Central Ground Water Board
Ministry of Water Resources, River Development and Ganga Rejuvenation
Government of India

AQUIFER MAPPING REPORT

Seoni District, Madhya Pradesh

North Central Region, Bhopal

Government of India
Central Ground Water Board
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AQUIFER MAPPING AND MANAGEMENT PLAN
SEONI DISTRICT, MADHYA PRADESH

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Chapter-1
INTRODUCTION

Central Ground Water Board has pioneered extensive groundwater studies, in all the hydrogeological terrain of the country. It has remarkably brought out comprehensive regional picture of the aquifers in terms of their water quality and yield potential. To meet the challenges of growing groundwater demand and sustainability of the resource, an effective aquifer based groundwater management in the country, through adequate and precise information on aquifers in time and space at a scale as large as possible, is the most imperative and earnestly desired. The aquifer-mapping programme demands for a multi-disciplinary, multi-institutional, innovative and modern approach to arrive at a comprehensive aquifer data base under National Aquifer Mapping Programmer.

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.

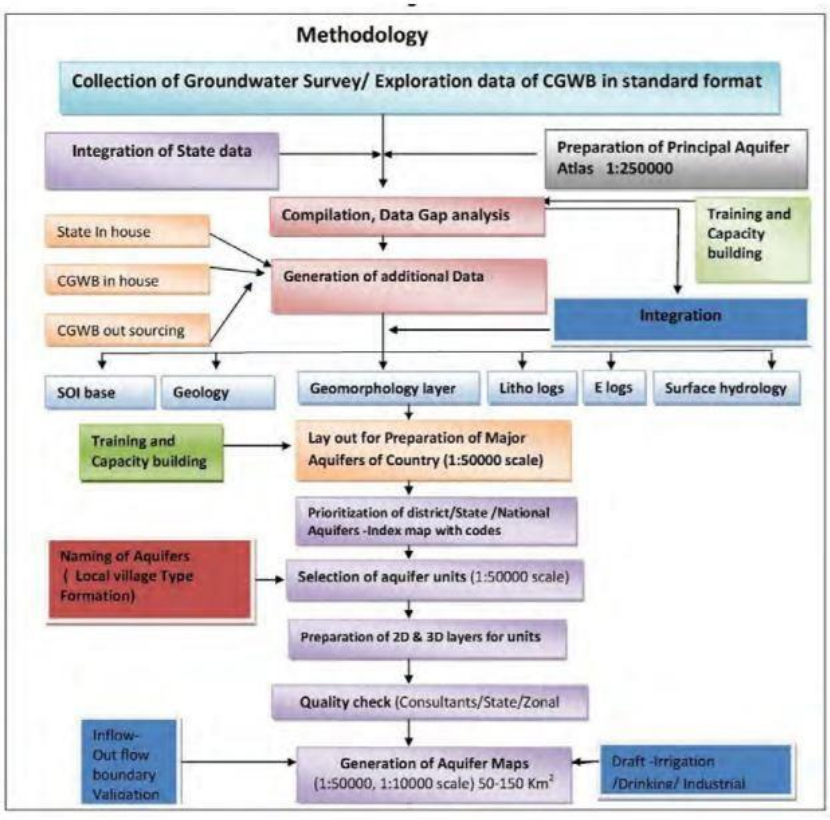
The information thus generated through additional drilling of boreholes shall be used for

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 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.

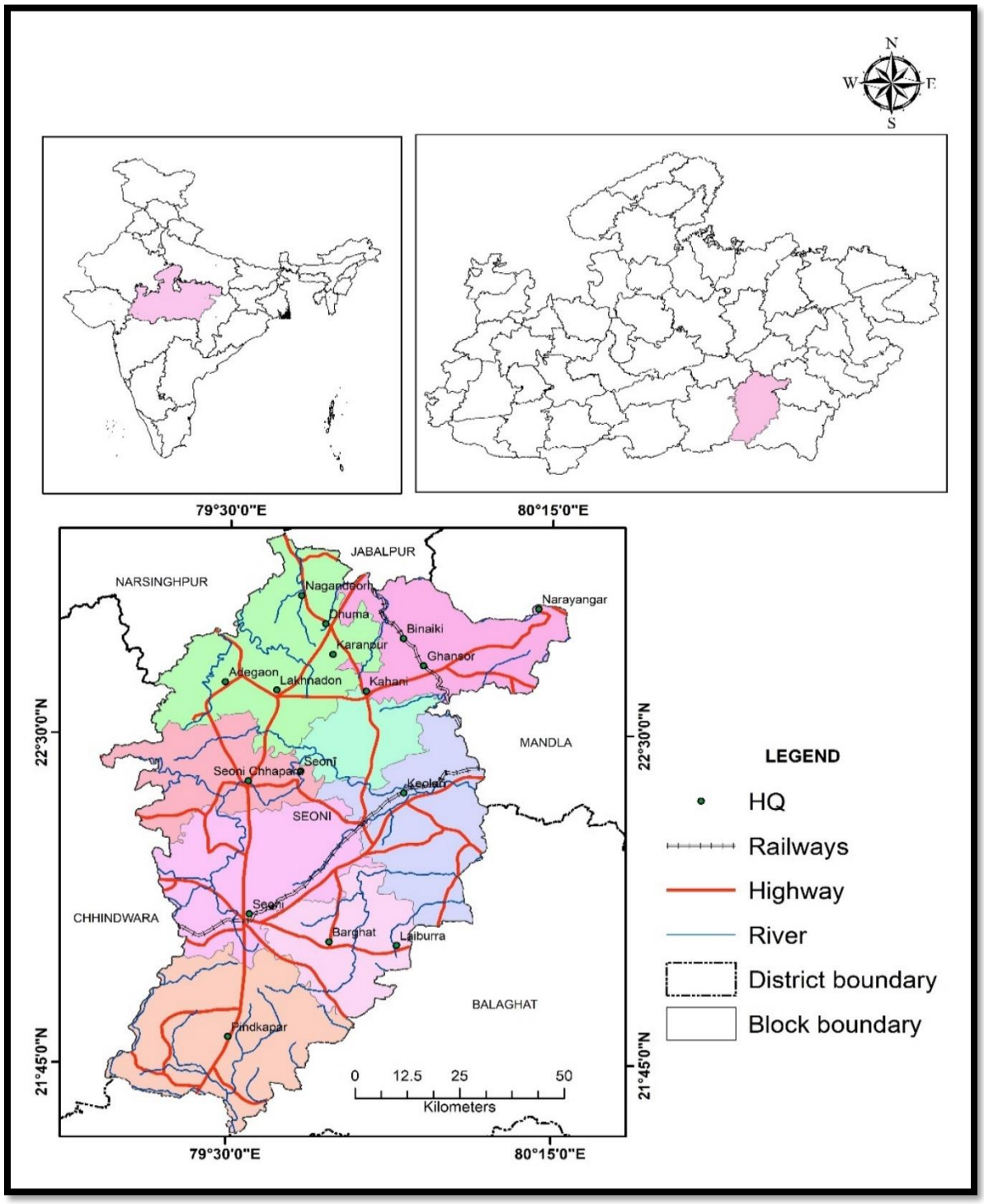
Fig:1 Flow Chart of Methodology



1.5 Study Area

Seoni district occupies the central portion of the Wainganga Valley. the district is spread over an area of 8758 sq. km and is located at the northern boundary of the state, laying between north latitudes 21°36′ to 22°57′ and east longitude 79°19′ to 80°17′ falls under the survey of India toposheet No. 55N, 55O, 64B. The district is bounded by the district Jabalpur in North, Mandla in Northeast, Balaghat in the East, Narsinghpur in Northwest, Chhindwara in West and Nagpur- Bhandana in South. (fig.-2).

Fig:2. Location Map



The District is divided into 08Thesils and 08 Blocks. There are 1593 Villages and 08 Towns in the District (Table- 1) and as per census 2011, the total population of the district is 13,79131.

Table 1 Statistical data of Seoni district

Total Blocks	Area (sq km)
Total Geographical Area (sq km)	8758.30
Recharge worthy Area (sq km)	8050.50 (91.91%)
Hilly/Forest (sq km)	707.80 (8.09%)

Table 2 Administrative Units of Seoni district. (data from Cencus digital library)

Block	ographical Area (Sq Km)	Population 2011	Male	Female
BARGHAT	720.00	185,536	92,107	93,429
CHHAPARA	731.00	123,024	62,321	60,703
DHANORA	667.00	85,066	42,997	42,069
GHANSORE	963.00	142,662	71,817	70,845
KEOLARI	827.00	158,200	79,275	78,925
KURAI	1783.00	116,895	58,188	58,707
LAKHNADON	1704.00	190,848	96,444	94,404
SEONI	1363.30	245,155	125,383	119,772
DISTRICT TOTAL	**8758.30**			

1.6 RAINFALL AND CLIMATE RAINFALL

The Climate of Seoni District, M.P. characterized by a hot summer and general dryness except during the southwest monsoon season. The year may 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 the middle of June to September is the southwest monsoon. October and November form the post monsoon or transition period.

The normal annual rainfall of Seoni district is 1322 mm. Seoni District received maximum rainfall received during southwest monsoon period i.e. June to September. About 86.3% of the annual rainfall received during monsoon season. Only 13.7% of the annual rainfall takes place between October to May period. Thus, surplus water for ground water recharge is available only during the southwest monsoon period.

The normal maximum temperature received during the month of May is 40.3□ C and minimum during the month of December is 11.3□C. The normal annual means maximum and minimum temperatures of Seoni district are 31.3˚C & 18.9˚C respectively.

During the southwest monsoon season the relative humidity generally exceeds 88% (August month). In the rest of the year it is drier. The driest part of the year is the summer season, when

relative humidity is less 34%. May is the driest month of the year.

The wind velocity is higher during the pre monsoon period as compared to post monsoon period. The maximum wind velocity 7.7 km/hr observed during the month of June and minimum 3.9 km/hr during the month of December.

The average normal annual wind velocity of Seoni district is 5.9 km/hr.

1.7 PHYSIOGRAPHY/DEM

The Seoni district lies on a section of the Satpura plateau covering 8758 sq.km with elevation of 760 m to 430 m above mean sea level. The plateaus generally lower down towards the east and marks the hill ranges along the southern scarps in Seoni district but the plateaus along north western boundary are crowded with the hills.The district is divided into five natural divisions such as 1) Lakhanadon plateau, 2) Upper Wainganga valley, 3) The valley of Sagar and Hirvi River, 4) The lower Wainganga valley, and 5) The southern lowland (Guru,1989).

The Lakhanadon plateau between the Narmada and the Wainganga slopes towards the North with ridges ofresidual hill stands in between the North flowing tributaries of the Narmada. The Southern hill range starts from the undulating plateaus of Chaurari on Chhindwara district and shoulders the town of Seoni from Mohgaon, known as Kariapahar.

The major Land-forms of the area are as follows

types existing in the area.

Fourteen land forms are delineated and described (Fig.2 & Table 6). The land forms are:

i) Structural plateaus (2697.92 ha)
ii) Middle level plateaus (71594.59 ha)
iii) Narrow inter-hill basin (81457.45 ha)
iv) Structural hills and ridges (152667.92 ha)
v) Undulating plateau (6.85%)
vi) Rolling pedilains (6.68%)

(vii&viii) Upper and lower denudational plateaus (37.22 percent of total area)

(ix,x,xi) Steeply sloping denudational escarpments,

(xii,xiii,xiv) Valleys, Broad interhill basins, gently sloping plains and floodplains (8.91 percent of total area).

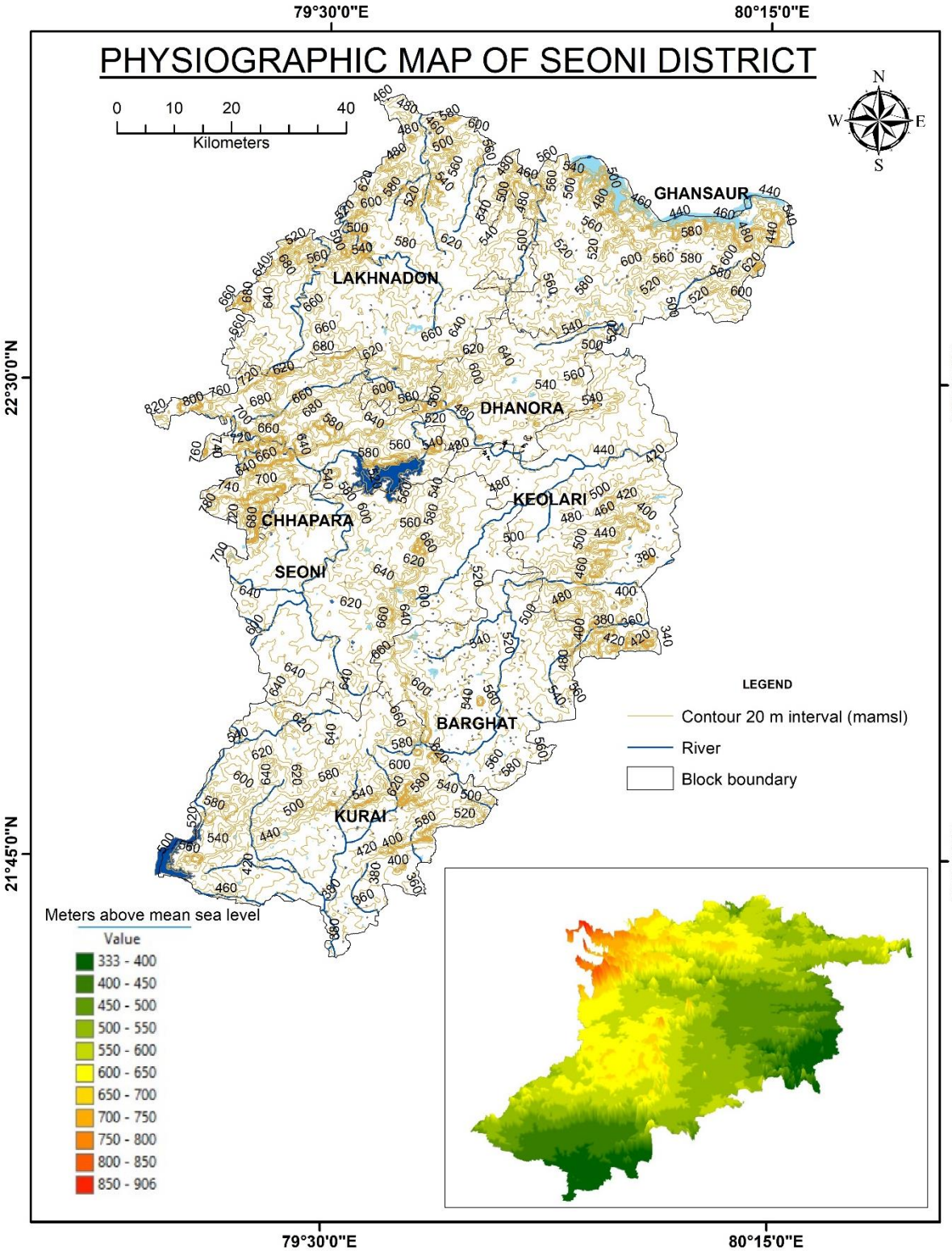


Fig:3. Digital Elevation Map

1.8 GEOMORPHOLOGY

The area has undulating topography comprising hills of Satpura plateau from South to North. While the North Eastern part covered by Deccan plateau and falls at the altitude in between 325 to 740 m above MSL. The general trend of hills in the district is North-south with some isolated hillocks. Physiographically the area is divided into five parts.

1. Lakhnadon Plateau.
2. Upper Wainganga Valley.
3. Lower Wainganga Valley.
4. Sagar and Hirri River Valley.
5. Southern Lower Land.

The area is undulating plane, hilly and forested. The area North of Barghat is plane and Rice producing belt has covered by Bori Canal system. The Keolari block has plateau like appearance and covered by good network of canals under Sanjay Sarovar Pariyojna. The Wainganga is the main river flowing in the area having perennial flow. The other rivers are Thawari, Hiui, Sagar, Thal and Shadu and Pench. The black cotton soil, sandy loam, loams soil and moland soils are main soils in the area.

