केंद्रीय भूमि जल बोर्ड

जल संसाधन, नदी विकास और गंगा संरक्षण

विभाग, जल शक्ति मंत्रालय

भारत सरकार

Central Ground Water Board

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

AQUIFER MAPPING AND MANAGEMENT OF GROUND WATER RESOURCES

MAHASAMUND BLOCK, MAHASAMUND DISTRICT, CHHATTISGARH

उत्तर मध्य छत्तीसगढ़ क्षेत्र, रायपुर

North Central Chhattisgarh Region, Raipur

स्वच्छ जल : स्वच्छ भारत

केन्द्रीयभूमिजलबोर्ड

उत्तर मध्य छत्तीसगढ़ क्षेत्र
द्वितीय तल, एल.के. कॉर्पोरेट एवंलॉजिस्टिकपार्क,
धमतरीरोड, डूमरतराई, रायपुर (छत्तीसगढ़)–492015
फोन–0771–2974405, फैक्स–2974405 ईमेल–rdnccr-cgwb@nic.in

AQUIFER MAPS AND MANAGEMENT PLANS
MAHASAMUND BLOCK, MAHASAMUND DISTRICT

1. Salient Information:

About the area: Mahasamund Block is situated on the western part of Mahasamund district of Chhattisgarh and is bounded on the north and west by Balodabazar district andRaipur district respectively, in the south-west by Gariaband district of Chhattisgarh, in the south by Bagbaharablock and in the west by Pithora block. The area lies between 21.00 and 21.33 N latitudes and 82.00 and 82.33 E longitudes. The geographical extension of the study area is 944 sq.km representing around 18 % of the district's geographical area. Administrative map of the block is shown in Fig. 1. Geomorphology comprises of structural plains in the western part, pediment and pediplains in the eastern part and structural hills and denudational plains in the north central part of the block. Geomorphology map is shown in Figure 2. Mahanadi, flowing northwards forms the western most limit of the block separating Raipur and Mahasamund district. Bagnainala, Kurarnala and Hathi nala, all flowing north-westward are a part of Mahanadi basin. Baaghnainala flowing north-west is also tributary of Mahanadi river. Drainage map shown in Fig.3.

Population: The total population of Mahasamund block as per 2011 Census is264115out of which rural population is 202308while the urban population is 61807.The population break up i.e. male- female, rural & urban is given below -

Table- 1: Population Break Up

Block	Total population	Male	Female	Rural population	Urban population
Mahasamund	264115	131779	132336	202308	61807

Source: CG Census, 2011

Growth rate: The decadal growth rate of the block is 20.26 as per 2011 census.

Rainfall: The study area receives rainfall mainly from south-west monsoon. The months of July and August are the heaviest rainfall months and nearly 95% of the annual rainfall is received during June to September months. Average annual rainfall in the study area is (Average of the last five years i.e. 2010 to 2015)1392.02 mm with 50 to 60 rainy days.

Table-2: Rainfall data in Mahasamund block in mm

Year	2010-11	2011-12	2012-13	2013-14	2014-15
Annual rainfall	1424.70	1545.30	1493.00	1208.70	1288.40

