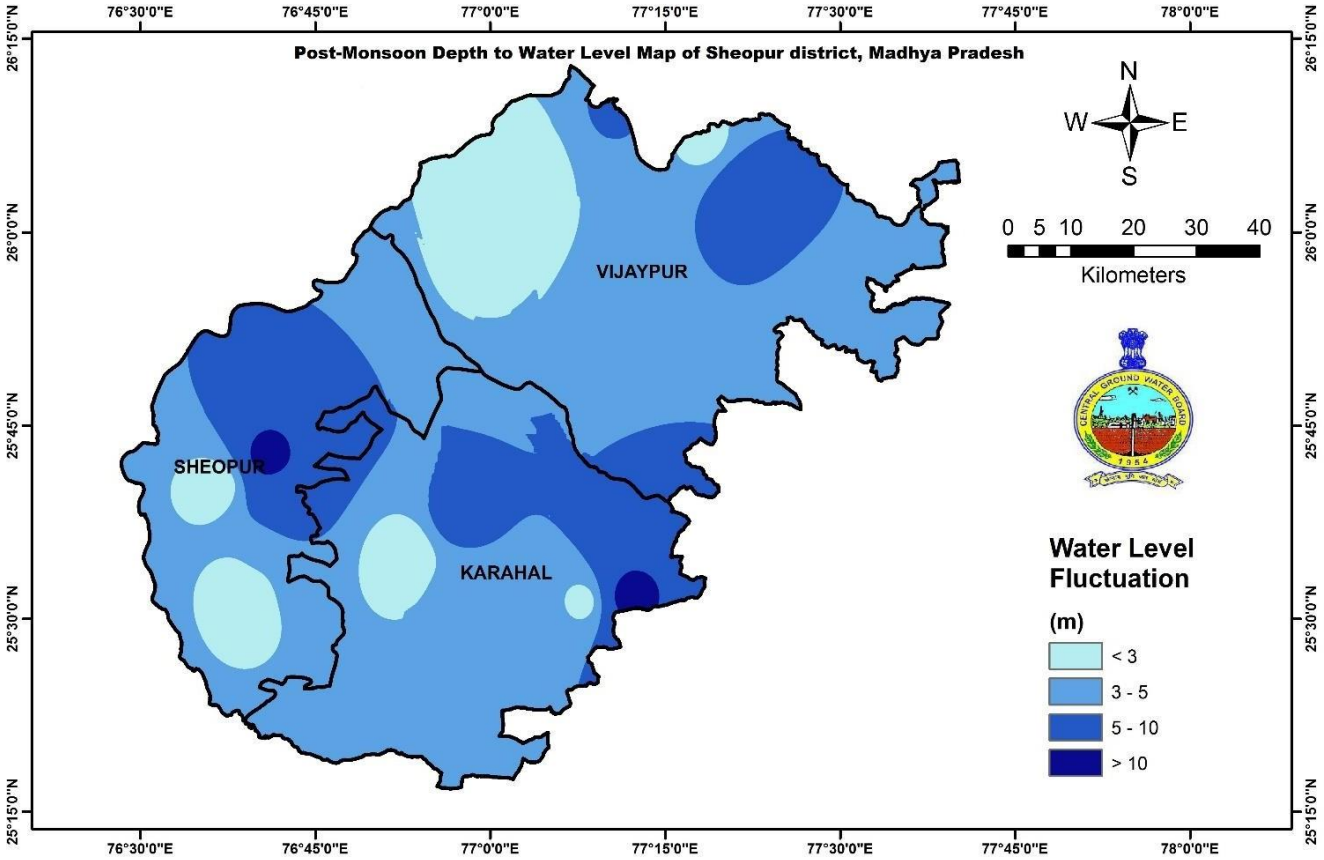


Fig-2.4 Post- Monsoon Depth of Water Level map of Sheopur District, MP

2.11.3 Water level Fluctuation

The water level measured during pre and post monsoon period (2021) was used to compute the seasonal fluctuation. The analysis of water level fluctuation data indicated that minimum water level fluctuation was observed towards Eastern side while maximum water level fluctuation was observed along western and southern parts of the district. The water level fluctuations were grouped under three categories i.e., less, moderate and high and the % of wells in each category was analyzed. The water level fluctuation map of the district is shown in the **fig-2.5.**