In Seoni district, land forms have been classified on the basis of genetic factor and the geomorphic processes involved. further, the geomorphic units have been classified on the basis of differential erosion of rock

material, process and relief amplitude. The classification system adopted in this report is as per ITC Scheme of classification of land forms.In the district four group of Landforms are identified and are given below:

1. Denudational landforms
2. Depositional landforms
3. Structural landforms
4. Intrusive landforms

Structural plateau: This unit is extensively found in upper northern parts of district. The elevation is between 700 m and above mean sea level. Mostly open scrubbed lands with thin forest cover and surface stoniness more than 35 percent. High drainage density and severely eroded steep land with slopes of 3 to 8 percent. This is widely occur in **Lakhanadon** plateau.

Middle level plateau: This unit is well distributed in central part of Seoni, Chhapara and Keolari tehsils of Seoni district. The elevation is between 500 and 700 m above mean sea level. This unit is moderately eroded with moderately sloping lands (8-15%). Most of the area under the cultivation of wheat, rice, sugar cane, mustard but at few places, vegetables are grown.

Narrow inter hill basin: This unit is mostly occur in Ghansur, Kahani, and Hiran sub basins of the Sher and Hiren rivers. This unit occurs at an elevation of 400 to 500 m, gently sloping (3-8%), slightlyeroded, deep soils with high water holding capacity and strong alkalinity.

Structural hills and ridges: These are linear continuous features with rock out crops and steep stony lands and sparse forest cover. This unit is found in central parts where in the ridges run in east to west wards with rock sheets. At few places cultivation is practised.

Undulating plateaus: This unit is distributed well in western parts at an elevation of 300 to 400 m above mean sea level. Mostly covered with Bijna reserve forest. Severely eroded, highly dissected and 30 percent of surface covered with stones.

Rolling pediplains: This unit is having lot of undulations with ups and downs, mostly occur at an elevation of 600 to 700 m, open jungle towards Mohgaon to Barghat, moderate erosion, but at

elevation of 420 to 520 m, with gentle slopes running towards east to west of mostly 2nd order streams near Mansur nala.

Upper denudational plateaus: This unit is in association with isolated hillocks, erosional pediment surfaces and dissected 1st order stream originating from flat top plateaus with 50 percent surface stones and 5 percent rock out crops. Thin forest cover, concentrated mostly in south-western parts of Seoni district, cultivation in patches, elevation in between 500 and 600 m.

Lower denudational plateaus: This unit is in between Gopalganj and Arharpur where in altitude is 600 to 650 m. This unit is barren rocky surface with open thin forest cover. Cultivation is in patches, highly dissected and moderately eroded.

Steeply sloping denudational escarpment: This unit has steeply sloping side slopes (30-50% slopes). Mostly occur in association with plateaus, severely eroded and highly dissected. Cultivation is in patches. Surface stoniness is more than 50 percent and rock outcrops are exposed with thin bushy vegetation and covers widely in the district.

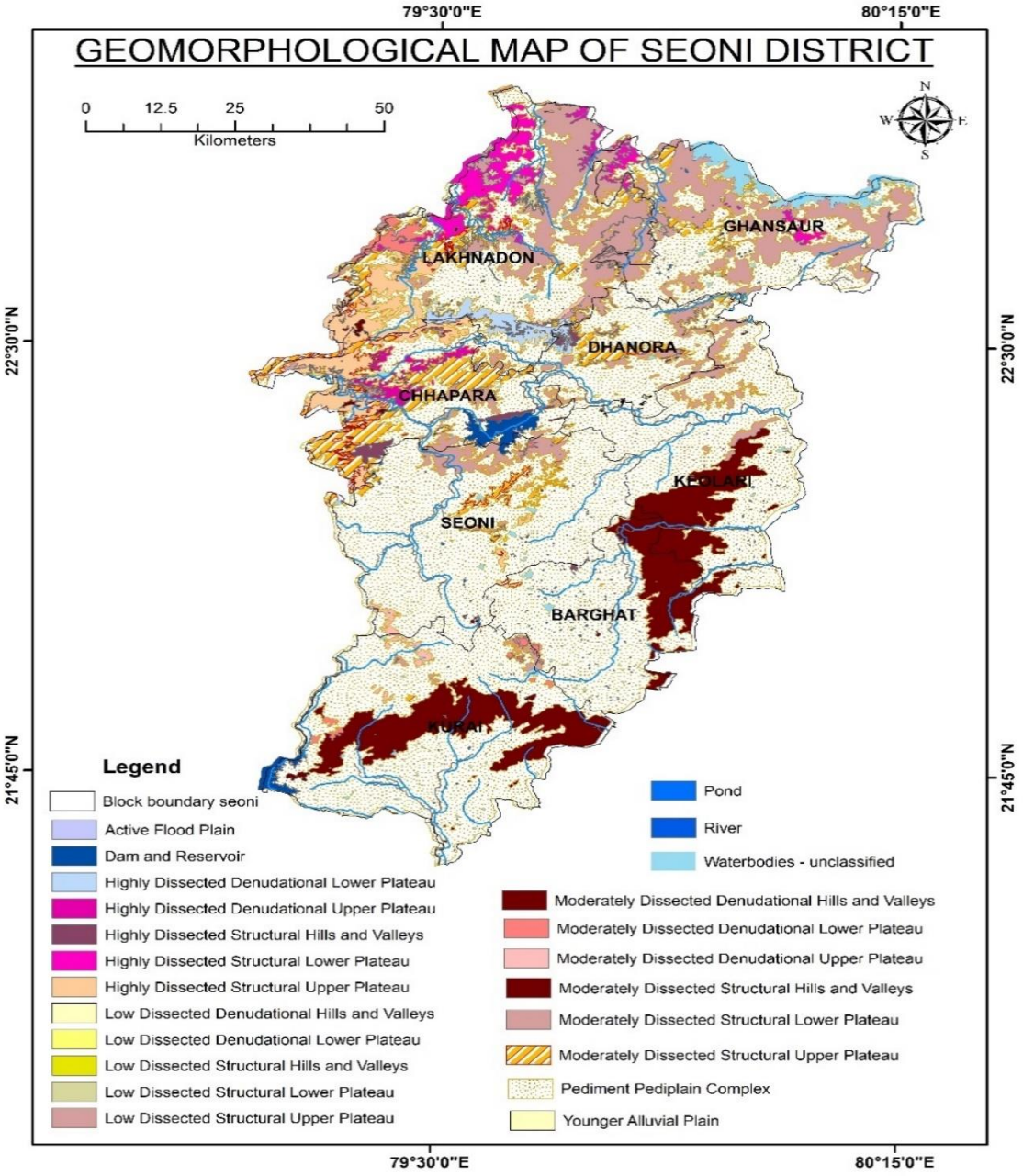
Valleys: This unit is flat, gently sloping (3-8%), strongly associated with river systems of Wainganga of upper and lower reaches. This unit is mostly under cultivation of double crops (rice, wheat, soybean).

Broad interhill basins: This unit is in between plateaus with gentle slopes, slight erosion, intensively cultivated, occurs in small areas and associated with plateaus and undulating lands.

Isolated hillocks: This unit is commonly seen in granitic landscapes, mostly covered with stones and rock out crops, thin vegetated

Gently sloping flood plain: This unit is common in southern lowlands with slopes of 3 to 8 percent. Mostly under cultivation of wheat, arhar and soybean.

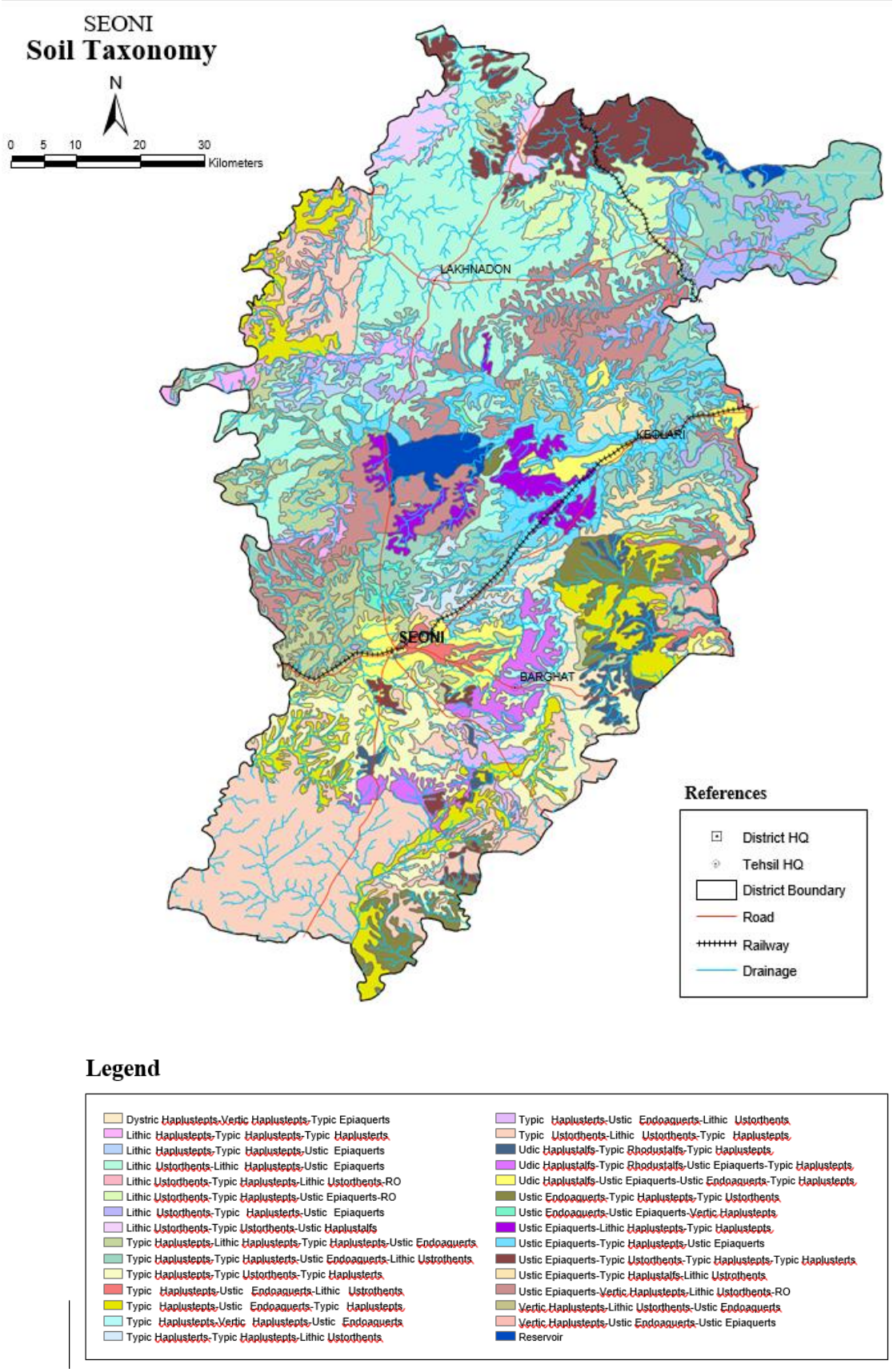
Fig:4. Geomorphology Map



1.9 Soil Covers

Soils in the district are generally of classified in four groups viz alluvial soils which occurs in north eastern part of the district. Red and yellow soil in north eastern parts mixed red & black yellow soil in central part and medium black soil in the south western extreme of the district.

Fig:5. Soil Map



1.10 GEOLOGY

Seoni is a part of ENE-WSE trending Central Indian Tectonic Zone (CITZ) limited by Sone-Narmada SouthcFault (SNSF) in the north and Central India Suture (CIS) in the north and Central India Suture (CIS) in the south, while Tan Shear Zone (TSZ) is located midway between the two. Geologically, the district comprises of Tirodi Biotite Gneiss (TBG) and Supracrustal Sausar Group (SSG) in the south eastern parts while major parts are covered with Deccan Traps with few outcrops of lameta, intertrappean beds, laterite cappings and alluvium ranging in age from Meso-Proterozoic to Recent. TBG forms the base mand of the Sausar Supracrustal and comprises grey stromatic and/or streaky gneisses with enclaves of high grade metamorphites, pink gneiss with migmatites and amphibolites. SSG is represented by Lohangi Fm, Mansar Fm, Chorbaoli Fm, Bichua Fm. Lithologically, cratonic assemblage consists of metamorphosed quartzite, pelites and carbonate and intrusive syntectonic strongly foliated granite and post-tectonic massive granite. The basement-cover contact was largely obliterated due to intense shearing and /or migmatitic foliation of TBG.

Table 3. Lithostratigraphy of Seoni

Lithology	Group	Formation	Age	Nature and Characteristics
Alluvium			Quaternary	Soft and unconsolidated sediments
Laterite				Medium to hard, brick red to yellowish brown, ferruginous, consolidated rock
Basic Dykes			Cenozoic	Dark grey, fine to medium grained, hard, compact massive rock
Four Basaltic lava flows, simple and compound pahoehoe flows with megacryst flow unit		Khamla Fm		Dark grey, fine to medium, hard, compact, massive, non-porphyritic to moderately porphyritic
Five to seven simple and compound pahoehoe flowswith megacrystflow at base	Amark a ntak (Deccan trap)	Amarward Fm	Upper cretaceous to Palaeogene	Dark grey, fine grained hard, compact, massive, non-porphyritic to porphyritic
Two basaltic flows, simple to compound pahoehoe type		Multai Fm		Dark grey, medium grained hard, compact, massive, mega porphyritic in nature
Four basaltic flows , simple to compound type		Linga Fm		Dark grey, fine to medium grained hard , compact, massive, moderately to highly porphyritic:
Two simple basaltic flows		Pipardhi Fm		Dark grey, fine grained hard , compact, massive, ono porphyritic to sparsely porphyritic
Eight basaltic flows, simple and compound, pahoehoe flows with megacrys flow unit		Dhuma Fm	Upper Cretaceous to Palaeogene	Dark grey, fine to medium grained hard , compact, massive, porphyritic in nature
Four basaltic flows, simple to compound pahoehoe flows with megacryst flow unit		MandlaFm		Dark grey, fine to medium grained hard, compact, massive, and moderately to sparsely porphyritic.