Source: IMD

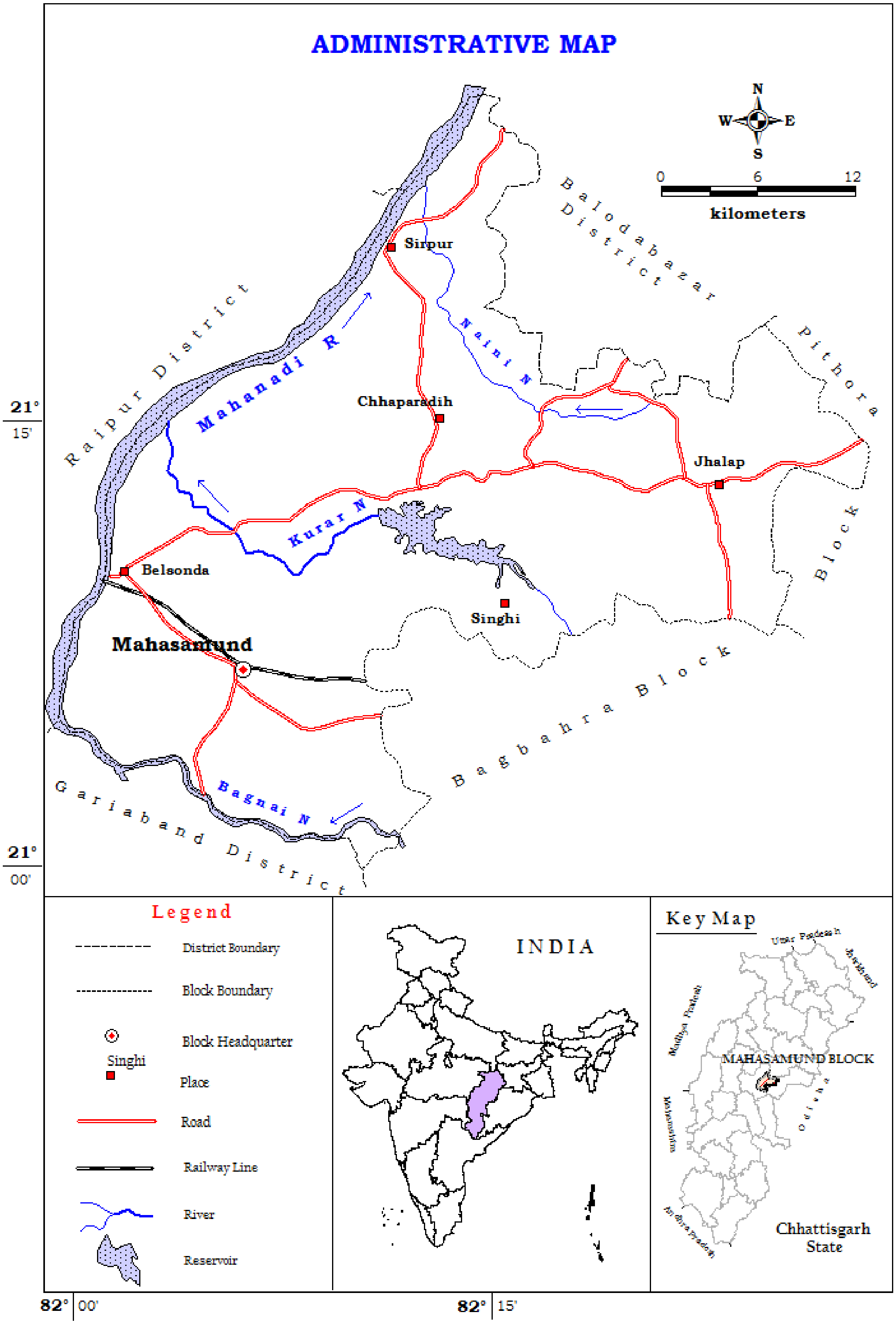

Figure: 1 Administrative Map of Mahasamund Block

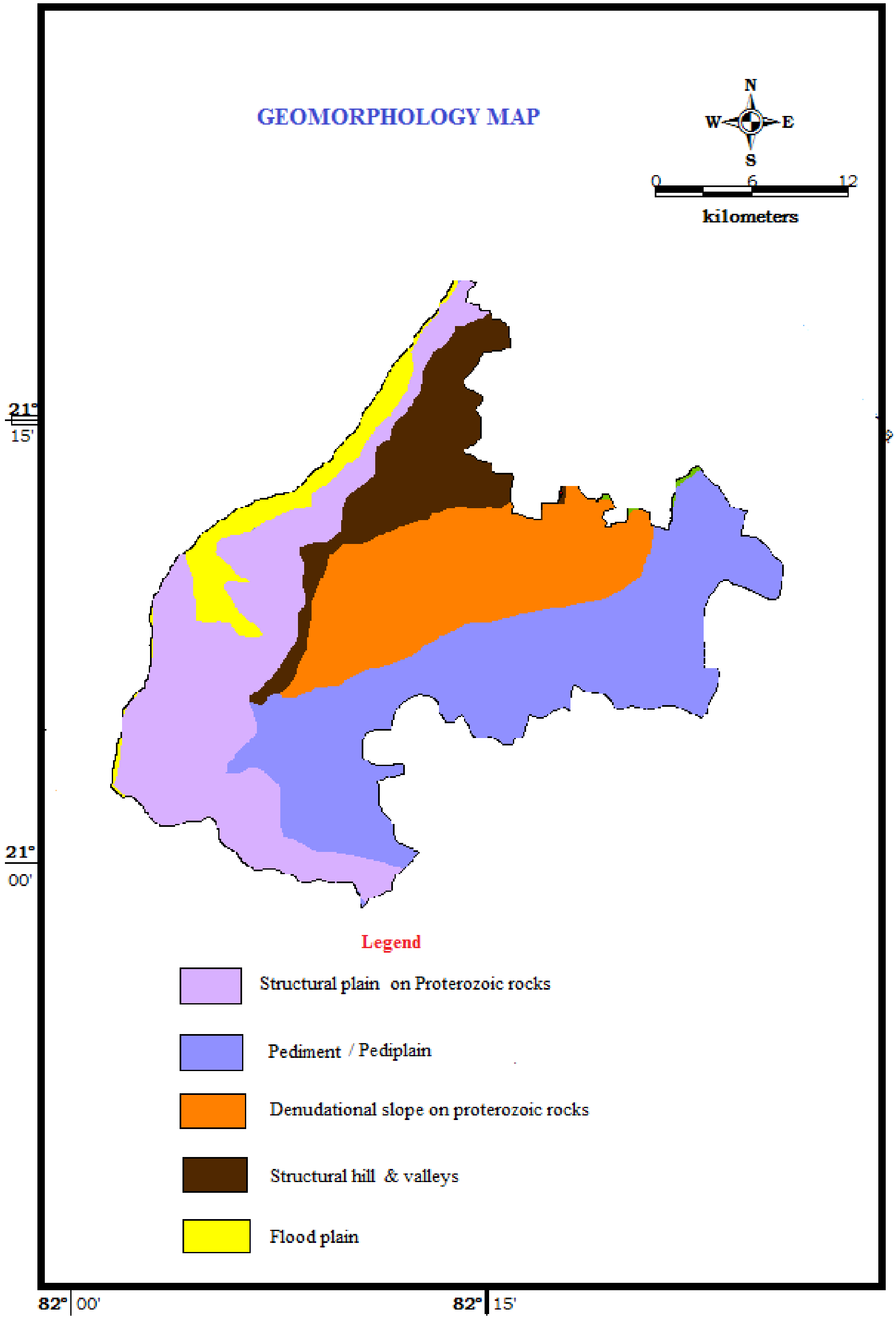

Figure 2: Geomorphology Map of Mahasamund Block

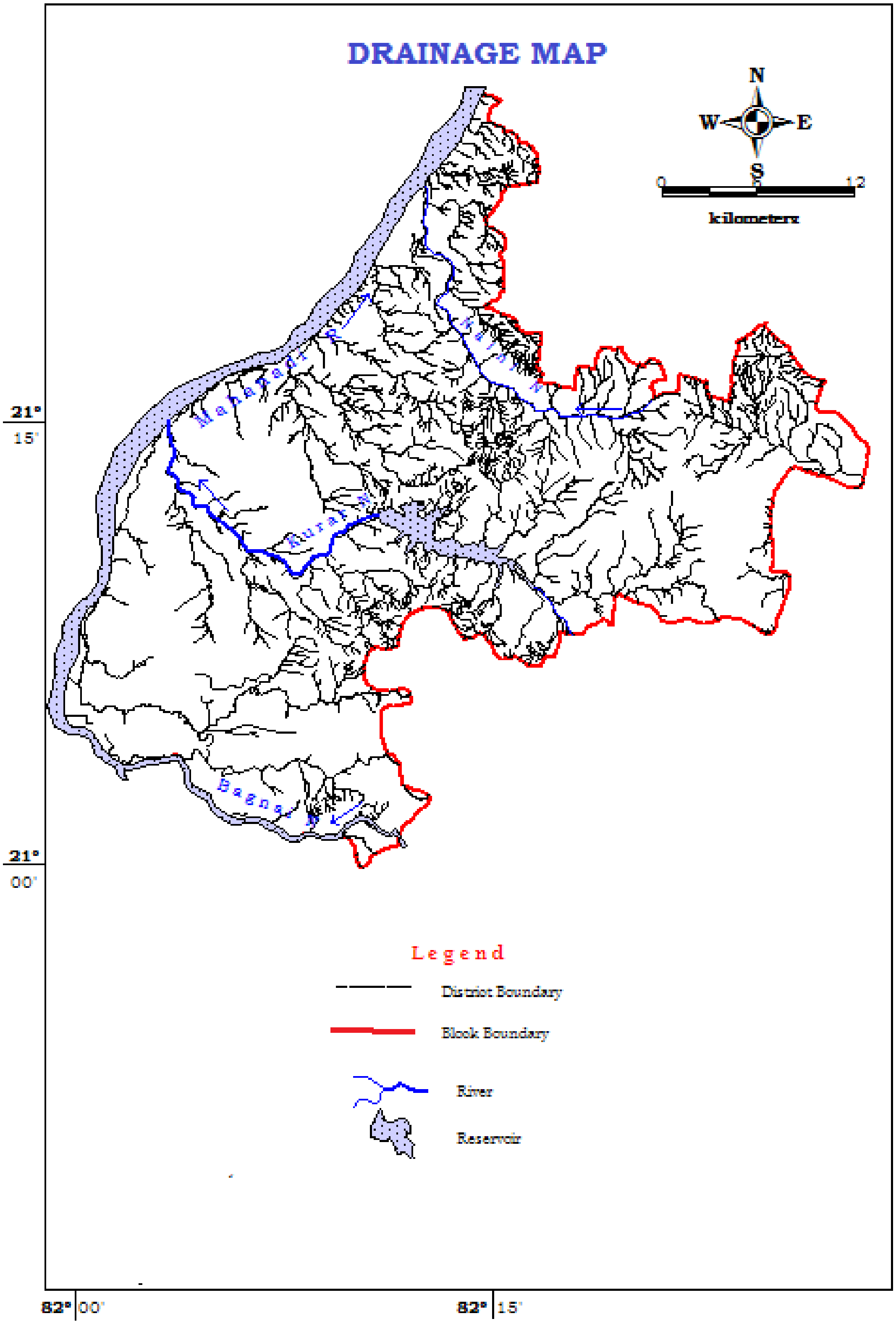

Figure 3: Drainage Map of Mahasamund Block

Agriculture and Irrigation**:** Agriculture is practiced in the area during Kharifand Rabi season every year. During the Kharif, cultivation is done through rainfall while during the Rabi season, it is done through ground water as well as partly through surface water like canals and other sources. The groundwater abstraction structures are generally Dugwells, Borewells /tubewells. The principal crops in the block are Paddy, Wheat, Vegetables and pulses.