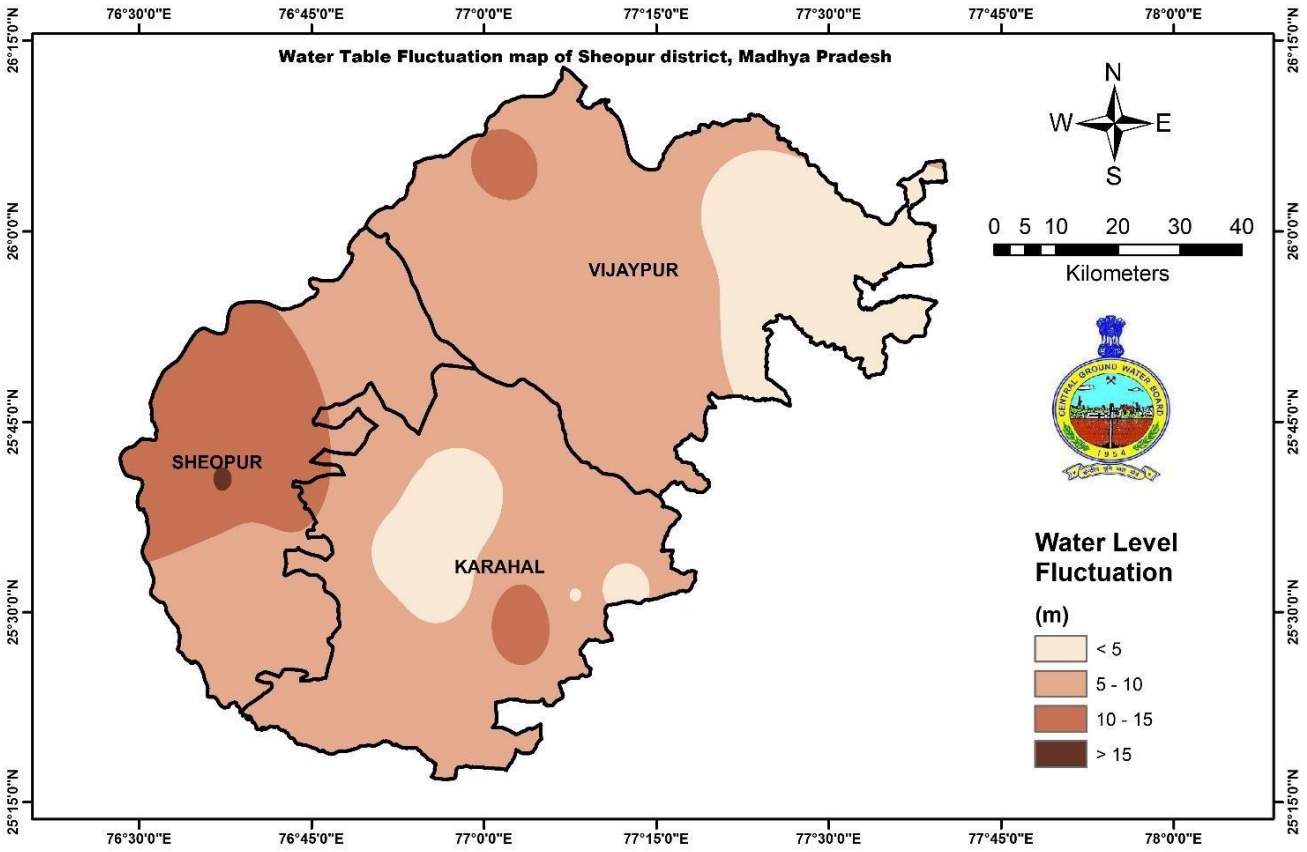


Fig-2.5 Water Table fluctuation map of Sheopur District, MP

2.12 Groundwater Quality

Hydro-chemical scenario of Sheopur District

The water samples were collected from National Hydrograph Stations in clean double stopper poly ethylene bottles from 21 different locations of Sheopur district during May 2021.

Quality of Ground Water for Drinking Purpose:

The ground water samples from Sheopur district have varied range of pH from 7.47 to 8.11. As per BIS (IS 10500 : 2012) recommendation, all the water samples have pH recorded within the permissible limits of 6.5 to 8.5, the maximum pH recorded in the water sample of Goras (8.11). The ground water of the study area can be assessed as neutral to slightly alkaline. The electrical conductivity of ground water samples in Sheopur district varies from 448 to 1680 µS/cm at 25°C. In the 12 nos. of water samples shows electrical conductivity less than 1000µS/cm; in 8 nos. of samples EC in between 1000 to 1500 µS/cm and remaining one sample is more than 1500 µS/cm. So, overall ground water quality in Sheopur district is good. The maximum electrical conductivity has been observed in the water sample of Vijaypur colony i.e. 1680 µS/cm at 25 °C.

The fluoride concentration in Sheopur district lies in between 0.12 to 1.02 mg/l, which represent that all the samples are within the permissible limit i.e. 1.5 mg/l as per BIS (IS 10500 : 2012). The maximum fluoride concentration has been observed in the water sample of Baroda village i.e. 1.02 mg/l. Nitrate in ground water samples of Sheopur district falls within the 4 to 112 mg/l. It is observed that 33.33% samples have Nitrate concentration more than the acceptable limit i.e. 45 mg/l, while rest 66.67% samples have concentration less than acceptable limit. Highest nitrate is reported in the water samples of Sheopur (104mg/l) and Pura (112 mg/l). High nitrate in ground water samples may be due to anthropogenic activities or excessive use of fertilizers. The range of Total Hardness (as $CaCO_3$) in ground water samples of study area is 150 to 460 mg/l. In all locations, total hardness concentrations are within the permissible limit of 600 mg/l. The maximum concentration of total hardness observed in the village of Ghaswani village (460 mg/l).

Piper diagram **(Fig-2.6)** has three parts: a Cation triangle, an Anion triangle, and a Central diamond-shaped field. In Cation triangle, the relative percentages of the major cations (Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}) are plotted. In Anion triangle the major anions ($HCO_3^{-}+CO_3^{2-}$, SO_4^{2-}, Cl^{-}) are plotted. These points are then projected to the central diamond shaped field. The piper diagram of Sheopur district shows the ground water samples are Calcium-Bicarbonate type, hence show temporary hardness; Mixed type and Sodium Chloride (saline) types.

Quality of Ground Water for Irrigation Purpose:

In classification of water for irrigation purpose, it is assumed that the water will be used for irrigation purpose based upon its soil texture, infiltration rate, drainage and climate. The chemical data of all the water samples from Sheopur district is plotted on U.S. Salinity Laboratory diagram **(Fig-2.7).**

It is clear that approximately 19% samples shows that the ground water are C_2-S_1 Class (Medium Salinity & Low Sodium); 81% samples of study area are observed under C_3-S_1 Class (High Salinity & Low Sodium) which means that these waters may be used for irrigation purpose for most of the crops, Water from these areas can be used for irrigation, considering the salinity content of the ground water.