Simple and compound basaltic flows				Dark grey, fine grained hard , compact flows massive and amygdalodal.
Chert, cherty limestone and shale				
Chert, cherty nodular limestone, variegated clay and shale	Lameta group	Intertrappean, Amarkantak (Deccan trap)	Late Cretaceous (Maestrichtian)	Hard, laminated and friable rocks
Granite	ntrusive		late Mesoproterozoic	Hard, compact, massive porphytic rocks
Foliated granite		Intrusive		Hard, Compact, Foliated rock
Crystalline limestone and dolomite		Bichua Fm		Hard and compact rocks
Muscovite-biotite schist band quartzitic biotitegranite		Junewani Fm		Soft and flaky rocks, hard and compact rocks
Quartzites and quartze muscovite schist'		Charbaoli Fm		Hard and flaky rocks
Muscovite-biotite schist	Sausar group	Mansar Fm	Meso Proterozoic	Soft and flaky rocks
Calc-silicate rocks		Lohangi Fm		Hard and flaky rocks
Grey stromatic and/or streaky gneiss with enclaves of high grade, metemorphites/pink gneisswith migmatite/Amphibolites		Tirodi Biotite gneiss		Hard and compact , foliated and banded rocks/hard and compact banded, foliated to massive pink megacrystic K.-feldspar bearing rocks, Hard and compact, dark greenish grey, massive to moderately foliated rocks

Fig:6. Tectonic Framework

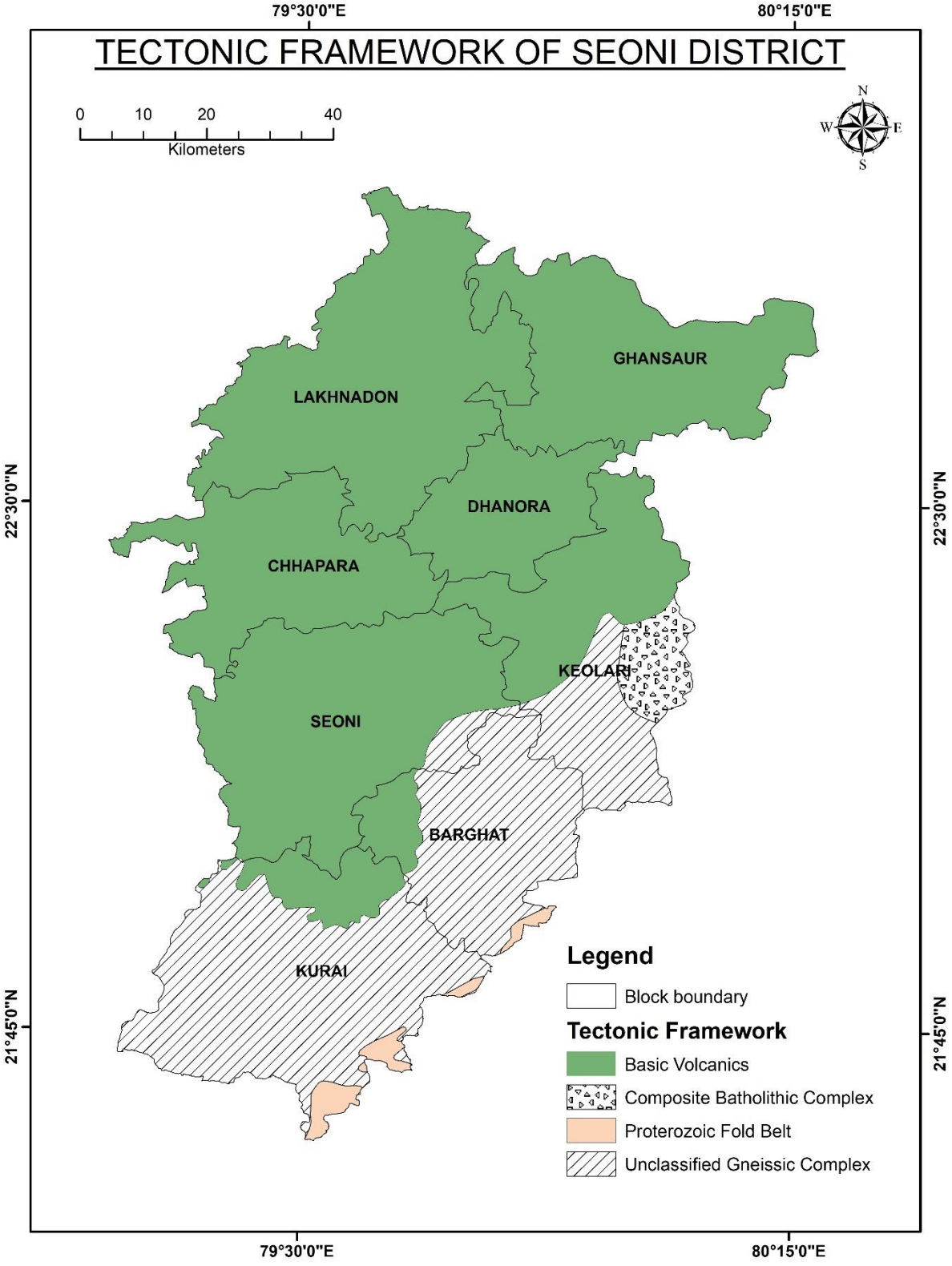
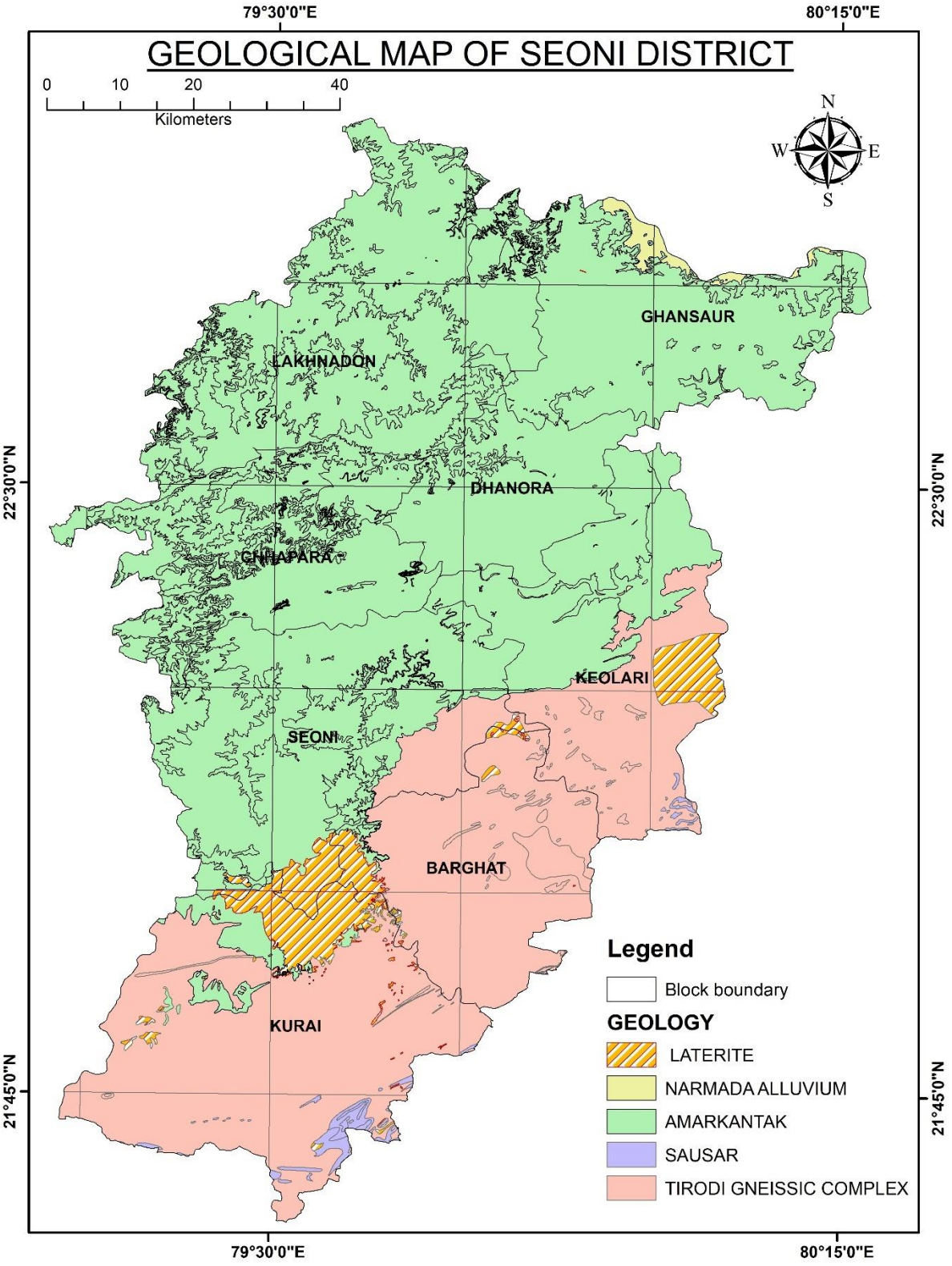


Fig:7. Geological map



1.11 HYDROLOGY AND DRAINAGE

The occurrence and movement of ground water in hard rock areas is widely controlled by the secondary priority present in them like joints, fractures, weathering and linearity etc. The district is mainly occupied by Archean rocks and Basaltic lava flows. The weathering of Archean rocks ranges from 0.50 mbgl to 10.00 mbgl. The weaker zones in Deccan traps are also developed at the contacts of two consecutive lava flows, which facilitate downward movement of ground water. In Vesicular basalts the voids provide more space for the accumulation 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 Archean rocks is mostly undulating. The ground water in these rocks occurs under unconfined conditions, which is widely controlled by the weathering of the rocks, presence of joints, fracture and lineament in them.

The area occupied by Deccan trappean rocks, where ground water occurs under phreatic conditions in the weaker zones of weathered, vesicular, fractured and jointed parts of the flows. The sheet joints, basal parts of flows and inter-connection of joints and fractures controls the horizontal as well as vertical movement of ground water. The plateau like topography plays an important role in occurrence and movement of ground water.

Under semi-confined conditions the ground water occurs at the contacts of two flows and at the contact of trappean rocks with Archean basement.

The Laterites are highly porous in nature and allows fast movement of ground water as well. The Laterite is porous enough in nature and absorbs rain water very fast and looses it also. The water bearing properties of these formations varies widely depending upon their lithological properties and structural control.

The drainage of the district forms parts of the Narmada and the Wainganga river systems. Narmada occupies about a quarter of the area in the north and the Wainganga occupies about three quarters of the area in the south. The main water dividing lines run from west to east.

The Narmada: This is a westward flowing primary river which forms the north-eastern boundary of the district. It rises from Amarkantak hills in the Shahdol district on the Maikal ranges. It flows through Satpura hills in a zigzag manner and forms the boundary between Seoni and Mandla district. The total length of the river is 1290 km of which a section about 35 km lies along the district boundary.

The Sher: The Sher river rises at Batka 7 km south-east of Lakhanadon and flows to the north east. It is joined by the Gurha, the Kanera, the Macharewa, the Berurewa and Umar belore it joins the Narmada at Ratikarar in Narsinghpur. Its total length is 113 km.

The Wainganga: The Wainganga is the most important river of the district. It rises from the hill above Pratappur. It forms a semicircular course in the district flowing first to the north, bending east and finally to the south along the south eastern boundary. The river flows on a lower plain along the Seoni-Balaghat boundaryFig:5. Drainage Map

Fig:7. Drainage map

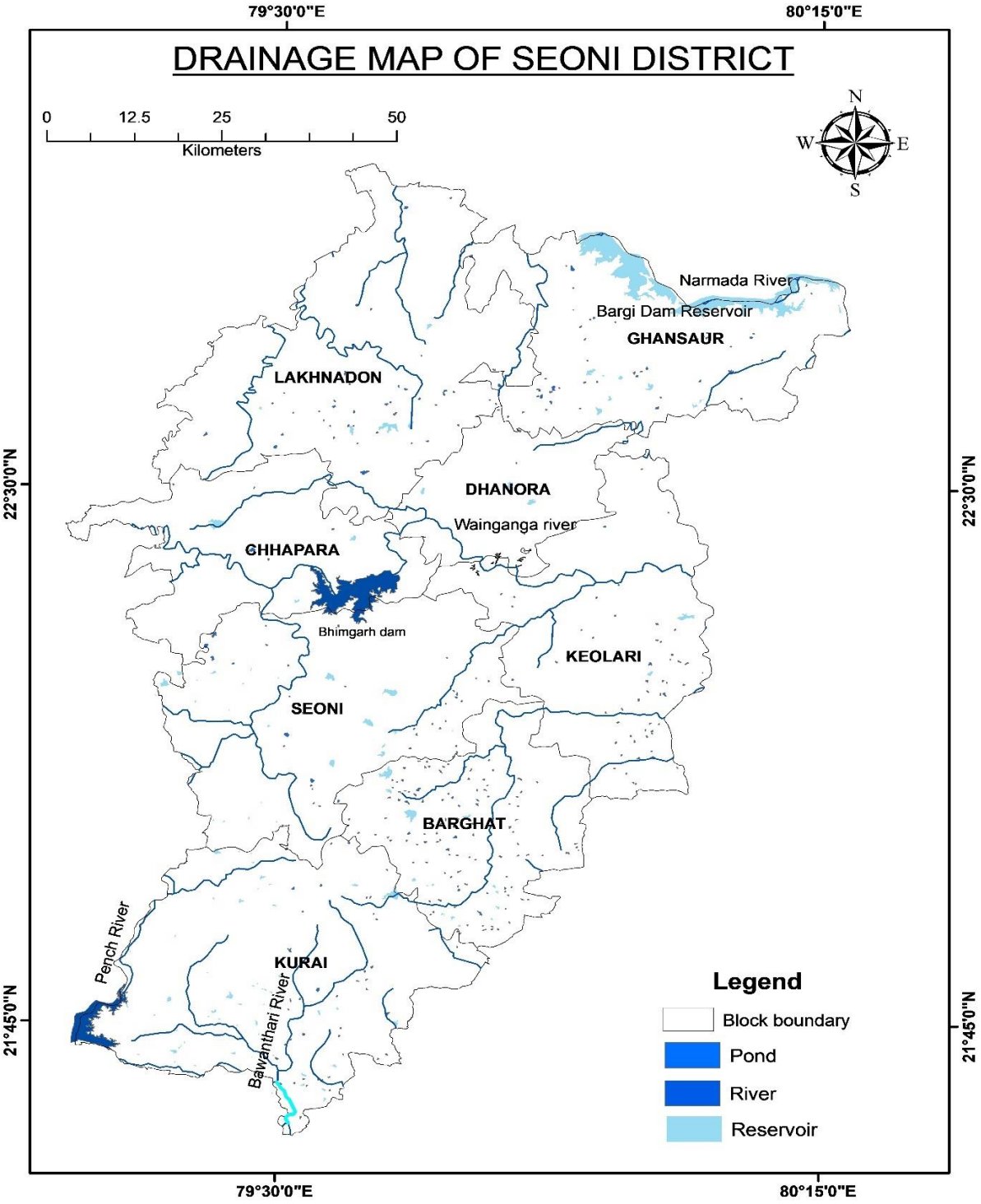
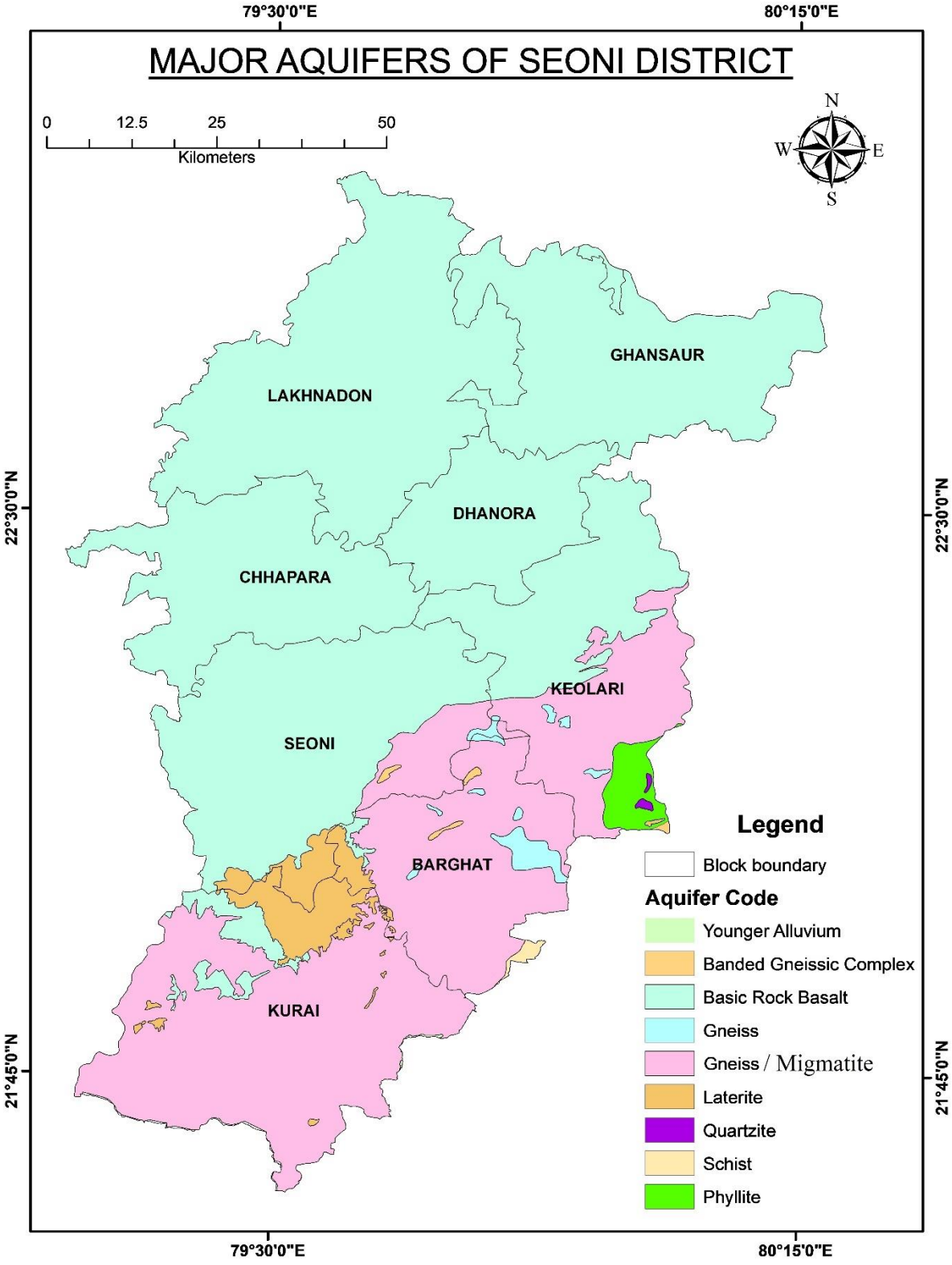