In some areas, double cropping is also practiced. The agricultural pattern, cropping pattern and area irrigated data of Mahasamundblock is given in Table 3 (A, B, C, D, E).

Table 3 (A): Agricultural pattern (in ha)

Block	Total geographical area	Revenue forest area	Area not available for cultivation	Net sown area	Double cropped area	Gross cropped area
Mahasamund	94400	46303	10932	48805	8927	57732

Table 3 (B): Land use pattern (in ha)

Block	Total geographical area	Revenue forest area	Area not available for cultivation	Non agricultural& Fallow land	Agricultural Fallow land	Net sown area	Double cropped area	Gross cropped area
Mahasamund	94400	46303	10932	6349	2205	48805	8927	57732

Table 3 (C): Cropping pattern (in ha)

Block	Kharif	Rabi	Cereal				Pulses	Tilhan	Fruits Vegetables	Reshe	Mirch Masala	Sugar-cane
			Wheat	Rice	Jowar& Maize	Others						
Mahasamund	48781	8951	220	55137	10	11	1305	341	573	nil	55	4

Table 3 (D): Area irrigated by various sources (in ha)

No. of canal s (private and Govt.)	Irrigated area	No. of bore wells/ Tube wells	Irrigated area	No. Of dug wells	Irrigated area	No. of Talabs	Irrigated area	Irrigated area by other sources	Net Irri-gated area	Gross irrigated area	% of irrigated area wrt. Net sown area
9	23731	6621	13500	846	78	563	140	465	37914	37914	66 %

Table 3 (E): Statistics showing Agricultural land Irrigated

Block	Net Irrigated Area	Net Irrigated Area by ground water	Percentage of Area Irrigated by ground water
Mahasamund	37914	13578	35.81

Groundwater Resource Availability and Extraction: Based on the resource assessment made, the resource availability in aquifer wise in Mahasamund block upto 200 m depth is given in the table-4.

Table – 4: Ground Water Resources of Mahasamund block in Ham

<table>
<tr><th rowspan="3">Block</th><th colspan="4">Dongargarh granite and gneiss</th></tr>
<tr><th colspan="2">Phreatic</th><th>Fractured</th><th rowspan="2">Total resource</th></tr>
<tr><th>Dynamic</th><th>Static</th><th>In-storage</th></tr>
<tr><td rowspan="5">Mahasamund</td><td>5962.29</td><td>1022.4</td><td>180.71</td><td>7165.4</td></tr>
<tr><td colspan="4">Argillaceous limestone</td></tr>
<tr><td>3219.59</td><td>368</td><td>97.58</td><td>3685.17</td></tr>
<tr><td colspan="4">Sandstone</td></tr>
<tr><td>4031.48</td><td>276.48</td><td>122.19</td><td>4430.15</td></tr>
</table>

Existing and Future Water Demand (2025): The existing demand for irrigation in the area is 6607.10 Ham while the same for domestic and industrial field is 2507.34 Ham. To meet the future demand for ground water, a total quantity of 6607.20 ham of ground water is available for future use.

Water Level Behavior: (i) Pre- monsoon water level: In the pre-monsoon period, it has been observed that in Mahasamund block, water level in dug wells varies between 3.1 to 13.5 mbgl with average water level of 9.18m bgl. In deeper fractured aquifer, the maximum water level is 21.56mbgl, the average water level is 13.91mbgl.

Table 5A: Aquifer wise Depth to Water Level (Pre-monsoon)

Block Name	Phreatic Aquifer		
	Min	Max	Avg
Mahasamund	3.1	13.5	9.18

Water Level (in mbgl)

Table 5B: Aquifer wise Depth to Water Level (Pre-monsoon)

Block Name	FracturedAquifer		
	Min	Max	Avg
Mahasamund	6.5	21.56	13.91

(ii) Post- monsoon water level**:** In the post-monsoon period, it has been observed that the water level varies from 1.36 to 8.93 mbgl with an average of 4.02 mbglin phreatic aquifer. Infracturedformation, the post monsoon water level variation range is 4.32 to 15.75mbgl with average of 9.05mbgl.

Table 5C: Aquifer wise Depth to Water Level (Post-monsoon)

Block Name	Phreatic Aquifer		
	Min	Max	Avg
Mahasamund	1.36	8.93	4.02

Water Level (in mbgl)

Table 5D: Aquifer wise Depth to Water Level (Post-monsoon)

Block Name	Fractured Aquifer		
	Min	Max	Avg
Mahasamund	4.32	15.75	9.05

(iii) Seasonal water level fluctuation: The water level fluctuation data indicates that in Mahasamundblock, water level fluctuationin phreatic aquifer varies from 1.24 to 10.08m with an average fluctuation of 5.16 m. Water level fluctuationin fractured aquifer varies from 2.14 to 8.71 m with an average fluctuation of 4.86m.