Fig 2.6: Hill Piper Diagram representing classification of water samples collected from National Hydrograph Stations, Sheopur District, Madhya Pradesh

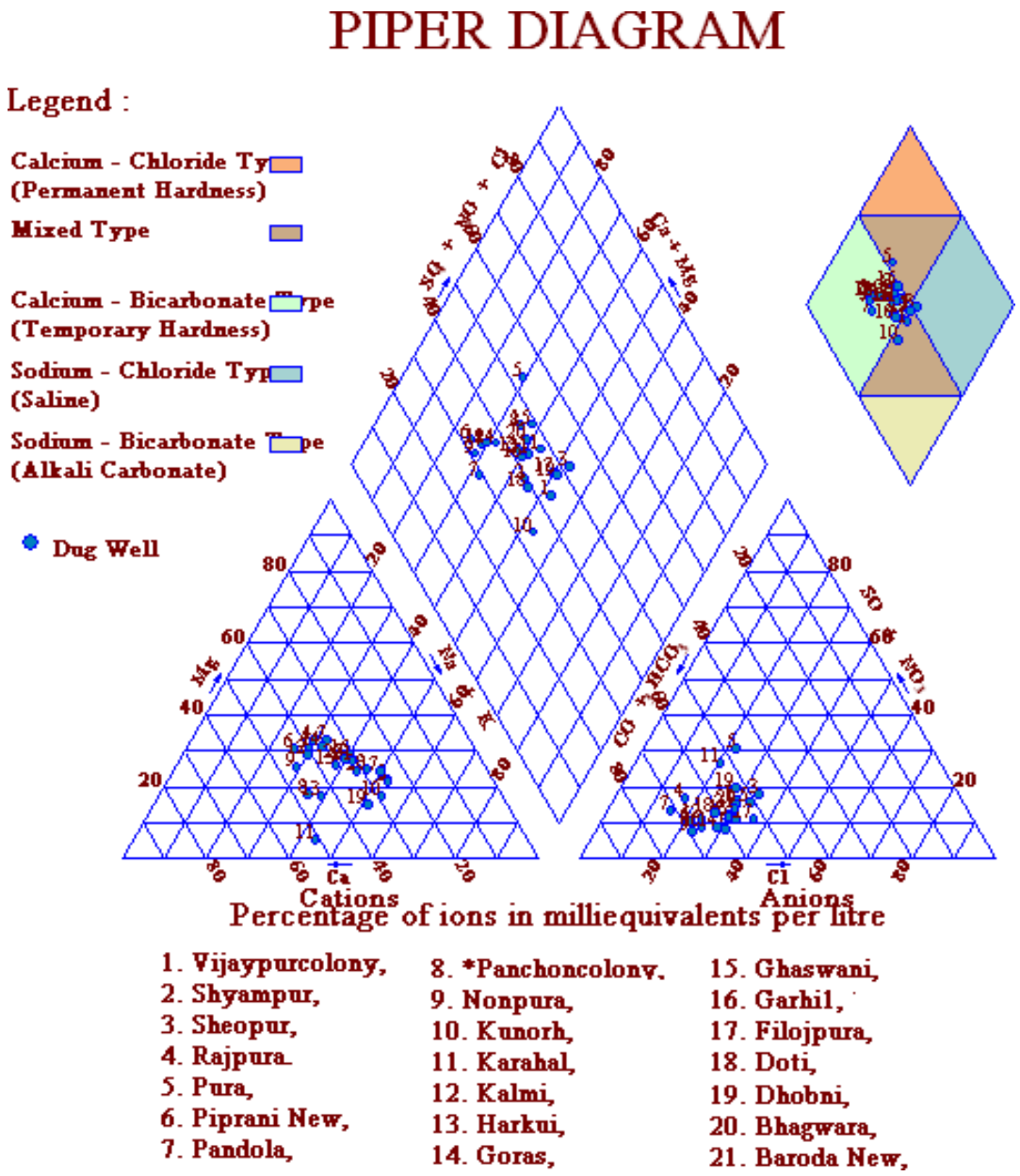
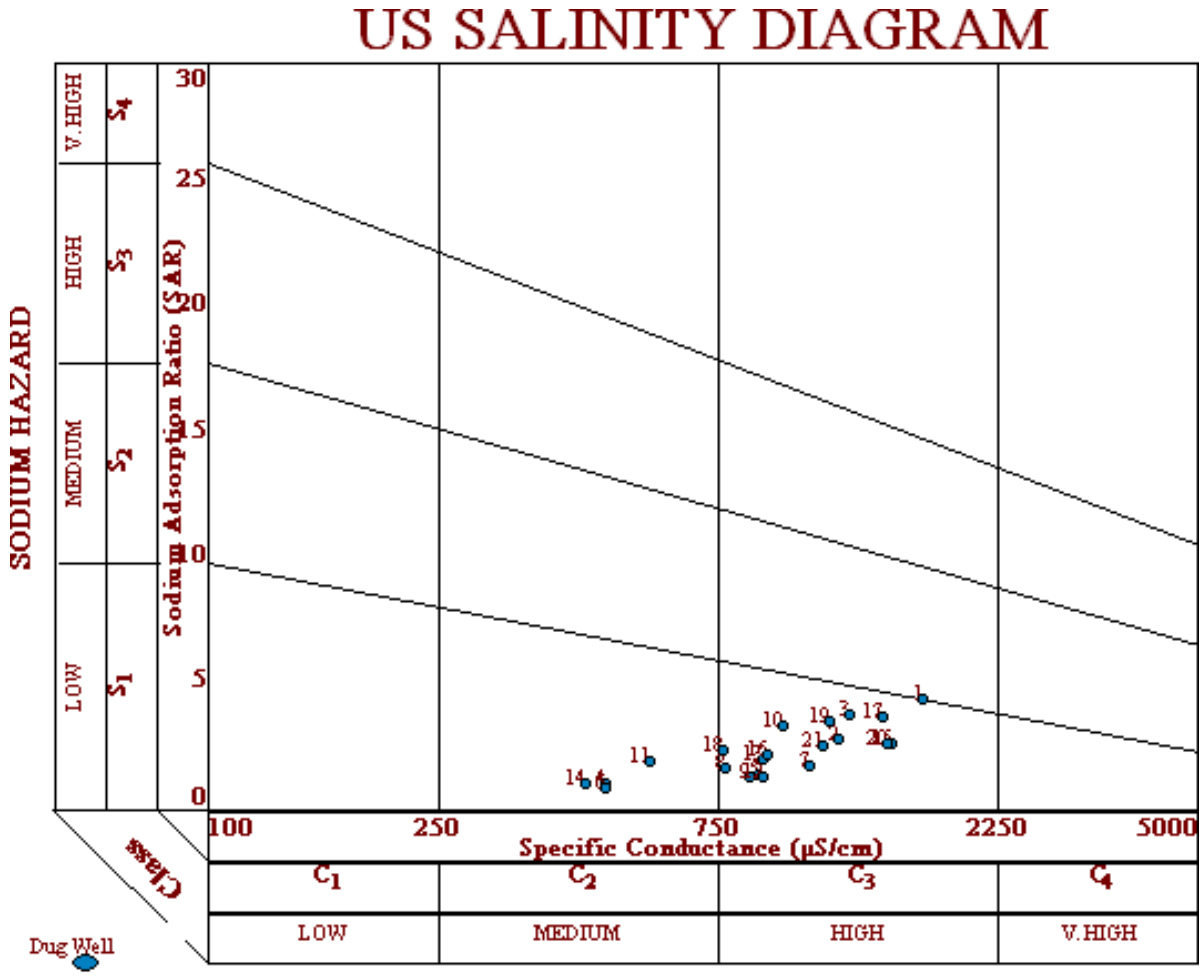