Fig:8. Aquifer system

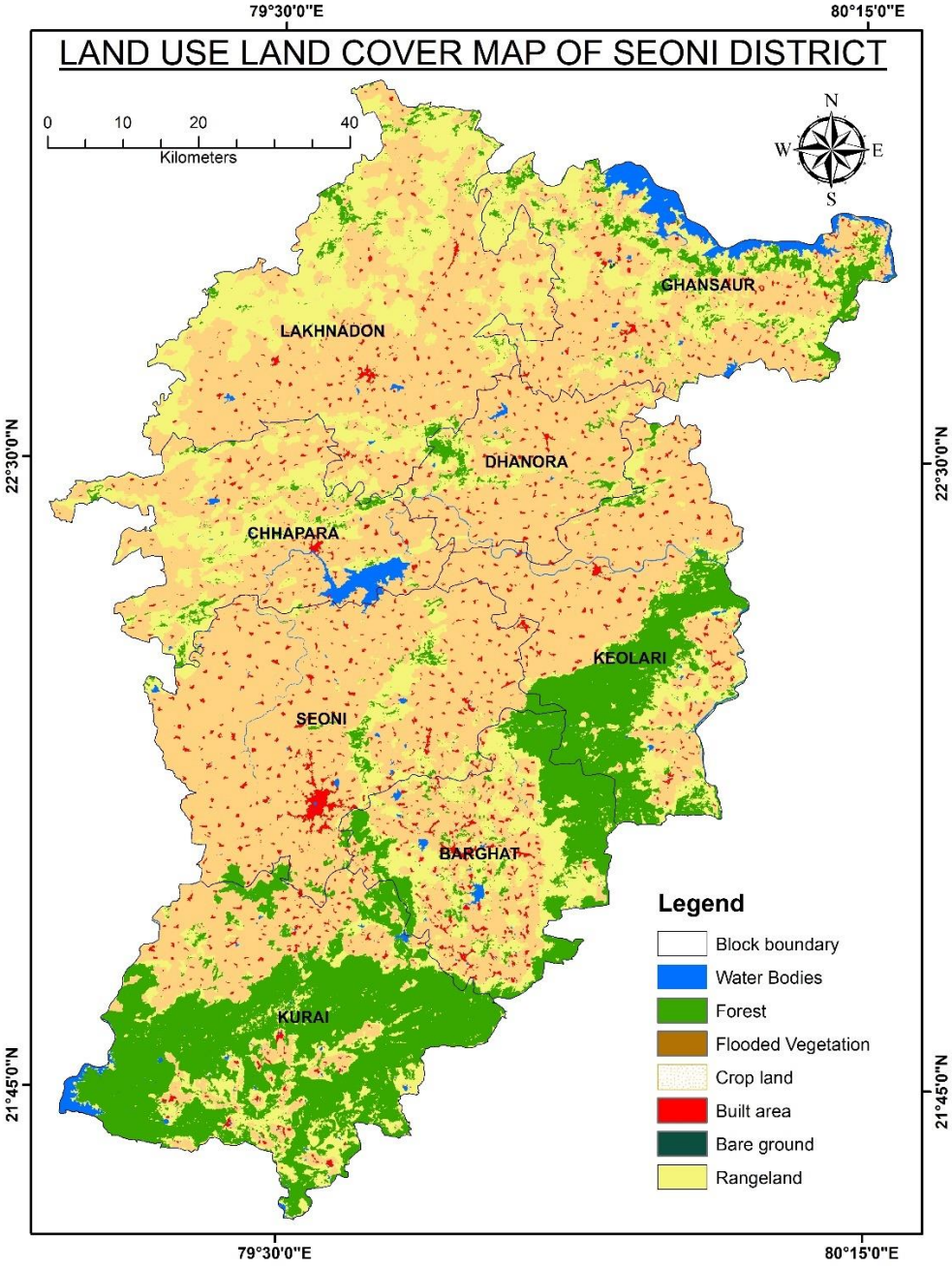


1.12. LAND USE, IRRIGATION, AND CROPPING PATTERN

A perusal of the table above shown that almost 10 percent of the total geographical area is under forest cover. Nearly 61 % of the total geographical area is fit for cultivation. However only 70 percent of the total cultivable land is actually under cultivation. Net cultivated area is only about 43 percent of the geographical area.

A comparison between the land utilization in 1988 and 1996 is given below ill table 4. It is observed that the increase in net cultivated land over the last eight years is only 2.08 present.

Fig:9. Landuse Map



The area under various crops in the district is given below in Table Perusal of the table shows that Rabi crops predominate with nearly 57 percent of the gross cropped area being Rabi crops. Wheat is the major Rabi crop Area under pulse cultivation is equally high at 28 percent of gross cultivated area. Oil seed production makes use of nearly 21 percent of the gross cropped area.

Table: no-4 Irrigation Area

Block	**Ground Water Irrigated Area (Ha)**	**Canal Irrigated Area (Ha)**	**Pond Irrigated Area (Ha)**	**Surface Water Irrigated Area (Ha)**
BARGHAT	655.88	291.74	1005.31	52.8
CHHAPARA	709.96	0	39.11	0
DHANORA	219.18	34.03	7.31	26.4
GHANSORE	312.01	0	25.7	0
KEOLARI	211.93	266.47	9.03	66
KURAI	680.03	0	27.58	0
LAKHNADON	1062.7	0	22	0
SEONI	1583.7	421.72	48.36	92.4
TOTAL	5435.39	1013.96	1005.31	237.6

Chapter-2
DATA COLLECTION AND GENERATION

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 presenting the data requirement, data availability, and data gap analysis is presented in the following table.

Table 3 Data Requirement, Data Availability, and Data Gap Analysis

S. No	Items	Data Requirement	Data Availability	Data Gap
..	Rainfall Data	Meteorological stations spread over the project area.	India-Wris	
².	Soil	Soil map and Soil infiltration rate	Available	
³.	Land Use	Latest Land Use Pattern	Prepared from Land Sat 8 Imagery in GIS.	
⁴.	Geomorpholo gy	Digitized Geomorphologic al Map	Bhukosh.	
⁵.	Geophysics	Geophysical data in each Quadrant	No VES done till now	54 VES
⁶.	Exploration Data	EW in each Quadrant with Aquifer Parameters	No exploratory wells drilled till now	24 exploratory wells required
⁷.	Aquifer Parameters	Aquifer parameters for all the quadrants	Not Available	
⁸.	Recharge	Recharge	Available	

	Parameters	parameters for different soil and aquifer types based on field studies		
9.	Discharge Parameters / Draft Data	Discharge parameters for different GW abstraction structures	GEC 2020	
10.	Geology	All the maps on a 1:50000 scale	Bhukosh	

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.

Table 4 Data Generated and Data collected for Aquifer Mapping Area.

S.No	Items	Data Generated	Data Collected
	Rainfall Data		INDIA-WRIS
	Ground Water Exploration	.	.
	GW Regime Monitoring	40 Key wells established	Not Available
	Chemical Quality	42 Samples of Naquim in 2022 and 40 samples of NHS in 2022.	

2.3 Hydrogeology

(i) Aquifer System

About 65% of the district is occupied by Deccan Traps in northern & north central part with a thin soil cover. The basalt is dark green in colour, fine grained porphyritic in texture. It is very hard & compact with well developed joints. The joints are open at the surface and persist to about 20 m below land surface. However, beyond 45m these are very tight, thus restricting the storage and movement of ground water. Ground water in the Deccan traps also occurs in the weathered mantle in joints and fracture under

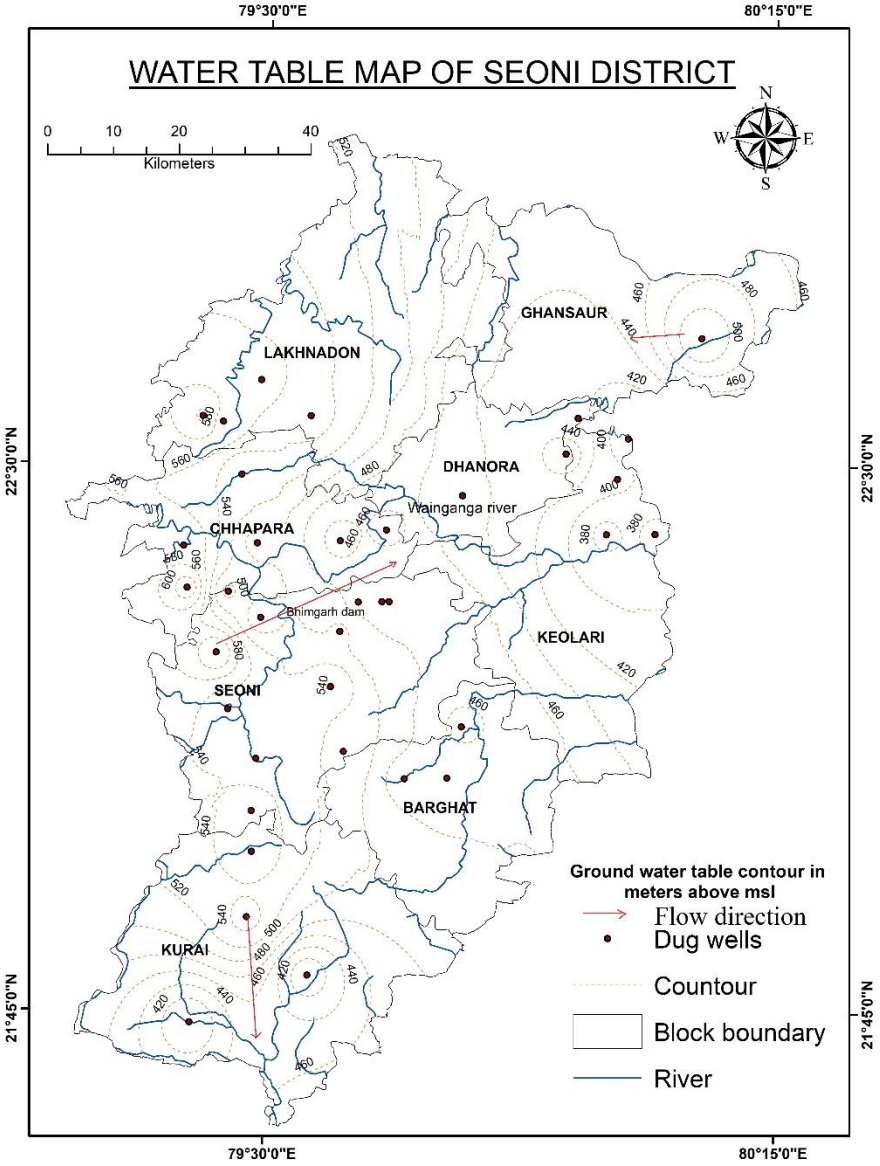
water table conditions and can sustain well having up to 2 lps discharge ground water in the alluvium also occurs under water table conditions. The depth of weathering is as high as 15m in areas where the basalt is well jointed.

The Archean gneissic complex in the southern part of the district occupy about 30% of the areas represented by gneiss and migmatites. Exposure of Granites are seen in the south eastern extremity of the district. Alluvium is restricted mainly to the area along the Wainganga and Narmada river valleys.

Ground water in granites occurs in joints, fractures planes and in weathered zone mostly under water table conditions and its occurrence is controlled by extent, size and interconnection of joints and degree of weathering which varies from place to place and under favorable conditions tube wells having discharge of 0.5 to 7.8 lps.

The ground water is present mostly in the soil cover overlying these igneous and metamorphic rock. At some places soil reaches thickness upto 15 meters. In the lean period the groundwater follows the contact along rock beds and soil cover. These water is used widely in irrigation and drinking purpose.

Fig:10. Hydrogelogical Map



2.4 Ground water scenario

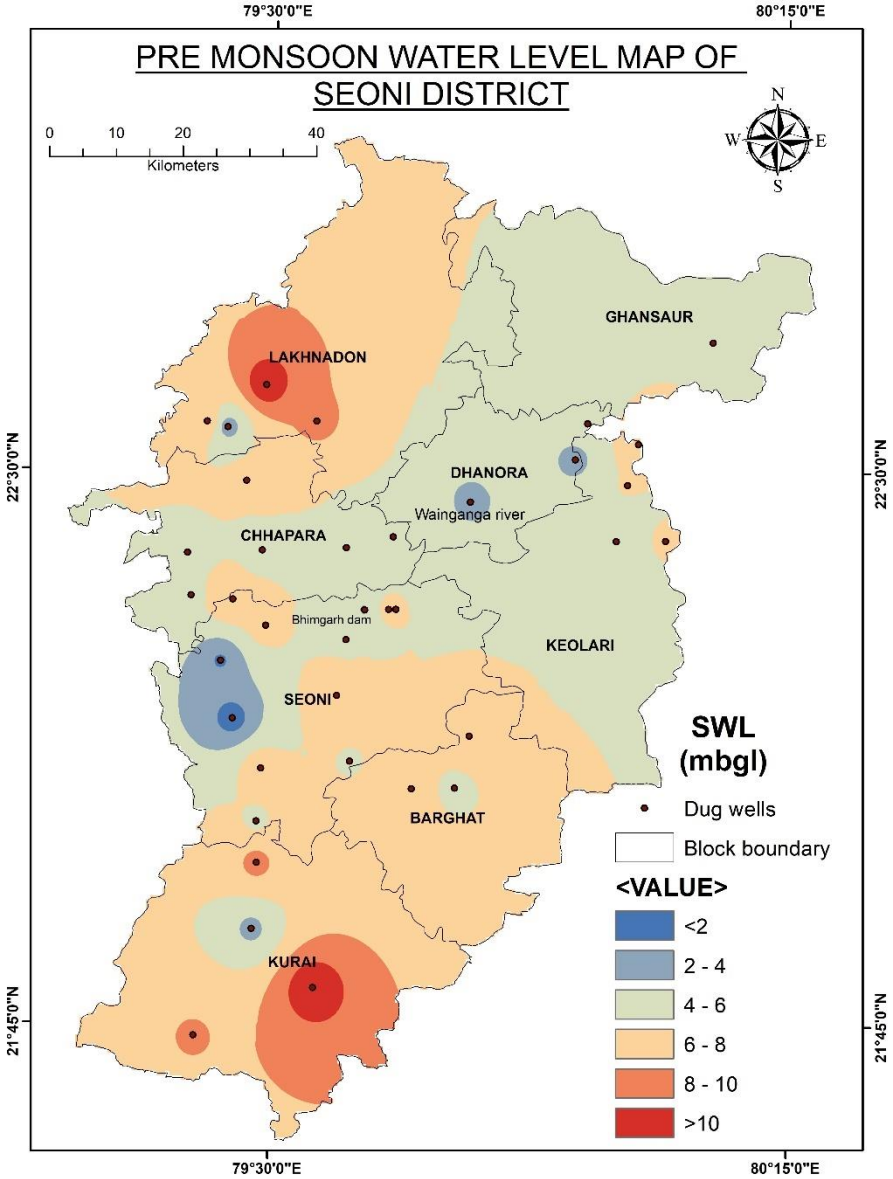
Water Levels

Water level data, including historical data are essential for not only to know the present ground water conditions but also for forecasting future trends in response to ground water reservoir operations. Using the water level data of 44 NHS monitoring wells, 40 NQUIM key wells data were used to prepare the pre-monsoon water level map

Pre Monsoon (May 2022)

Pre-Monsoon depth to water level in the year 2022 range from 1.1 to 11.60 mbgl. Shallow water level (< 3.00 m) occurs north eastern and north western part of the district.