Table 5E: Aquifer wise Depth to Water Level Fluctuation

Block Name	PhreaticAquifer		
	Min	Max	Avg
Mahasamund	1.24	10.08	5.16

Water Level (in m)

Table 5F: Aquifer wise Depth to Water Level Fluctuation

Block Name	FracturedAquifer		
	Min	Max	Avg
Mahasamund	2.14	8.71	4.86

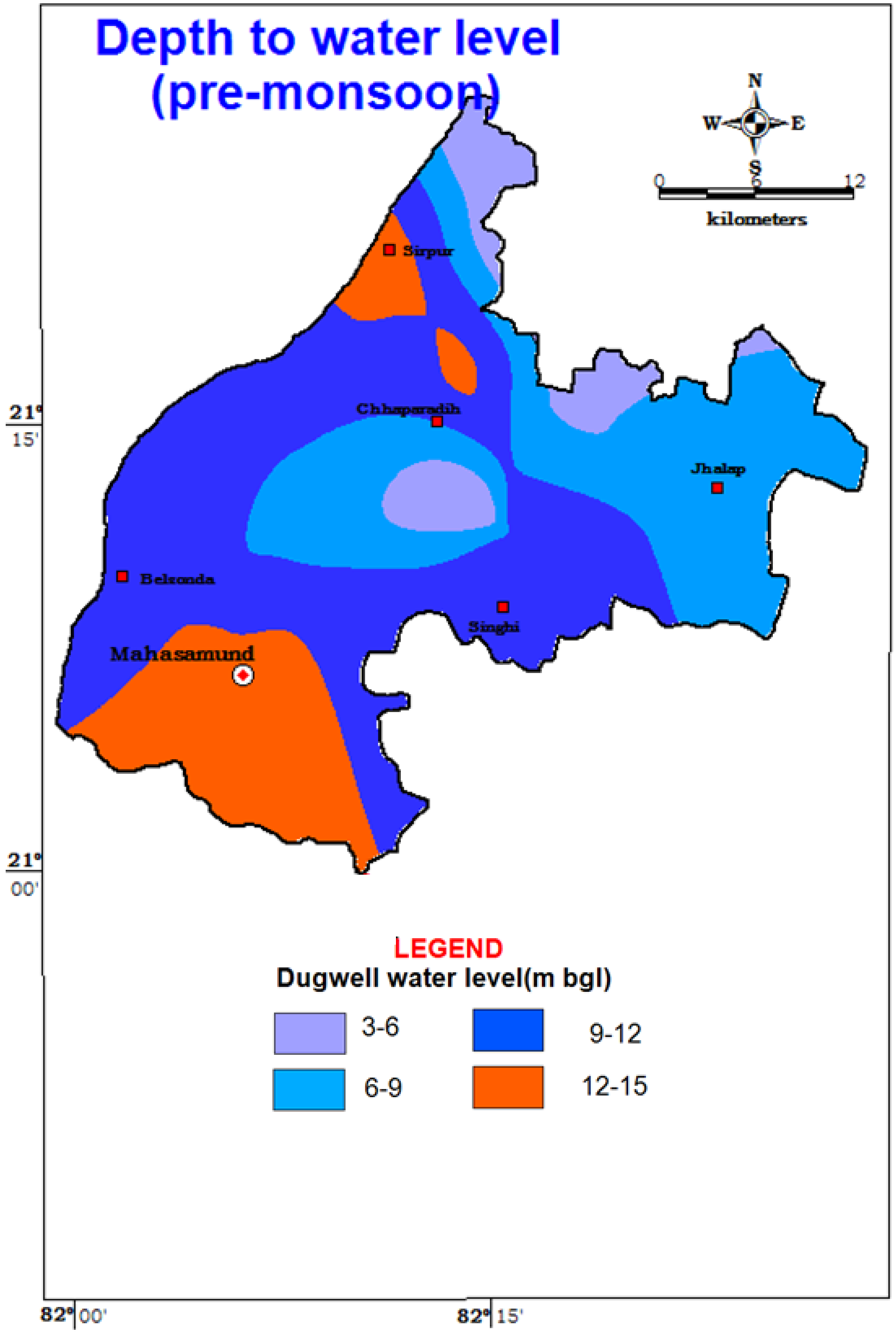

Figure-4: Depth to water level map Phreatic Aquifer (Pre-monsoon)