Fig 2.7: US Salinity Diagram for water samples collected from National Hydrograph Stations of Sheopur District, Madhya Pradesh



1. Vijaypurcolony,
2. Shyampur,
3. Sheopur,
4. Rajpura,
5. Pura,
6. Piprani New,
7. Pandola,
8. *Panchoncolony,
9. Nonpura,
10. Kunorh,
11. Karahal,
12. Kalmi,
13. Harkui,
14. Goras,
15. Ghaswani,
16. Garhil,
17. Filojpura,
18. Doti,
19. Dhobni,
20. Bhagwara,
21. Baroda New,

Table-2.5 Water Quality data of NHS wells, Sheopur District, MP

S. No.	District	Block	Location	Lat.	Long.	pH	EC	CO_3	HCO_3	Cl	SO_4	NO_3	F	PO_4	SiO_2	TH	Ca	Mg	Na	K
						at 25°C	µS/cm at 25°C	mg/l												
1	Sheopur	Sheopur	Baroda New	25.491	76.656	7.95	1139	0	378	122	46	38	1.02	0.11	36	330	70	38	109	1.2
2	Sheopur	Sheopur	Bhagwara	25.673	76.615	7.65	1465	0	476	157	58	64	0.74	0.09	24	445	96	50	132	1.7
3	Sheopur	Vijaypur	Dhobni	25.832	77.580	7.93	1170	0	360	115	43	86	0.55	0.14	36	285	78	22	138	2.3
4	Sheopur	Sheopur	Doti	25.671	76.599	8.10	767	0	275	70	28	25	0.59	BDL	25	205	44	23	80	1.6
5	Sheopur	Sheopur	Filojpura	25.585	76.665	7.84	1442	0	451	185	50	33	0.74	0.18	33	360	74	43	166	1.5
6	Sheopur	Vijaypur	Garhi1	26.120	77.306	7.47	912	0	317	97	28	31	0.40	0.07	24	275	56	33	86	1.2
7	Sheopur	Vijaypur	Ghaswani	25.892	77.506	7.68	1494	0	451	173	48	83	0.23	0.21	32	460	106	47	131	2.4
8	Sheopur	Karahal	Goras	25.534	76.945	8.11	448	0	165	45	16	4	0.12	BDL	24	150	32	17	32	1.6
9	Sheopur	Vijaypur	Harkui	26.159	77.179	7.52	901	0	311	95	15	48	0.78	BDL	37	275	78	19	78	3.9
10	Sheopur	Karahal	Kalmi	25.581	76.879	7.87	898	0	345	76	18	39	0.56	BDL	26	310	72	32	57	7.2
11	Sheopur	Karahal	Karahal	25.493	77.057	7.79	574	0	177	42	31	53	0.22	BDL	38	160	58	4	57	0.9
12	Sheopur	Karahal	Kunorh	25.529	77.199	7.88	974	0	378	87	25	20	0.54	BDL	39	225	56	21	119	2.2
13	Sheopur	Karahal	Nonpura	25.522	77.131	7.56	858	0	354	72	22	13	0.47	BDL	41	305	78	27	56	1.8
14	Sheopur	Vijaypur	Panchoncolony	26.135	77.124	7.57	772	0	250	82	29	41	0.65	BDL	25	250	72	17	64	1.1
15	Sheopur	Sheopur	Pandola	25.546	76.644	8.00	1076	0	458	60	36	45	0.80	BDL	28	365	74	44	81	2.3
16	Sheopur	Karahal	Piprani New	25.633	76.953	7.71	484	0	195	37	18	8	0.39	0.09	28	180	42	18	28	1.6
17	Sheopur	Vijaypur	Pura	25.953	76.991	7.47	886	0	244	69	42	112	0.52	0.11	32	310	70	33	59	1.8
18	Sheopur	Sheopur	Rajpura	25.710	76.681	8.01	484	0	189	30	18	26	0.48	0.16	28	170	36	19	32	1.1
19	Sheopur	Sheopur	Sheopur	25.665	76.693	7.69	1268	0	360	152	27	104	0.74	0.09	27	295	64	33	154	1.9
20	Sheopur	Vijaypur	Shyampur	26.081	77.034	8.05	1205	0	433	132	35	18	0.48	0.15	34	340	76	36	121	2.7
21	Sheopur	Vijaypur	Vijaypurcolony	26.057	77.364	7.86	1680	0	561	190	58	42	0.53	BDL	40	400	84	46	206	1.2