Fig:10. Water level map



Groundwater Fluctuation

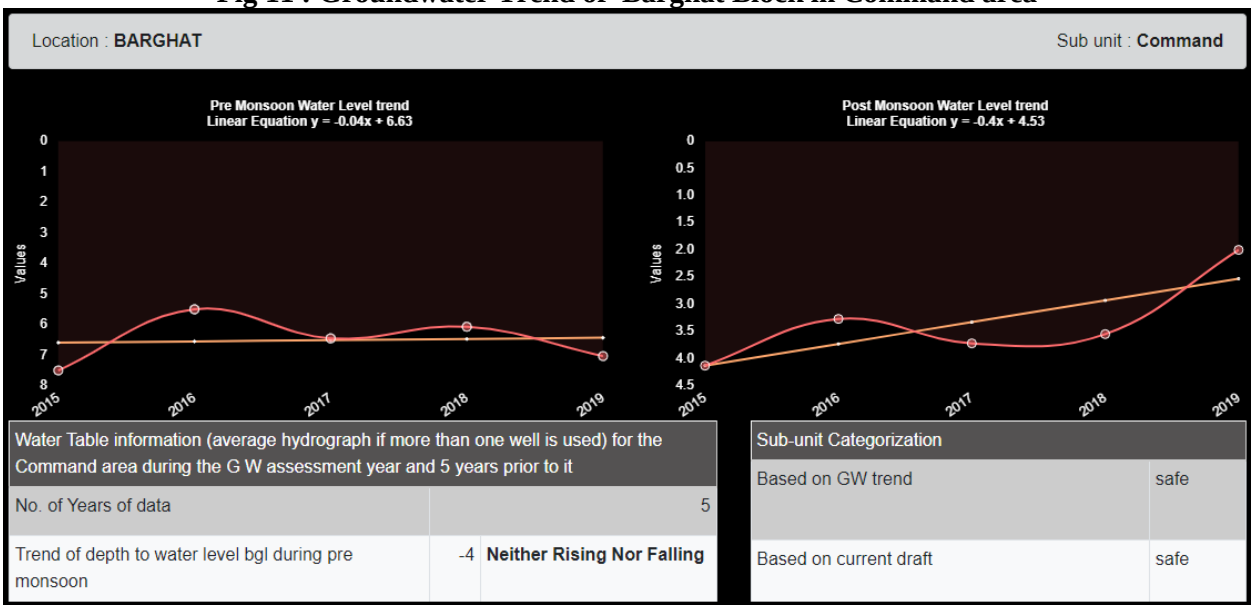
The water level trend map was plotted for both pre monsoon and post-monsoon in both command

and non-command areas of all the eight blocks of Seoni district.

Barghat Block :

The pre monsoon water level trend was neither rising nor falling in both command and non-command areas indicating approximately constant water levels

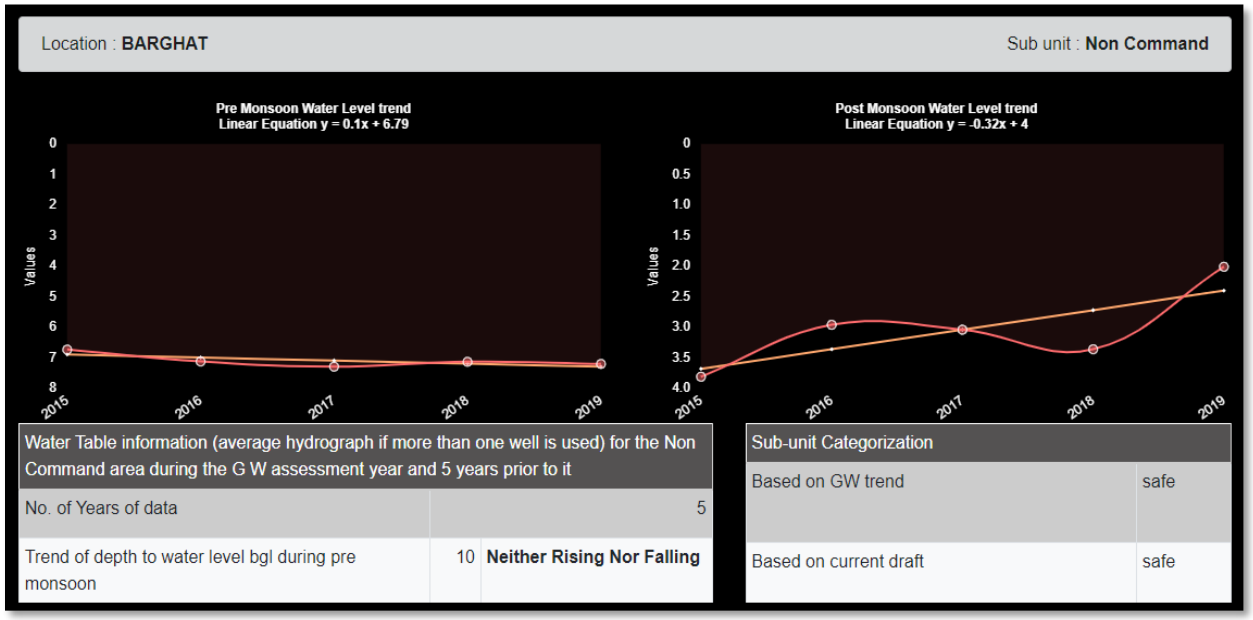
Fig 11 : Groundwater Trend of Barghat Block in Command area



Water Table information (average hydrograph if more than one well is used) for the Command area during the G W assessment year and 5 years prior to it		
No. of Years of data	5	
Trend of depth to water level bgl during pre monsoon	-4	**Neither Rising Nor Falling**

Sub-unit Categorization	
Based on GW trend	safe
Based on current draft	safe

Fig 11 : Groundwater Trend of Barghat Block in Non - Command area



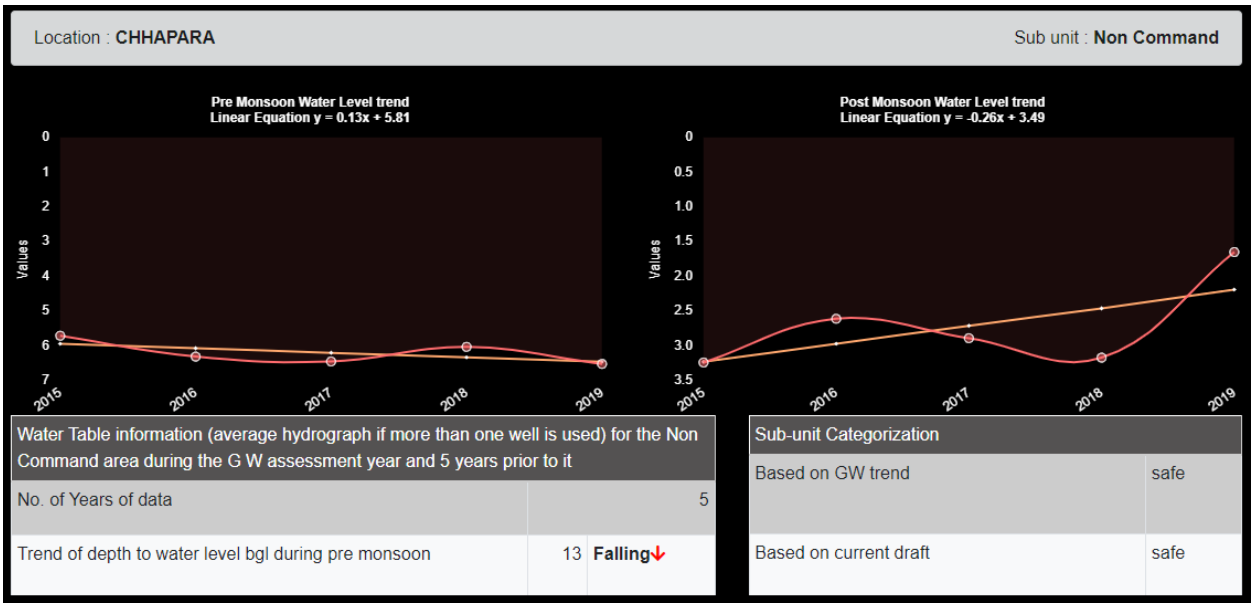
Water Table information (average hydrograph if more than one well is used) for the Non Command area during the G W assessment year and 5 years prior to it		
No. of Years of data	5	
Trend of depth to water level bgl during pre monsoon	10	**Neither Rising Nor Falling**

Sub-unit Categorization	
Based on GW trend	safe
Based on current draft	safe

Cahhapara Block :

The Chhapara block showed falling trend indicating deepening ground-water levels.

Fig 12 : Groundwater Trend of Chhapara Block in Command area



Dhanora Block :

The Dhanora block showed rising trend in the command area indicating increasing ground-water levels. Whereas in the non-command areas it was neither rising nor falling.

Fig 13 : Groundwater Trend of Dhanora Block in Command area

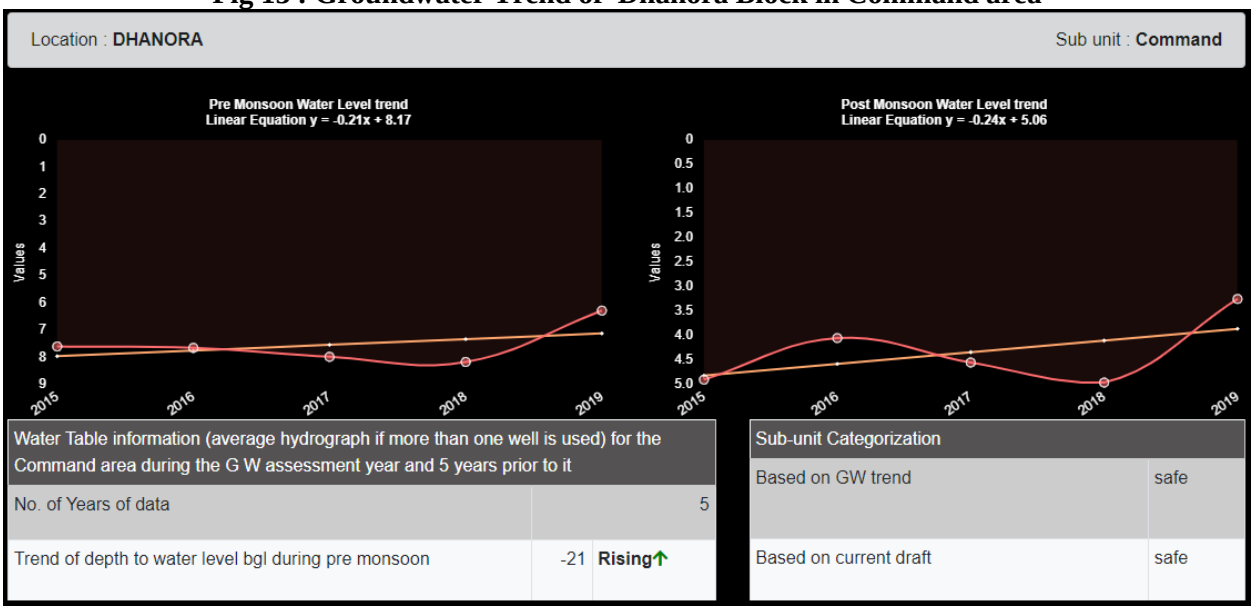
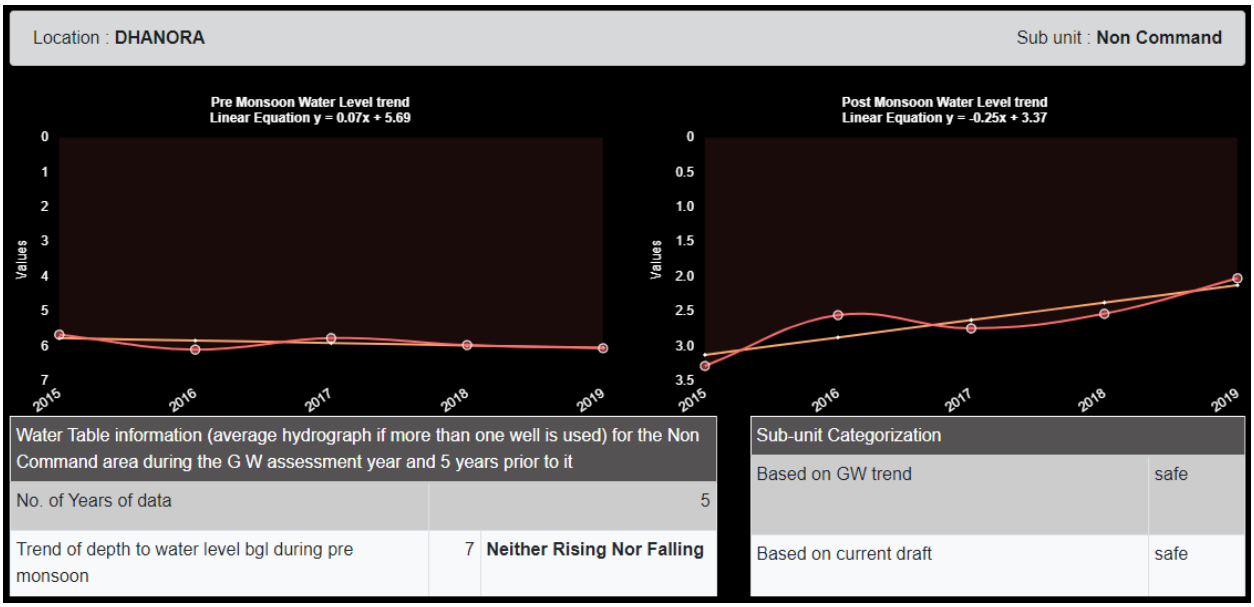


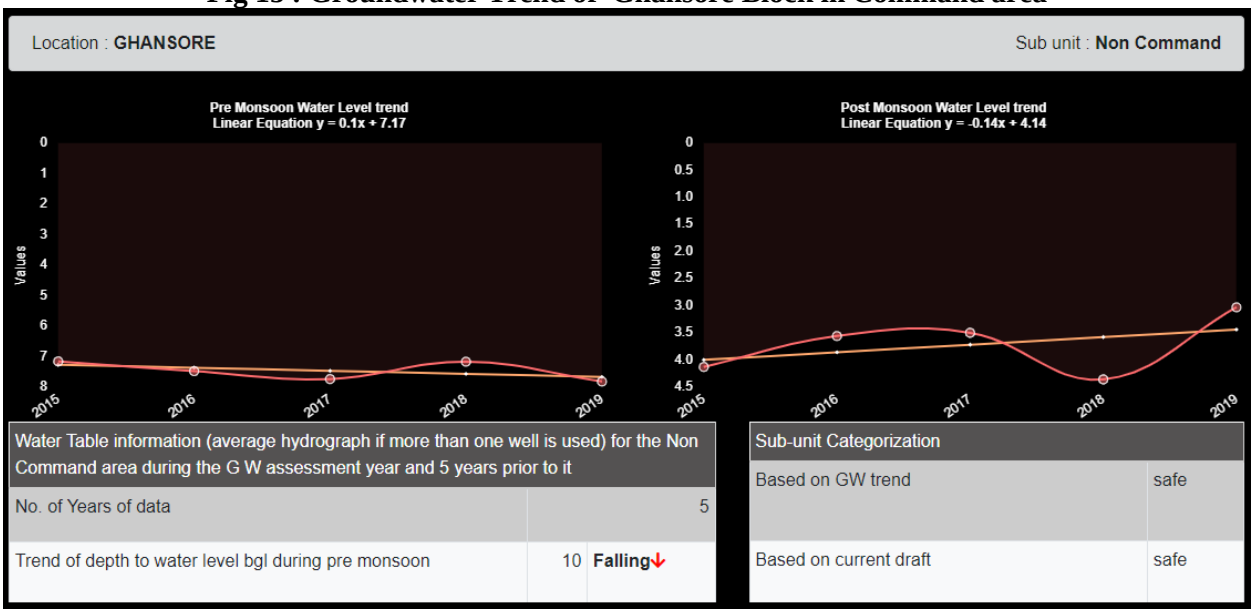
Fig 14 : Groundwater Trend of Dhanora Block in Non - Command area



Ghansore Block :

The Ghansore block showed falling trend indicating decreasing ground-water levels.