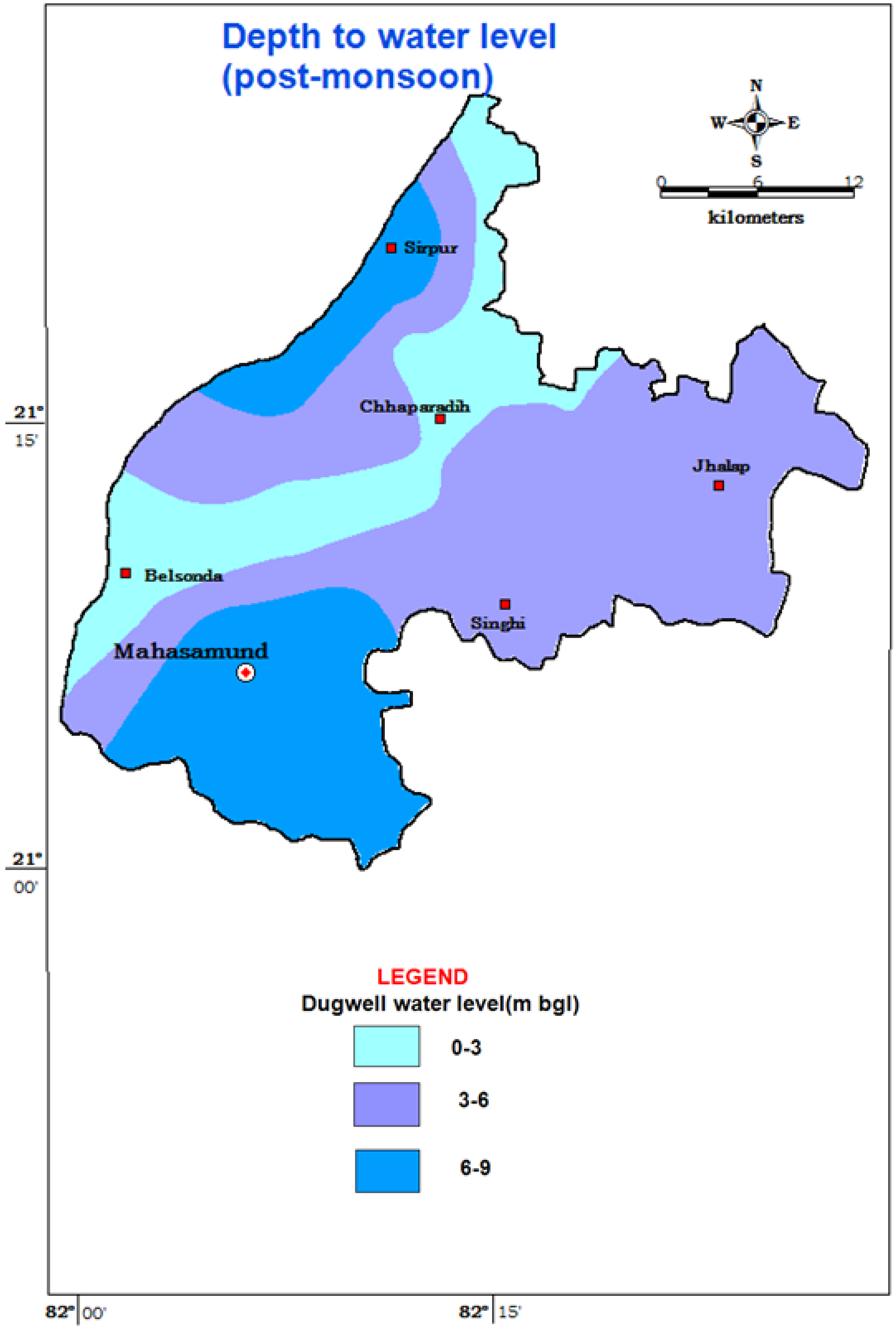

Figure 5: Depth to water level map Phreatic Aquifer (Post-monsoon)