2.13 Ground Water Exploration

Central Ground Water Board, has taken up 24 exploratory drilling in Sheopur district so far. In addition to this, 27 no's of key wells **(Fig-2.8)** were established in Sheopur district excluding forest area **(Fig-2.8).** The details of Key wells and Exploratory wells are given in **Annexure-I** and **Annexure-III** respectively.

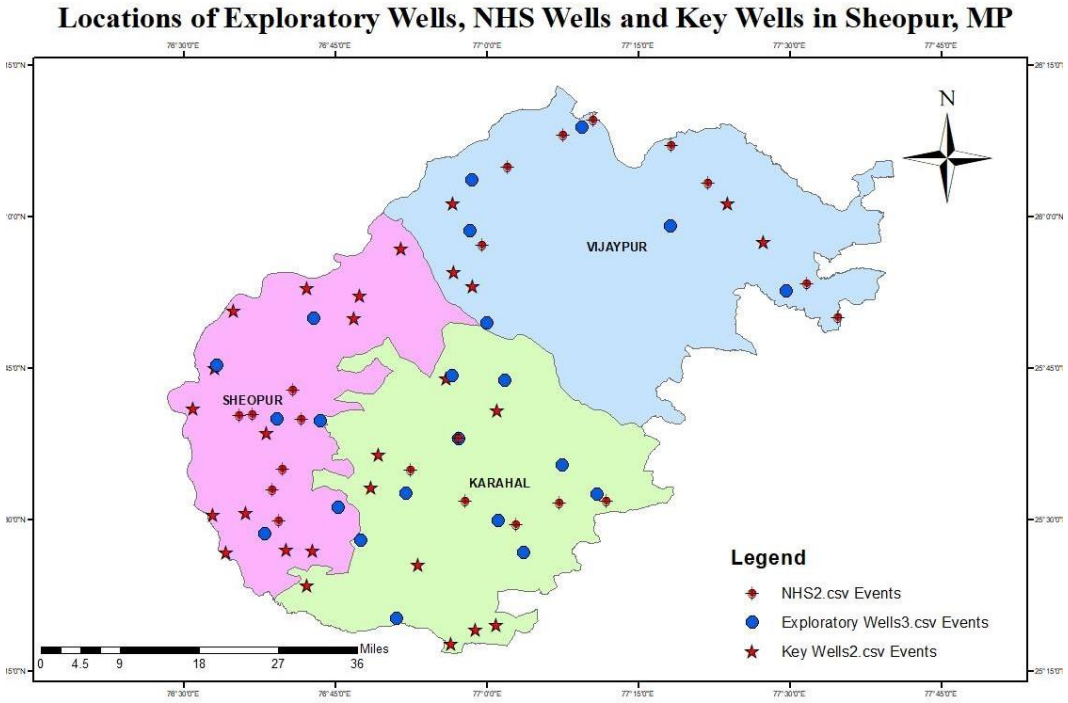


Fig-2.8 Locations of Key wells, NHS wells and Exploratory wells, Sheopur district, MP

3.0 Geophysical studies

A total of 27 VES have been done under Geophysical investigation in the district under National aquifer mapping program. The locations are shown in the following **figure-3.0**

Fig:3.0 VES locations in Sheopur District

4.0 GROUND WATER RESOURCES

Even though the district continues to be of 3 safe blocks the Stage of Ground Water Extraction has increased over the period of time & Stage of Ground Water Extraction has been observed to be approaching towards Semi critical category from Safe category in 2 blocks as mentioned in GW resource table no- **4.1.**

4.1 Groundwater Resources of Sheopur district

Based on GWRE-2020 the status of ground water resources in the district is as tabulated below. All blocks are under safe category.

Table-4.1 Ground Water Resources of Sheopur district, Madhya Pradesh

Assessment Unit Name	Ground Water Extraction for Irrigation Use (Ham)	Ground Water Extraction for Industrial Use (Ham)	Ground Water Extraction for Domestic Use (Ham)	Total Extraction (Ham)	Annual GW Allocation for Domestic Use as on 2025 (Ham)	Net Ground Water Availability for future use (Ham)	Stage of Ground Water Extraction (%)	Categorization
SHEOPUR	5433.55	0	762.71	6196.26	864.4	22644.9	21.41	safe
KARHAL	6087.84	0	328.28	6416.12	380.2	5991.06	51.50	safe
VIJAYPUR	6109.95	0	628.30	6738.26	723.91	2936.78	68.96	safe
DISTRICT TOTAL	**17631.34**	**0**	**1719.3**	**19350.64**	**1968.51**	**31572.74**	**37.81**	

4.2 GROUND WATER RELATED ISSUES

4.2.1 DECLINING WATER LEVEL TREND

The ground water exploitation has resulted in decline of water levels over the period of time. In Pre-monsoon season, decline has been observed in most of the wells **(Fig- 4.2-a, b, c)** in the district. The decline may be because the area has experienced increased ground draft water and less annual rainfall received than the normal rainfall.