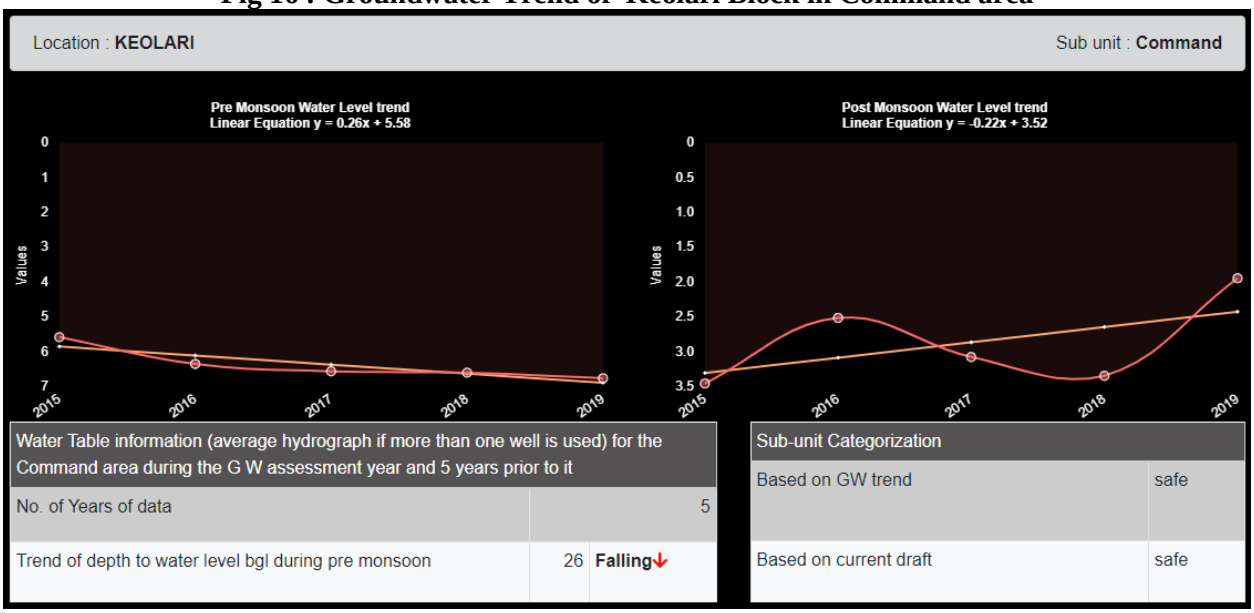
Fig 15 : Groundwater Trend of Ghansore Block in Command area



Keolari Block :

The Keolari block also showed falling trend indicating decreasing ground-water levels in both command and non command areas.

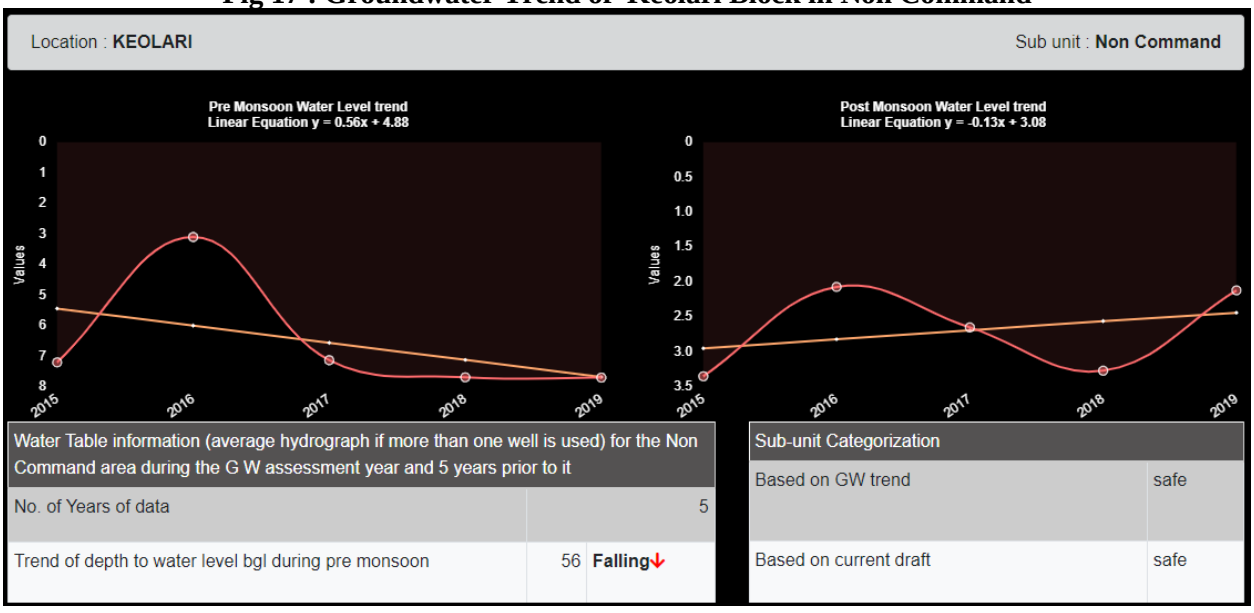
Fig 16 : Groundwater Trend of Keolari Block in Command area



Water Table information (average hydrograph if more than one well is used) for the Command area during the G W assessment year and 5 years prior to it		
No. of Years of data	5	
Trend of depth to water level bgl during pre monsoon	26	Falling↓

Sub-unit Categorization	
Based on GW trend	safe
Based on current draft	safe

Fig 17 : Groundwater Trend of Keolari Block in Non Command



Water Table information (average hydrograph if more than one well is used) for the Non Command area during the G W assessment year and 5 years prior to it		
No. of Years of data	5	
Trend of depth to water level bgl during pre monsoon	56	Falling↓

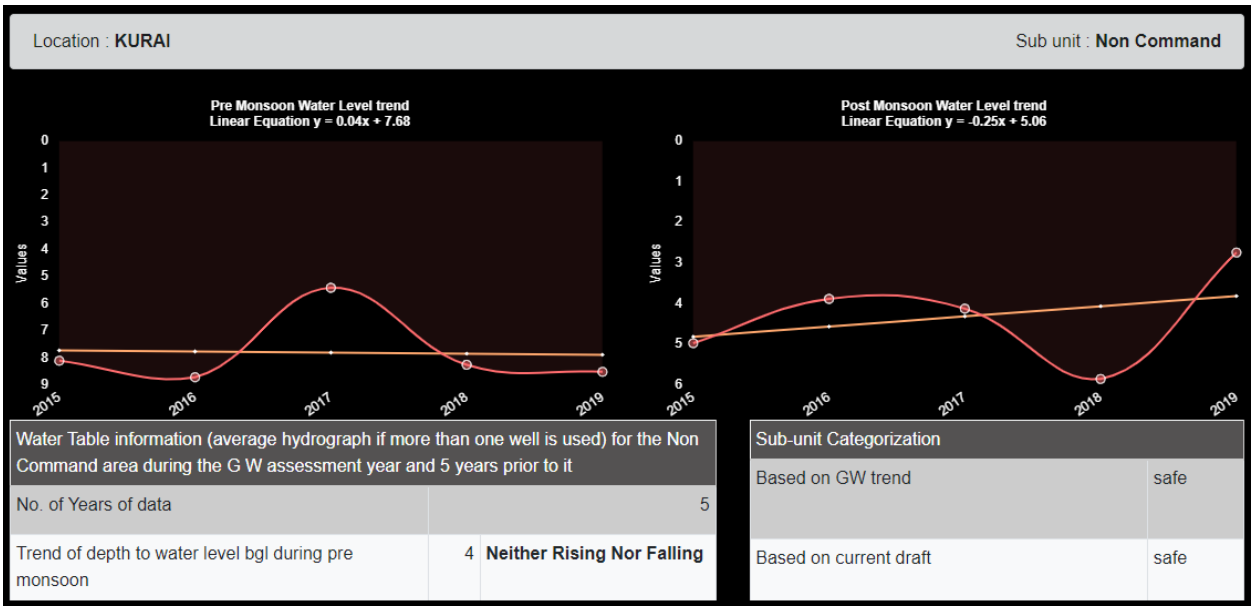
Sub-unit Categorization	
Based on GW trend	safe
Based on current draft	safe

area

Kurai Block :

The pre monsoon water level trend was neither rising nor falling in non-command areas indicating approximately constant water levels.

Fig 18 : Groundwater Trend of Kurai Block in Non Command



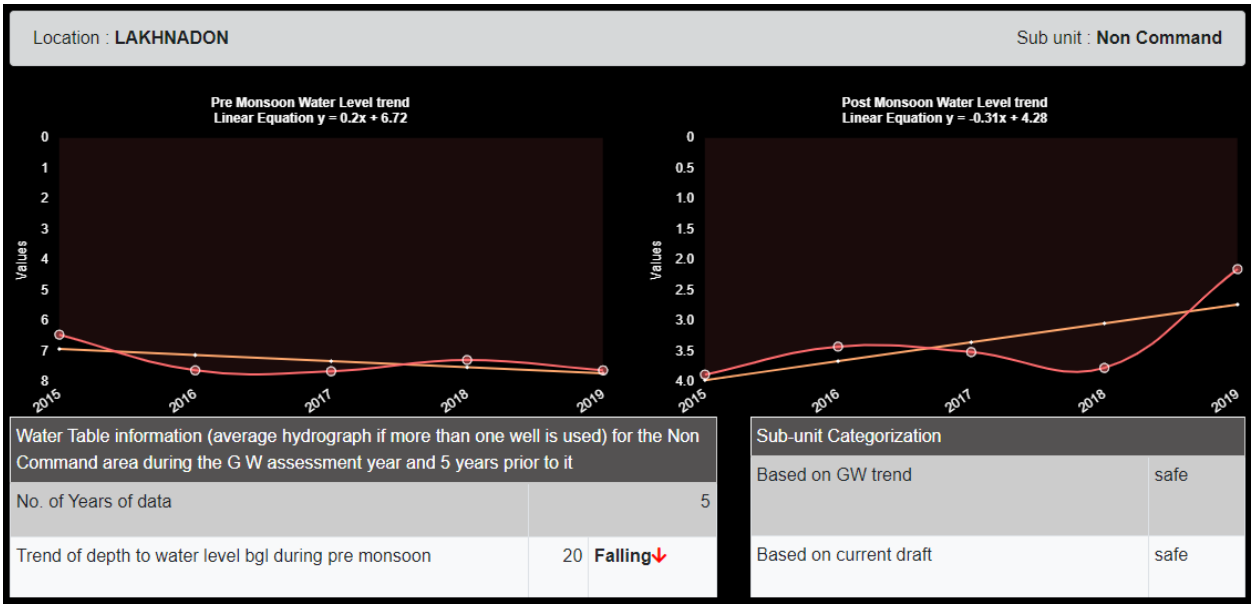
Water Table information (average hydrograph if more than one well is used) for the Non Command area during the G W assessment year and 5 years prior to it		
No. of Years of data		5
Trend of depth to water level bgl during pre monsoon	4	**Neither Rising Nor Falling**

Sub-unit Categorization	
Based on GW trend	safe
Based on current draft	safe

Lakhnadon Block :

The Lakhnadon block also showed falling trend indicating decreasing ground-water levels in both command and non command areas.

Fig 19 : Groundwater Trend of Lakhnadon Block in Non Command



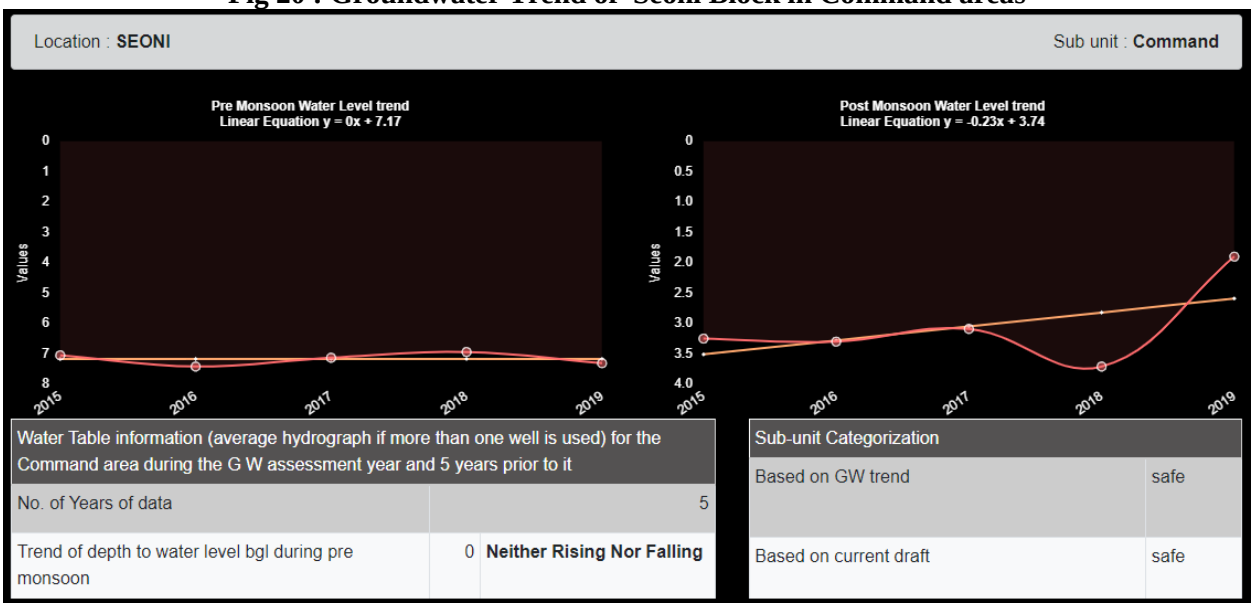
Water Table information (average hydrograph if more than one well is used) for the Non Command area during the G W assessment year and 5 years prior to it		
No. of Years of data		5
Trend of depth to water level bgl during pre monsoon	20	**Falling↓**

Sub-unit Categorization	
Based on GW trend	safe
Based on current draft	safe

Seoni Block :

The Seoni block also showed falling trend indicating decreasing ground-water levels in both command and non-command areas.

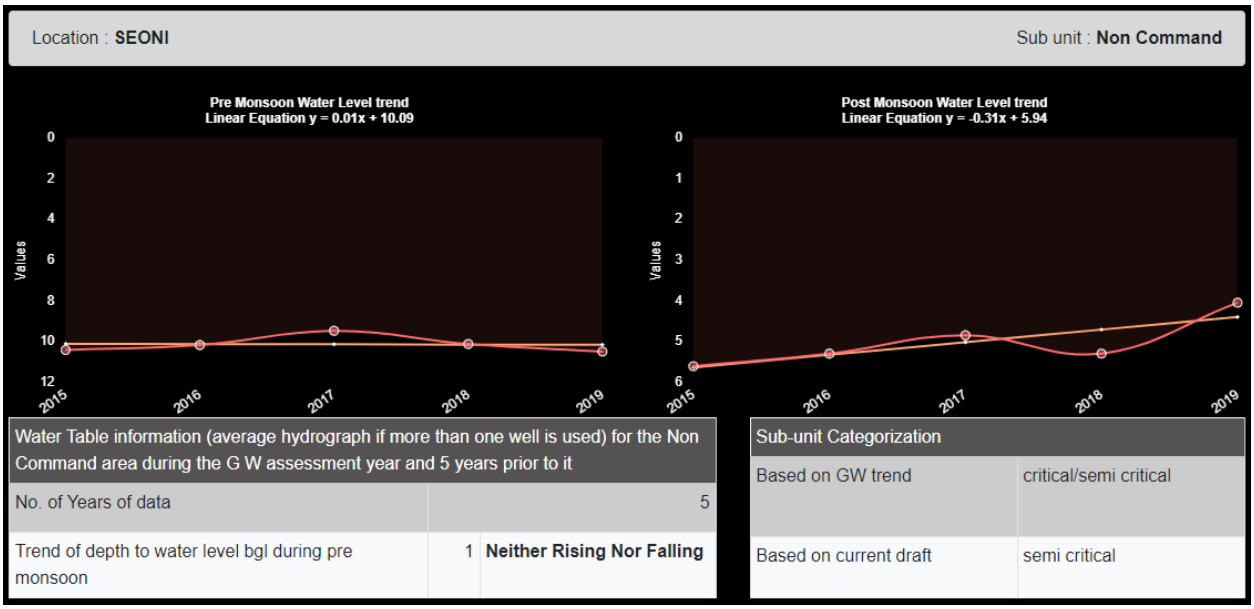
Fig 20 : Groundwater Trend of Seoni Block in Command areas



Water Table information (average hydrograph if more than one well is used) for the Command area during the G W assessment year and 5 years prior to it		
No. of Years of data	5	
Trend of depth to water level bgl during pre monsoon	0	**Neither Rising Nor Falling**

Sub-unit Categorization	
Based on GW trend	safe
Based on current draft	safe

Fig 21 : Groundwater Trend of Seoni Block in non-command areas



Water Table information (average hydrograph if more than one well is used) for the Non Command area during the G W assessment year and 5 years prior to it		
No. of Years of data	5	
Trend of depth to water level bgl during pre monsoon	1	**Neither Rising Nor Falling**

Sub-unit Categorization	
Based on GW trend	critical/semi critical
Based on current draft	semi critical

2.5 Groundwater Quality

Groundwater quality sampling was carried out in 43 locations under National Hydrograph Monitoring in 2021-22. The overall chemical quality of the Seoni district is good and safe for drinking except in few areas the fluoride and niterate concentration was found above acceptable limit. The minimum and maximum values are summarized in table 5 and overall groundwater quality is summarized in table 8.