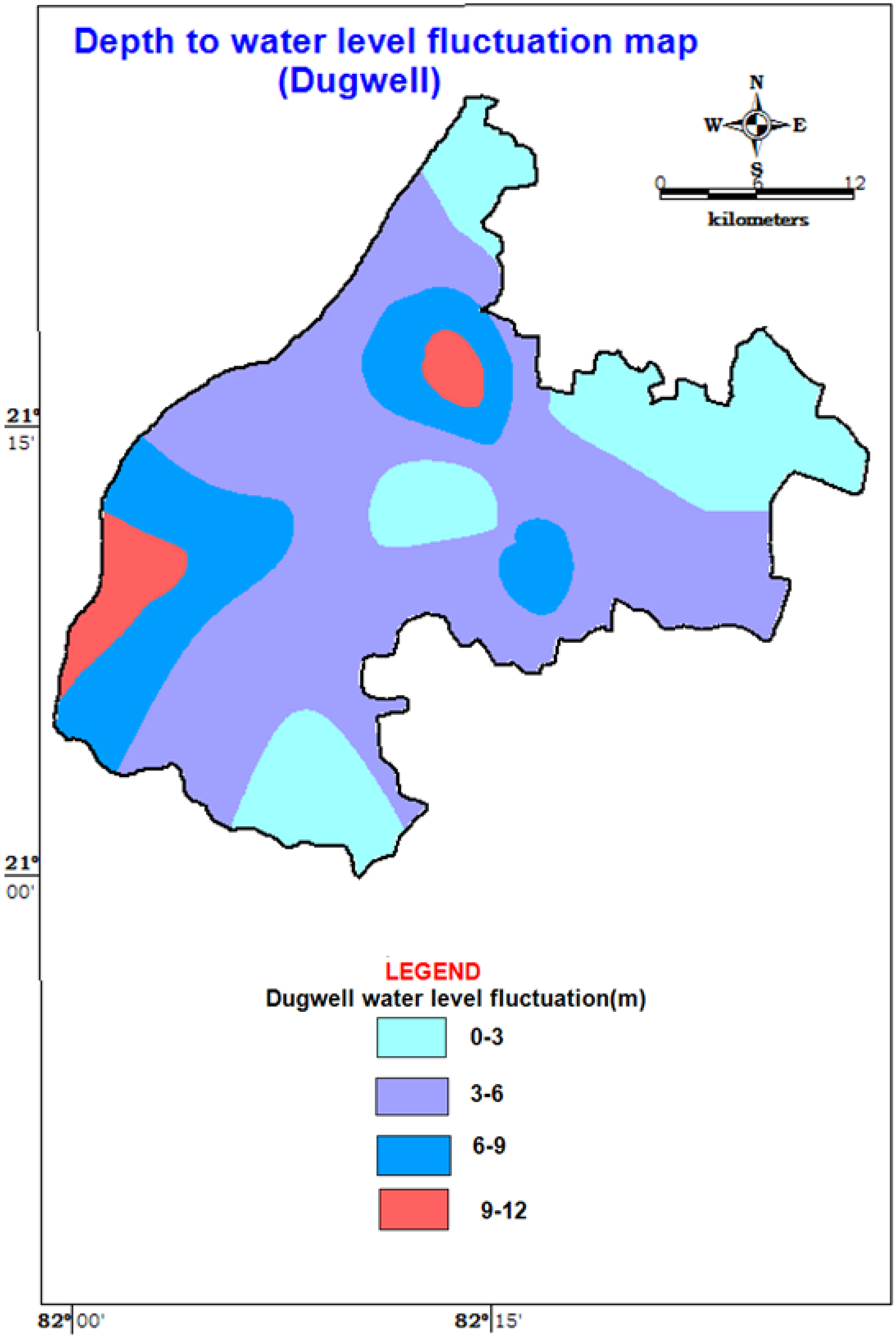

Figure 6: Depth to water level fluctuation map of Phreatic Aquifer

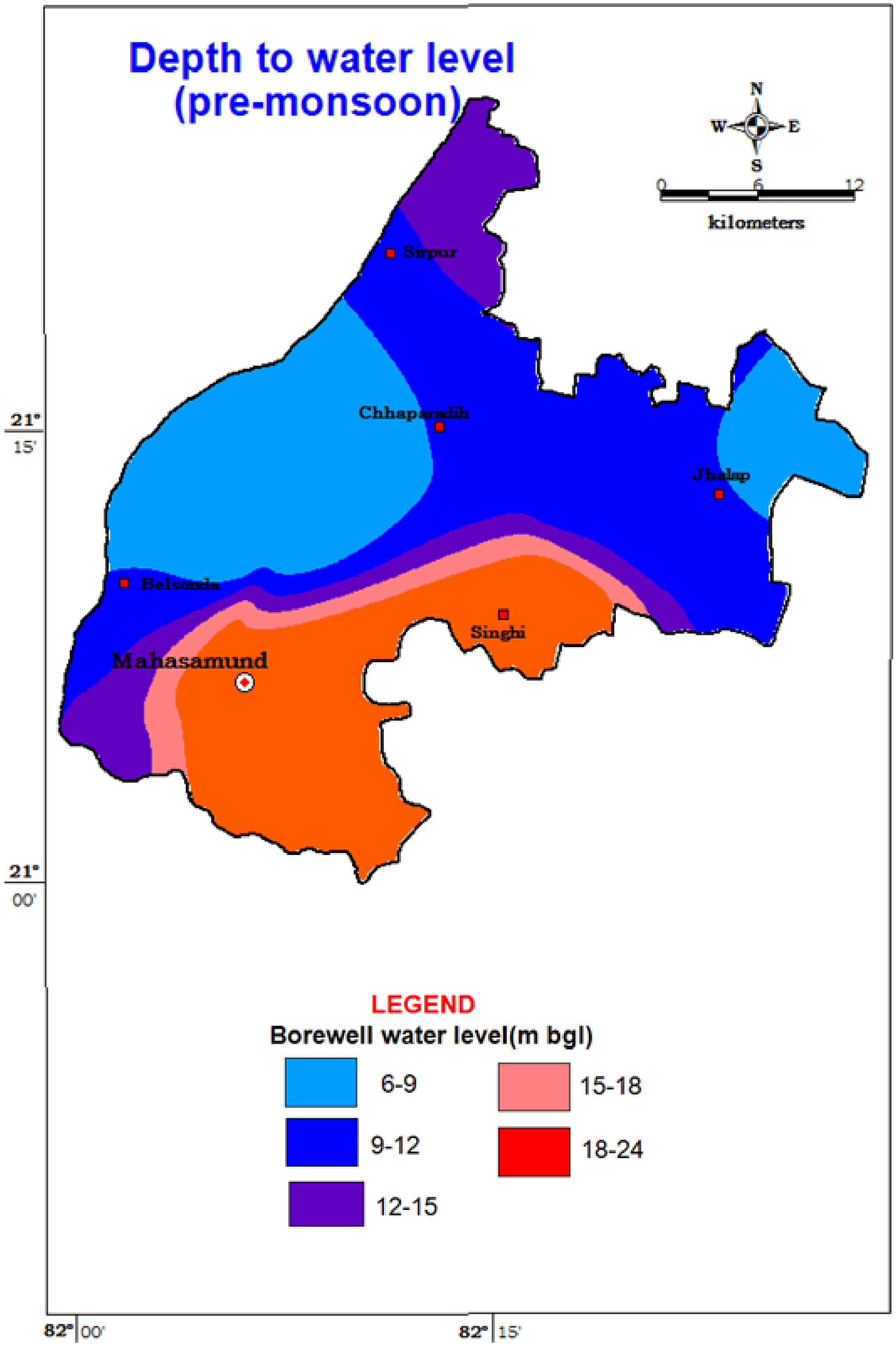