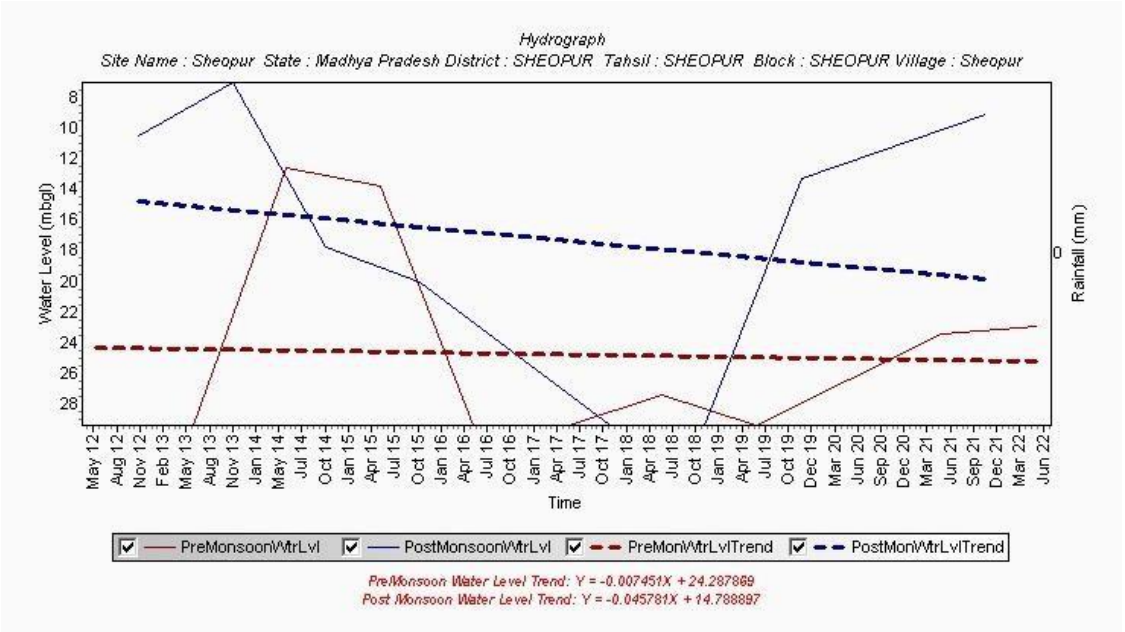


Fig-4.2 (a) Hydrographs of Sheopur, Sheopur district, MP

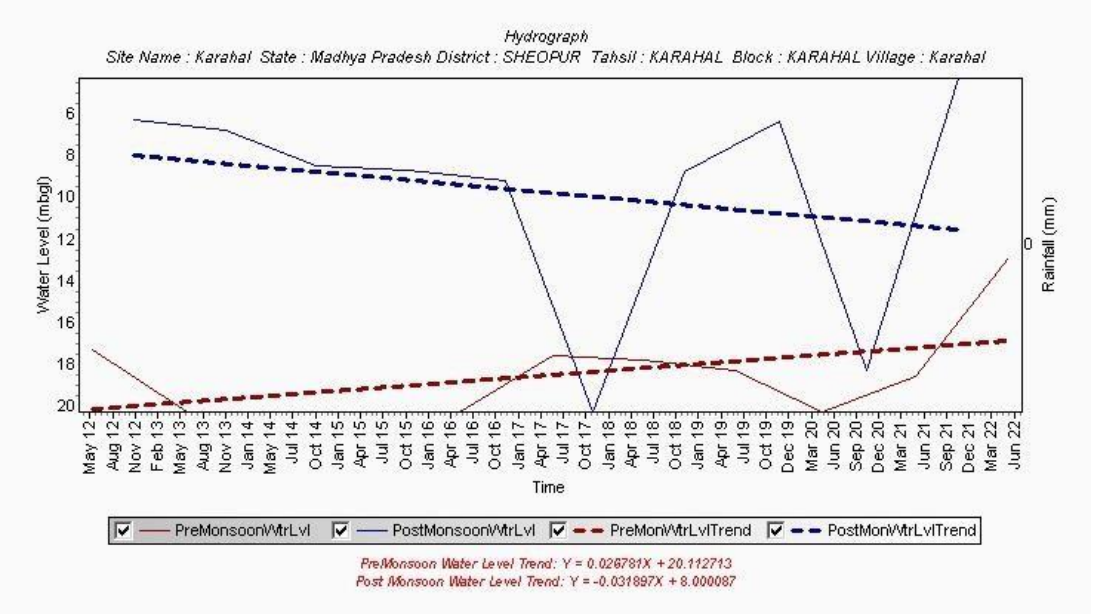


Fig-4.2 (b) Hydrographs of Karahal, Sheopur district, MP

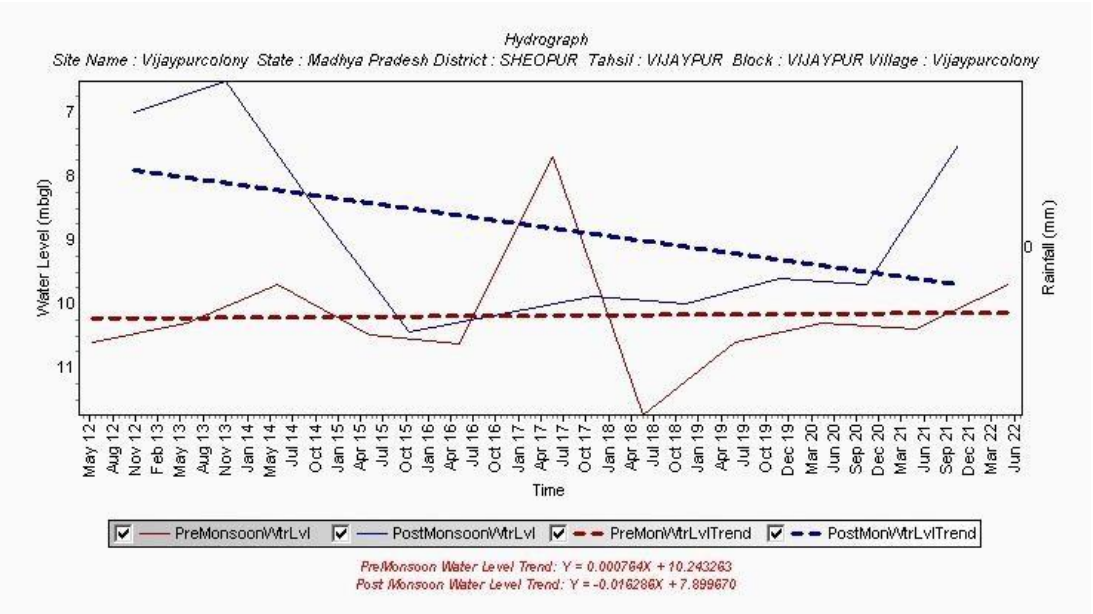


Fig-4.2 (c) Hydrographs of Vijaypur, Sheopur district, MP

The declining water level trend during pre-monsoon and post-monsoon for last 10 year is observed and the hydrographs of Sheopur, Karahal and Vijaypur were presented as above.

4.2.2 SUSTAINABILITY IN THE PROTEROZOIC COMPACT ROCK AREAS

The major part of the district is occupied by hard Vindhyan sandstone and shale rock formations, that inherently consist of limited extent of porous and pervious zone due to high degree of compaction; predominance of secondary porosity that has evolved from prevailing erratic joint pattern and also low rainfall, altogether results in poor sustainability of the aquifers. However, the erratic nature of existing joints/fractures pattern results in highly varying yield capacities of the aquifers in the area.

4.3 GROUND WATER MANAGEMENT PLAN

A comprehensive ground water resources management plan to be proposed to arrest further decline in water levels. The management plan comprises two components namely supply-side management and demand side management. The supply side management is proposed based on surplus surface water availability and the unsaturated thickness of aquifer whereas the demand side management is proposed by use of micro irrigation techniques and change in cropping pattern.

4.3.1 SUPPLY SIDE MANAGEMENT

The supply side management of ground water resources can be done through the artificial recharge by utilization of surplus runoff available within river sub basins and micro watersheds. Also, it is necessary to understand the unsaturated aquifer volume available for recharge. The unsaturated volume of aquifer was computed based on the area feasible for recharge, unsaturated depth below 3 mbgl and the specific yield of the aquifer.

4.3.2 DEMAND SIDE MANAGEMENT

The Demand Side Management is proposed in areas where the Stage of Ground Water Development is relatively high and adopting micro-irrigation techniques for water intensive crops (Sugarcane) or change in cropping pattern or both are required to save water.

In the district, micro-irrigation techniques, like drip irrigation techniques can be adopted in water intensive rice & wheat crop areas.