Table 5 – Ground water chemical parameters

Drniking water Quality									
	max	min	Avg	No of wells above accepta ble limit	No of wells above permissi ble limit	Accepta ble limit	Permissi ble limit	% of samples above accepta ble limit	% of samples above permissi ble limit
pH	8.16	7.11	7.80	Na	Na	6.5	8.5	Na	Na
EC	3312	188	919.19	Na	Na	Na	Na	Na	Na
CO_3 in mg/lt	0	0	0.00	Na	Na	Na	Na	Na	Na
HCO_3 in mg/lt	857.5	61	339.12	Na	Na	Na	Na	Na	Na
Cl in mg/lt	630.0	15.0	90.75	1	Na	~~500~~	1000	2.33	Na
SO_4 in mg/lt	86	3	21.74	Na	Na	200	400	Na	Na
NO_3 in mg/lt	152	4	30.72	Na	10		45	Na	23.3
F in mg/lt	1.45	0.05	0.43	5	0	1	1.5	11.63	Na
PO_4 in mg/lt	0.2	0.1	0.15	Na	Na	Na	Na	Na	Na
SiO_2 in mg/lt	47	16	29.02	Na	Na	Na	Na	Na	Na
TH in mg/lt	625	45	282.91	25	2	200	600	58.14	4.7
Ca in mg/lt	212	10	82.79	18	2	75	200	41.86	4.7
Mg in mg/lt	37.696	4.864	18.47	4	Na	30	100	9.30	Na
Na in mg/lt	489	15	82.86	Na	Na	Na	Na	Na	Na
K in mg/lt	10.5	1.1	3.51	Na	Na	Na	Na	Na	Na
TDS in mg/lt	2152.8	122.2	597.47	20	1	500	2000	46.51	2.3
No of Samples =43						Na = Not applicable			

TDS : The TDS of the study area ranges from 122.2 to 2152.8 mg/lt. The maximum TDS was recorded from Khariya village in Dhanoura block.

Fluoride : Fluoride in the study area ranges between 0.05 to 1.45 mg/lt with 5 samples above acceptable limit. The maximum Fluoride was recorded from Khariya village in Dhanoura block. The fluoride enrichment areas are depicted in figure-11.

Niterate : Niterate in the study area ranges between 4 to 152 mg/lt with 10 samples above acceptable limit. The maximum Fluoride was recorded from Ari village in Barghat block. The fluoride enrichment areas are depicted in figure-11.

Fig:22. Fluoride concenteration map

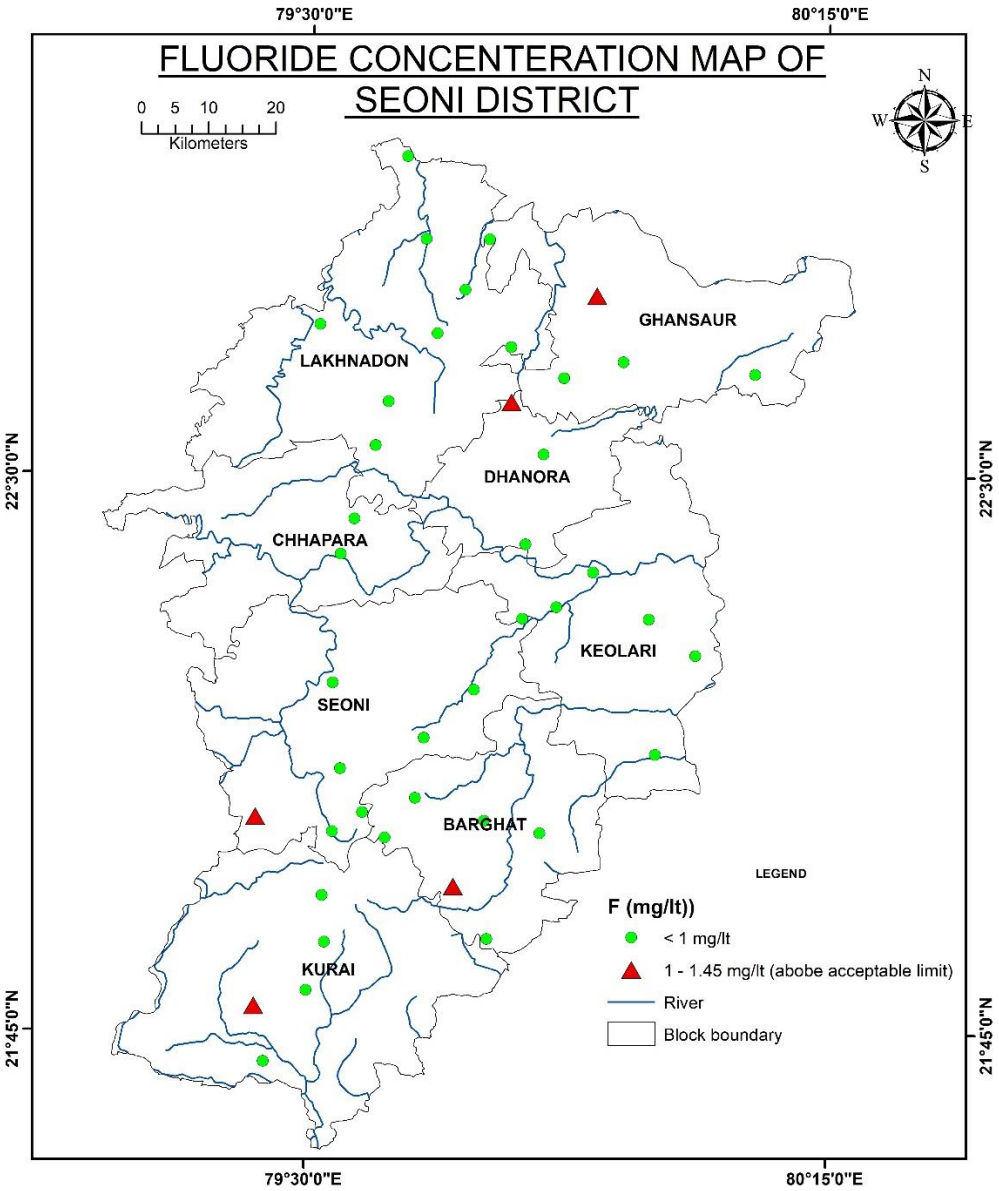
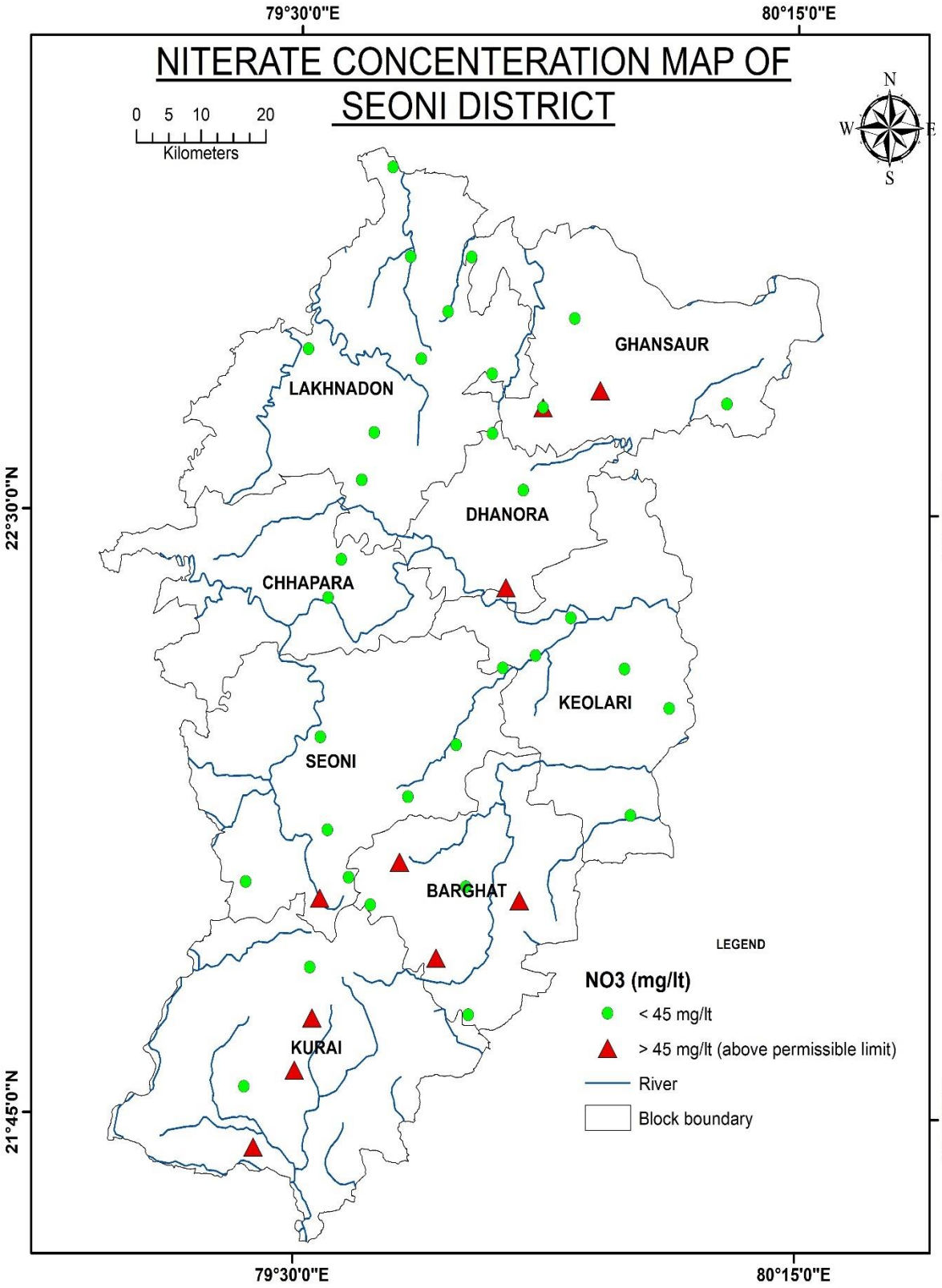


Fig:23. Niterate concenteration map



2.6 GROUNDWATER RESOURCES

The quantitative estimation of various inputs to ground water resources and their temporal variation in space and time is imperative for a planned management and development of ground water resources. The resources in the surveyed area are computed on the basis of methodology recommended by the Ground Water Estimation Committee of Ministry of Water Resources, Govt. of India, 2015.
The entire aquifer mapping area, falls under command area and has been covered under ground water resource assessment. The estimation of ground water resource in the surveyed area is taken as on March 2020.

Methodology adopted

The primary source of recharge of groundwater in Seoni district is rainfall. Therefore, water table balance method has been used for estimating the resources. Rainfall recharge factor or Infiltration factor is a recharge parameter that indicates a quantum of water recharged to the groundwater system in relation to the rainfall. It is a function of rate of infiltration and ability of the system to accept the infiltrated water. The infiltration factor can be expressed as follows

IF = (Qi/Qa) X SY,
Where,
IF = Infiltration Factor
Qi = Quantum of water infiltrated over the test period in m
Qa = Quantum of water applied in m
SY = Specific Yield

Recharge of ground water involves several components and the rainfall being the major one. The other components are return irrigation flow from surface water and ground water.
Rainfall infiltration factor for alluvial formations is taken as 20%. The Return Flow Factor for recharge from surface water irrigation has been taken as 15-25 % for non-paddy crops and 50-60 % for paddy crops. In case of ground water irrigation, the return flow factor has been taken as 15-25 % for non-paddy crops. Canal seepage factor, for lined and unlined canals, has been taken as per GEC' 2015 norms. The recharge from other sources i.e. ponds and lakes have also been estimated based on the spread area of the water bodies.

DYNAMIC GROUND WATER RESOURCES (As on March 2020)

. The overall stage of ground water development in the NAQUIM area of Seoni is 37.54 %, falls under safe category. The details are given in table-7.

Table 6 Dynamic water resources of seoni district

STATE	DISTRICT	BLOCK	Total area	Rainfall (mm)	Recharge Worthy Area (ha)	Total ground water recharge	Annual Ground water Recharge (Ham)	Env flows	Annual Extractable Ground water Resource (ham)	Domestic Draft	Irrigation Draft	Industrial draft	Total draft	Stage of Extraction	Categorization
MADHYA PRADESH	SEONI	BARGHAT	72000	1322	69170	7853.88	7853.88	482.29	7371.59	472.891	2806.584	0	3279.47	44.488	safe
MADHYA PRADESH	SEONI	CHHAPARA	73100	1322	63240	5812.82	5812.82	290.64	5522.18	313.553	2839.861	0	3153.42	57.1046	safe
MADHYA PRADESH	SEONI	DHANORA	66700	1322	60900	4599.89	4599.89	230	4369.89	216.81	897.4	0	1114.21	25.4974	safe
MADHYA PRADESH	SEONI	GHANSORE	96300	1322	83790	7125.32	7125.32	356.26	6769.06	363.606	1248	0	1611.6	23.8083	safe
MADHYA PRADESH	SEONI	KEOLARI	82700	1322	77270	6628.37	6628.37	331.42	6296.95	403.227	862.07	0	1265.3	20.0939	safe
MADHYA PRADESH	SEONI	KURAI	178300	1322	166970	12570.39	12570.4	628.52	11941.9	297.932	2720.1	0	3018.03	25.2727	safe
MADHYA PRADESH	SEONI	LAKHNADON	170400	1322	154480	14418.61	14418.6	720.93	13697.7	486.419	4250.8	0	4737.22	34.5841	safe
MADHYA PRADESH	SEONI	SEONI	136330	1322	129230	13493.4	13493.4	1212.79	12280.6	582.361	6860.2	0	7442.56	60.6042	semi_critical
			875830			72502.68	72502.7	4252.85	68249.8	3136.8	22485.015	0	25621.8	37.5412	

2.7 GROUNDWATER ISSUES AND MANAGEMENT PLAN FOR PRE-MONSOON

There are two major issues in Seoni districts

1- Falling water levels in Lakhnadon, Keolari, Dhansore, Chhapra blocks.-

The Lakhnadon, Keolari, Dhansore, Chhapra blocks showed falling water level trend is probably due to increased draft and the alluvium over Gneissic and Granitic terrain consist mostly of well drained soils with high permeability with majority of the water being released in the form of baseflow. The decreasing groundwater levels in the north-eastern part of the Laknadon may be attributed to its high elevation, and also as a result more runoff and increased extraction.

2- Fluoride and Niterate contamination

Flurodide has been reported from 5 sites in Seoni, Barghat and Kurai blocks premonsoon samples and niterate above permissible limit has been reported from 10 locations most of which are concenterated in Seoni, Barghat and Kurai blocks.

2.7.2 MANAGEMENT OPTIONS –

DEMAND SIDE

Conjunctive Use

The Valley portion of Seoni mainly the Wainganga valley possesses good groundwater potential. For efficient and sustainable agriculture in surface water-deficient areas, surface water and groundwater can be harnessed conjunctively to have a more or less drought-proof water management system. In the piedmont slopes, the perennial nalas should be used as a source of both domestic and industrial use and the groundwater piedmont area should only be used for drinking water. Numerous check dams should be built in the seasonal and perenneal streams passing through the black cotton soils overlying the Basaltic rock

Irrigation Strategies

Drought proofing can be achieved by promoting the use of drip & sprinkler irrigation system, with proper infrastructural support and government subsidies.

Solid Waste Disposal/Landfill site

As the aquifer extent is limited and is made up of high permeable sediments therefore the waste disposal site should be chosen judiciously so that the quality of groundwater does not get affected.

Capacity Building

People should be made aware of water management practices, modern agricultural and irrigation techniques, changing climate, etc.

1.1 MANAGEMENT OPTIONS - SUPPLY SIDE

Protection of Aquifers

a- Banning of mining in the river bed.

Rejuvenation

a- Construction of check dams at suitable places in the river.
b- Sub-surface dyke across the river and nalas.