*The comprehensive Management plans along with number of structures, locations will be detailed after the study of post-monsoon water level behavior & other studies in the district.

4.4 SUM UP

The study was carried out based on the data available in-house as well as acquired from State Govt. departments and in pursuit to fill up the data gaps, generated data in-house; prepared GIS maps for various themes. All the available data was brought on GIS platform and an integrated approach was adopted for preparation of block wise aquifer maps and aquifer management plans of the district.

Sheopur district covering an area of about 6606 sq. km. is occupied by majority Vindhyan formations. The stage of ground water development of the district is 37.81%. The area has witnessed declining water level, low rainfall; low yield potential of aquifers and Low development of GW resources are the major issues in the district. These declines may be due to less rainfall or exploitation of ground water resources due to domestic/ irrigation uses.

The management plan to be proposed to manage the ground water resources and to arrest further decline in water levels which comprises two components namely supply-side management and demand side management.

As a part of Supply side Management, implementation of recharge & conservation structures as Check dam, Percolation tank, Nala bund etc. can be proposed to overcome the groundwater availability related issues.

As a part of Demand side Management, micro-irrigation techniques can be adopted in water intense cropping like rice & wheat areas. Change in cropping patterns is not proposed in any of the blocks.

The ground water development plan to be proposed for the safe blocks as Karahal (51.50%), Sheopur (21.41%) with less SGWE in view of the developing additional ground water resources available after supply side interventions to bring the stage of ground water development up to 60% but not beyond that. In order to do so, number of borewells & Dug wells can be constructed to use the available resources.

IEC activities and capacity building activities needs to be aggressively propagated to establish the institutional framework for participatory ground water management. These types of programmes have helped the general public to understand the problems, that they will face in future if the ground water is continued to be exploited in unplanned way.