Uneven distribution of Aquifers

The inconsistency in the lateral and vertical extent of aquifers creates excess water availability in one area and scarcity in the other. The Scarcity of water should be augmented by developing proper water supply schemes hanenessing surface water resources like streams.

Scientific Approach

Construction of tube wells should be done in a scientific manner. Appropriate distance should be maintained between tube wells to avoid interference of the wells. The well assembly of the should have proper slot size according to lithologies encountered.

Estimation of Aquifer parameters

Proper pumping tests need to be carried out to arrive at safe yield from the pumpsgroundwater aquifer parameters of the tube wells and installation of the pumps of appropriate capacity.

Over Pumping/ Overdraft from Aquifer Ground Water

Over pumping from tube wells have to be stopped at all, as it is likely to damage not only the tube well but also the surrounding groundwater bearing formation.

Reclamation of water bodies and wetlands

The water bodies and wetlands should be protected and conserved and they should be restored to their original boundaries.

Groundwater development

Most of the district is concentrated in the valley portion which is drained by the Wainganga River and its tributaries. In the past, the development of groundwater was mainly through dug wells, wells along the Rivers, nallas. Some springs have played a major role in sustainable domestic and irrigational supplies. However, in recent years modern means of groundwater development have been employed. Public Health Engineering has been constructing a number of hand pumps and shallow to moderate deep tube wells for large-scale water supplies.

Ground Water Quality Issues

The main Sources of Fluoride is fluorine-bearing minerals: apatite, fluorite, biotite, hornblende which is found abundantly in both granitic and gneissic rocks which can be augmented by setting up fluoride treatment plants and taking calcium and Vitamin-D supplements

Table 7 Details of the Key well established in Naquim

Sl. No.	**District**	**Block**	**Location**	**Source**	**Latitude**	**Longitude**	**Date of Collection**	**Temp. (°C)**	**pH**	**EC**	**EC* 1000 mS/ Cm**	DTWL May 2022 BMP	MP	SWL	MRL	WATER TABLE	DTWL Nov 2022	**Samples**
1	Seoni	Kurai	Kuppitola	HP	21.73409	79.39104	27/05/22	30.4	7.39	1.016	1016	8.73	0.63	8.1	413	404.9		B, HM
2	Seoni	Kurai	Pindrai (Butte)	HP	21.79974	79.56364	27/05/22	34.2	6.85	0.892	892	11.3	0	11.3	419	407.7		B, HM
3	Seoni	Kurai	Alesar	HP	21.87889	79.47409	27/05/22	29.8	6.71	0.384	384	4.13	0.5	3.63	550	546.37		B, HM
4	Seoni	Kurai	Chikli	HP	21.96875	79.48036	27/05/22	30	6.47	0.61	610	9.23	0.7	8.53	562	553.47		B, HM
5	Seoni	Seoni	Gondrai	HP	22.02476	79.47936	28/05/23	32	6.96	1.382	1382	5.08	0	5.08	554	548.92		B
6	Seoni	Seoni	Sargapur	HP	22.0946	79.48546	28/05/24	33.6	7.99	0.659	659					0		B, HM
7	Seoni	Seoni	Sargapur	BW	22.09653	79.48546	28/05/25	32.8	7.74	0.696	696	6.92	0	6.92	540	533.08		B
8	Seoni	Seoni	Sangai	HP	22.08818	79.47297	28/05/26	33.9	6.82	1.509	696			6.92				B
9	Seoni	Seoni	Badi Mungwani	HP	22.16397	79.44329	28/05/27	33	7.27	0.751	751	1.6	0.5	1.1	528	526.9		B, HM
10	Seoni	Seoni	Chandori Kalan	HP	22.24163	79.42552	28/05/28	34.9	7.64	0.398	398	1.98	0.2	1.78	603	601.22		B
11	Seoni	Seoni	Bakhari	HP	22.3251	79.44246	28/05/29	33.7	6.96	1.199	1199	8.6	0.5	8.1	504	495.9		B
12	Seoni	Seoni	Jujhatpur	HP	22.2897	79.49066	28/05/30	32.1	7.33	0.458	458	7.35	0.5	6.85	493	486.15		B,HM
13	Seoni	Seoni	Bithli	HP	22.10696	79.61429	29/05/2016	35.2	9.05	0.515	515	6.2	0.3	5.9	524	518.1		B
14	Seoni	Seoni	Ghatpipariya		22.19569	79.59474	29/05/2017	28.7	7.35	0.923	923	8	0	8	549	541		B, HM
15	Seoni	Seoni	Poundi	HP	22.2713	79.60772	29/05/2018	31.1	7.06	0.815	815	6.44	0.6	5.84	509	503.16		B

16	Seoni	Seoni	Lungsa	DW	22.31195	79.63437	29/05/2019	31.7	7.57	0.577	577	4.2	0.4	3.8	478	474.2		B
17	Seoni	Seoni	Bajarwada	HP	22.31265	79.6798	29/05/2020	30.7	8.83	0.467	467	6.73	0.8	5.93	473	467.07		B, HM
18	Seoni	Seoni	Mehlon	HP	22.31265	79.66934	29/05/2021	33.5	8	0.449	449	6.9	0.2	6.7	486	479.3		B
19	Seoni	Barghat	Muar	HP	22.14173	79.78783	29/05/2022	35	6.98	1.26	1260	8.05	0.9	7.15	462	454.85		B, HM
20	Seoni	Barghat	Nagjhir	HP	22.07151	79.7669	29/05/2022	28.4	6.85	0.376	376	6.1	0.5	5.6	473	467.4		B, HM
21	Seoni	Barghat	Khurshipar	HP	22.0699	79.7045	29/05/2022	27.2	6.03	1.636	1636	7.5	0.73	6.77	478	471.23		B, HM
22	Seoni	Chhapra	Keolari	DW	22.33012	79.38184	30/05/2022	29.7	6.92	0.537	537	6.25	0.5	5.75	619	613.25		B
23	Seoni	Chhapra	Pipardhana	HP	22.38777	79.37611	30/05/2022	27.1	7.11	0.441	441	6.15	0.55	5.6	585	579.4		B
24	Seoni	Chhapra	Mahulpani	HP	22.44717	79.34728	30/05/2022	27.5	6.63	1.135	1135					0		B, HM
25	Seoni	Chhapra	Dungwani	DW	22.48604	79.46095	30/05/2022	25.2	6.8	0.752	752	6.9	0.55	6.35	528	521.65		B
26	Seoni	Chhapra	Khatkar	DW	22.3917	79.48489	30/05/2022	24.7	6.96	0.568	568	6.1	0.9	5.2	497	491.8		B
27	Seoni	Chhapra	Bhimgarh Ryt		22.41095	79.67502	30/05/2022	26.9	6.66	0.582	582	6	0.3	5.7	460	454.3		B, HM
28	Seoni	Chhapra	Gorakhpur	DW	22.39585	79.60695	30/05/2022	26.1	6.86	0.478	478	5.4	0.45	4.95	455	450.05		
29	Seoni	Keolari	Gangutola	HP	22.40674	79.99979	31/05/2022	28.6	7.14	0.443	443	4.75	0.72	4.03	378	373.97		B
30	Seoni	Keolari	Shaliwada	DW	22.40762	80.0714	31/05/2022	27.9	6.5	0.474	474	6.9	0.6	6.3	381	374.7		B, HM
31	Seoni	Keolari	Chandan Kheda	DW	22.48292	80.01572	31/05/2022	28.2	7.64	0.463	463	6.8	0.7	6.1	407	400.9		B
32	Seoni	Keolari	Sarrai Tola	HP	22.53831	80.0313	31/05/2022	27.1	6.97	0.535	535	8.05	0.2	7.85	391	383.15		B
33	Seoni	Dhanora	Begarwani	DW	22.51701	79.93952	31/05/2022	27.5	7.06	0.486	486	3.8	0.3	3.5	459	455.5		B
34	Seoni	Dhanora	Madhdeori	DW	22.56601	79.95696	31/05/2022	27.5	7.53	0.486	486	5.7	0.9	4.8	425	420.2		B, HM

35	Seoni	Ghansour	Chargaon	DW	22.71138	30.13897	31/05/2022	30.3	8.53	0.187	187	5.8	0.7	5.1	511	505.9		B
36	Seoni	Ghansour	Binori	HP	22.67636	80.13897	31/05/2022	29.8	8.88	0.919	919	6.2	0.3	5.9	521	515.1		B, HM
37	Seoni	Dhanora	Harduli	HP	2.411661	79.70179	1/6/2022	29.4	9.11	0.538	538	5.25	0	5.25	440	434.75		B, HM
38	Seoni	Dhanora	Chota Dhanora	HP	22.45899	79.78715	1/6/2022	28.8	6.39	0.667	667	3.9	0.2	3.7	448	444.3		B
39	Seoni	Lakhnodon	Chulgaon	HP	22.56703	79.56246	1/6/2022	28.9	6.57	1.268	1268	9	0.57	8.43	557	548.57		B
40	Seoni	Lakhnodon	Khakhariya	HP	22.56561	79.40266	1/6/2022	29	9.07	0.454	454	7.65	0	7.65	611	603.35		B, HM
41	Seoni	Lakhnodon	Jamuwa	HP	22.55816	79.43289	1/6/2022	26.8	8.63	0.2	200	3.4	0.3	3.1	577	573.9		B
42	Seoni	Lakhnodon	Adegaon	HP	22.6157	79.48882	1/6/2022	29.7	8.99	0.449	449	12.5	0.9	11.6	581	569.4		B

Table 8 Ground water Quality data of Seoni district

Location	Source	Lat.	Long.	Field Temp. (^oC)	pH	EC	CO_3 (mg/lt)	HCO_3 (mg/lt)	Cl (mg/lt)	SO_4 (mg/lt)	NO_3 (mg/lt)	F (mg/lt)	PO_4 (mg/lt)	SiO_2 (mg/lt)	TH (mg/lt)	Ca (mg/lt)	Mg (mg/lt)	Na (mg/lt)	K (mg/lt)	TDS (mg/lt)
Amagarh	DW	22.012	79.613	25	7.48	188	0	66	22	3	5	0.05	0.2	22	60	16	5	15	2.7	122
Ari	DW	21.947	79.712	25.2	7.62	1575	0	507	132	22	152	1.08	BDL	26	555	178	27	108	1.3	1024
Bamandehi	DW	22.046	79.58	24.3	7.84	365	0	121	40	10	10	0.17	BDL	32	110	24	12	35	1.1	237
Bamhodi	HP	22.0657	79.6562	25.4	7.85	520	0	193	30	18	51	0.30	0.1	28	215	62	15	21	2.8	338
Banjal	HP	22.308	79.992	24.3	7.64	565	0	169	87	14	7	0.65	BDL	23	145	38	12	65	1.3	367
Banjari	DW	22.818	79.758	24.6	8.06	275	0	79	27	22	5	0.81	BDL	25	45	10	5	43	1.5	179
Borghat	DW	22.0357	79.7559	23.5	8.05	643	0	223	84	13	4	0.37	BDL	31	190	52	15	63	2.8	418
Chhapara	HP	22.3935	79.5457	22.5	7.73	725	0	308	30	22	37	0.27	BDL	36	235	64	18	65	2.1	471
Chunatola	DW	22.147	79.668	23.6	7.11	389	0	145	20	32	13	0.33	BDL	22	120	24	15	29	8.1	253
Dargada	DW	22.929	79.638	24	7.63	865	0	374	62	18	27	0.05	BDL	26	350	102	23	42	2.1	562
Dhanaura	DW	22.529	79.838	24	8.14	615	0	187	89	15	9	0.13	0.1	24	170	42	16	65	1.8	400
Dhangada	DW	22.3239	79.858	24.9	7.92	986	0	405	67	21	36	0.41	BDL	39	405	112	30	45	3.1	641
Dharamkuan	HP	21.8766	79.7608	24.9	7.82	1025	0	417	92	14	33	0.11	BDL	26	375	104	28	65	3.0	666
Dhuma	DW	22.75	79.723	24.1	7.97	1420	0	525	178	16	8	0.09	BDL	27	430	126	28	135	2.4	923
Gaurabibi	DW	22.702	79.513	22	8.11	723	0	332	32	25	12	0.51	0.2	31	100	22	11	127	2.5	470
Ghansor1	DW	22.654	79.953	24.8	7.89	1052	0	471	25	28	84	0.17	BDL	32	455	138	27	36	2.2	684
Gharghatia	DW	22.673	79.79	24	8.06	750	0	302	62	16	29	0.05	BDL	36	285	102	7	42	2.8	488
Ghunai	DW	22.441	79.565	23	7.96	412	0	169	30	12	18	0.16	0.1	34	165	52	9	21	2.2	268
Gorakhpur	DW	22.743	79.914	24	8.06	965	0	465	22	45	26	1.28	BDL	26	325	84	28	75	3.3	627
Kaniwara	DW	22.212	79.74	24.1	7.42	2802	0	858	445	32	14	0.51	BDL	28	610	204	24	376	3.5	1821
Kauria	HP	22.0195	79.8361	25	8.13	1402	0	500	135	46	49	0.36	0.2	29	435	112	38	123	5.2	911
Keolari	DW	22.371	79.911	23.6	8.08	972	0	482	45	12	15	0.17	BDL	34	330	102	18	72	7.5	632
Khamaria	DW	22.599	79.791	25.1	7.56	3312	0	805	630	86	6	1.45	BDL	18	625	212	23	489	4.4	2153
Khawasa	HP	21.7102	79.4404	26.5	7.95	1189	0	470	92	25	63	0.91	BDL	16	325	106	15	123	3.5	773
Kudari	DW	22.408	79.813	24.7	7.72	1212	0	439	107	16	88	0.26	0.1	32	400	124	22	98	2.9	788
Kudopar	HP	22.6319	79.8669	27.1	7.76	545	0	165	77	22	8	0.77	BDL	25	75	20	6	92	2.6	354
Kurai New	DW	21.806	79.501	24.3	8.15	611	0	146	65	44	52	0.42	BDL	26	210	64	12	45	4.0	397
Lakhnadon 1	DW	22.599	79.613	24.3	7.42	1512	0	659	127	14	15	0.19	0.2	42	515	178	17	108	4.7	983
Madai	DW	22.54	79.595	23.4	8.16	642	0	305	20	26	19	0.10	BDL	35	250	64	22	36	3.3	417
Makarjhir	DW	22.691	79.683	24	7.98	485	0	226	17	22	13	0.05	0.1	29	180	62	6	28	4.5	315
Masurbhanwari	DW	22.638	80.144	25	7.46	1242	0	500	110	10	34	0.08	BDL	47	445	124	33	72	3.2	807
Mehta	HP	22.6319	79.8669	24.2	8.12	1416	0	573	102	14	96	0.13	BDL	31	530	164	29	82	3.1	920
Nagan Deori	DW	22.818	79.666	23.5	7.92	282	0	61	47	12	7	0.09	BDL	30	65	18	5	33	2.7	183
Nandora	DW	22.02	79.537	25	7.82	652	0	238	35	15	75	0.22	0.2	26	250	62	23	37	3.4	424
Palari	DW	22.308	79.809	23.3	7.46	852	0	366	55	18	21	0.36	BDL	24	300	82	23	63	3.7	554
Pandiachhappara	DW	22.126	80.002	24	7.26	989	0	403	92	5	24	0.45	BDL	23	305	84	23	82	10.5	643
Pipardahi	BW	22.0394	79.4258	24	8.11	511	0	122	95	8	5	1.42	0.1	36	95	20	11	74	3.6	332
Piparia1	HP	21.7849	79.4258	24	7.26	830	0	397	37	28	8	1.29	BDL	32	285	64	30	58	3.9	540
Rahiwara	DW	22.22	79.536	23.8	7.42	712	0	378	15	14	11	0.30	BDL	25	245	62	22	57	3.5	463
Rukhar	HP	21.8711	79.5267	23.9	8.09	1365	0	525	102	24	100	0.58	BDL	32	505	164	23	82	5.1	887
Seoni1	HP	22.1046	79.5478	25.9	7.59	822	0	201	142	32	11	0.95	0.2	22	200	62	11	95	3.9	534
Suktara	DW	21.934	79.523	24	7.62	545	0	134	82	30	14	0.05	BDL	36	110	22	13	76	5.3	354
Ugli	HP	22.2592	80.0595	23.2	7.89	565	0	171	90	14	7	0.47	BDL	24	140	32	15	65	3.9	367