These interventions also need to be supported by regulations for deeper aquifer and hence it is recommended to regulate/ban deeper tube wells/bore wells of more than 60 m depth in these blocks, so that the deeper ground water resources are protected for future generation and also serve as ground water sanctuary in times of distress/drought.

ANNEXURE-I

TABLE-1 DETAILS OF KEY WELLS ESTABLISHED DURING 2022 JUNE 2022 IN SHEOPUR DISTRICT

Sl No	District	Locations	Lat	Long
1	Sheopur	Kariyadeh	25.3256	77.0151
2	Sheopur	Sondhni	25.3186	76.981
3	Sheopur	Kurkuta	25.2956	76.9408
4	Sheopur	Pahla	25.4247	76.8871
5	Sheopur	Kalmi	25.6061	76.8212
6	Sheopur	Ladpura	25.8323	76.7813
7	Sheopur	Semalda	25.8692	76.7907
8	Sheopur	Dodar	25.9465	76.8581
9	Sheopur	Sumrera	26.022	76.9439
10	Sheopur	Dantarda Kalan	25.8442	76.583
11	Sheopur	Jaini	25.8808	76.7032
12	Sheopur	Sirsod	25.4478	76.7125
13	Sheopur	Bagalda	25.3915	76.7029
14	Sheopur	Kaloney	25.4503	76.669
15	Sheopur	Kuhanjpur	25.4454	76.5708
16	Sheopur	Pahadli	25.5071	76.5479
17	Sheopur	Lohad	25.5101	76.6028
18	Sheopur	Gaondi	25.6828	76.5163
19	Sheopur	Bitthalpur	25.7502	76.5512
20	Sheopur	Kanapur	25.6426	76.6366
21	Sheopur	Bhojka	25.5529	76.8092
22	Sheopur	Budhera	25.7319	76.933
23	Sheopur	Gadhla	25.6796	77.0164
24	Sheopur	Pathar	25.8846	76.9765
25	Sheopur	Kotka	25.9078	76.9464
26	Sheopur	Chandeli	26.021	77.3973
27	Sheopur	Bagwani	25.9581	77.4557

ANNEXURE-II

Table- Locations of NHS Wells in Sheopur District

Sl No	District	Locations	Lat	Long
1	Sheopur	Baroda New	25.4984	76.657
2	Sheopur	Bhagwara	25.6733	76.6138
3	Sheopur	Dhobni	25.8327	77.5785
4	Sheopur	Doti	25.6718	76.5912
5	Sheopur	Filojpura	25.5842	76.6637
6	Sheopur	Garhi1	26.1177	77.3045
7	Sheopur	Ghaswani	25.8899	77.5274
8	Sheopur	Goras	25.5301	76.9638
9	Sheopur	Harkui	26.1592	77.1749
10	Sheopur	Kalmi	25.5818	76.875
11	Sheopur	Karahal	25.4918	77.048
12	Sheopur	Kunorh	25.5303	77.1967
13	Sheopur	Nonpura	25.5272	77.1199
14	Sheopur	Panchoncolony	26.1347	77.125
15	Sheopur	Pandola	25.5488	76.6466
16	Sheopur	Piprani New	25.6341	76.9531
17	Sheopur	Pura	25.9531	76.9919
18	Sheopur	Rajpura	25.714	76.6806
19	Sheopur	Sheopur	25.6663	76.6943
20	Sheopur	Shyampur	26.0814	77.0348
21	Sheopur	Vijaypurcolony	26.056	77.3648

ANNEXURE-III

Table-Details of Exploratory Wells Drilled in Sheopur District.

Sl No	District	Block	Locations	Lat	Long
1	Sheopur	Sheopur	Behrauda	25.8314	76.7151
2	Sheopur	Sheopur	Bhitalpur	25.7542	76.5544
3	Sheopur	Karhal	Dob Kund	25.7302	77.0294
4	Sheopur	Sheopur	Lalitpur	25.4771	76.6344
5	Sheopur	Karhal	Masauni	25.4661	76.7926
6	Sheopur	Sheopur	Policeline	25.6632	76.726
7	Sheopur	Sheopur	Premsar	25.6655	76.6538
8	Sheopur	Sheopur	Shahpura Rundi	25.5193	76.755
9	Sheopur	Karhal	Amet	25.59.02	77.1244
10	Sheopur	Karhal	Bargawan	25.676	76.0538
11	Sheopur	Karhal	Botupura	25.4455	77.0604
12	Sheopur	Karhal	Butera	25.7373	76.9418
13	Sheopur	Karhal	Panar	25.5426	76.8672
14	Sheopur	Karhal	Parond	25.4985	77.0185
15	Sheopur	Karhal	Piprani	25.6336	76.9528
16	Sheopur	Karhal	Richhi	24.4566	76.8938
17	Sheopur	Karhal	Sesaipura	25.5413	77.181
18	Sheopur	Karhal	Suswadatongra	25.3365	76.8511
19	Sheopur	Vijaypur	Raghunathpur (EW)	26.0597	76.9752
20	Sheopur	Vijaypur	Raghunathpur (OW)	26.0597	76.9752
21	Sheopur	Vijaypur	Moreka	25.9763	76.9715
22	Sheopur	Vijaypur	Sironi	25.8243	77.0006
23	Sheopur	Vijaypur	Shyarda	26.1463	77.1562
24	Sheopur	Vijaypur	Arrod (EW)	25.9836	77.3021
25	Sheopur	Vijaypur	Arrod (OW)	25.9836	77.3021
26	Sheopur	Vijaypur	Keenjari	25.8774	77.4927