Figure-7: Depth to water level map Fractured Aquifer (Pre-monsoon)

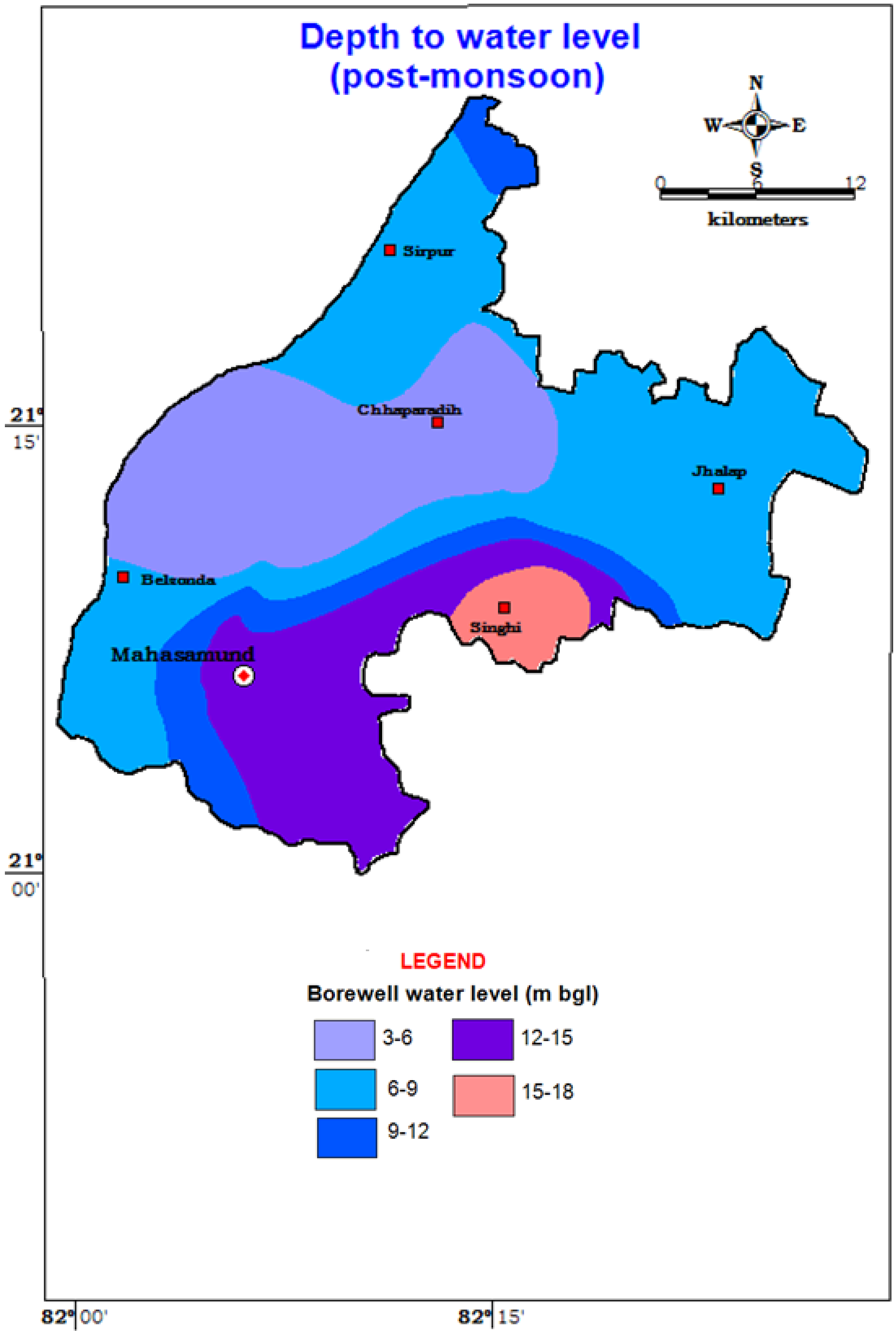

Figure-8: Depth to water level map Fractured Aquifer (Post-monsoon)

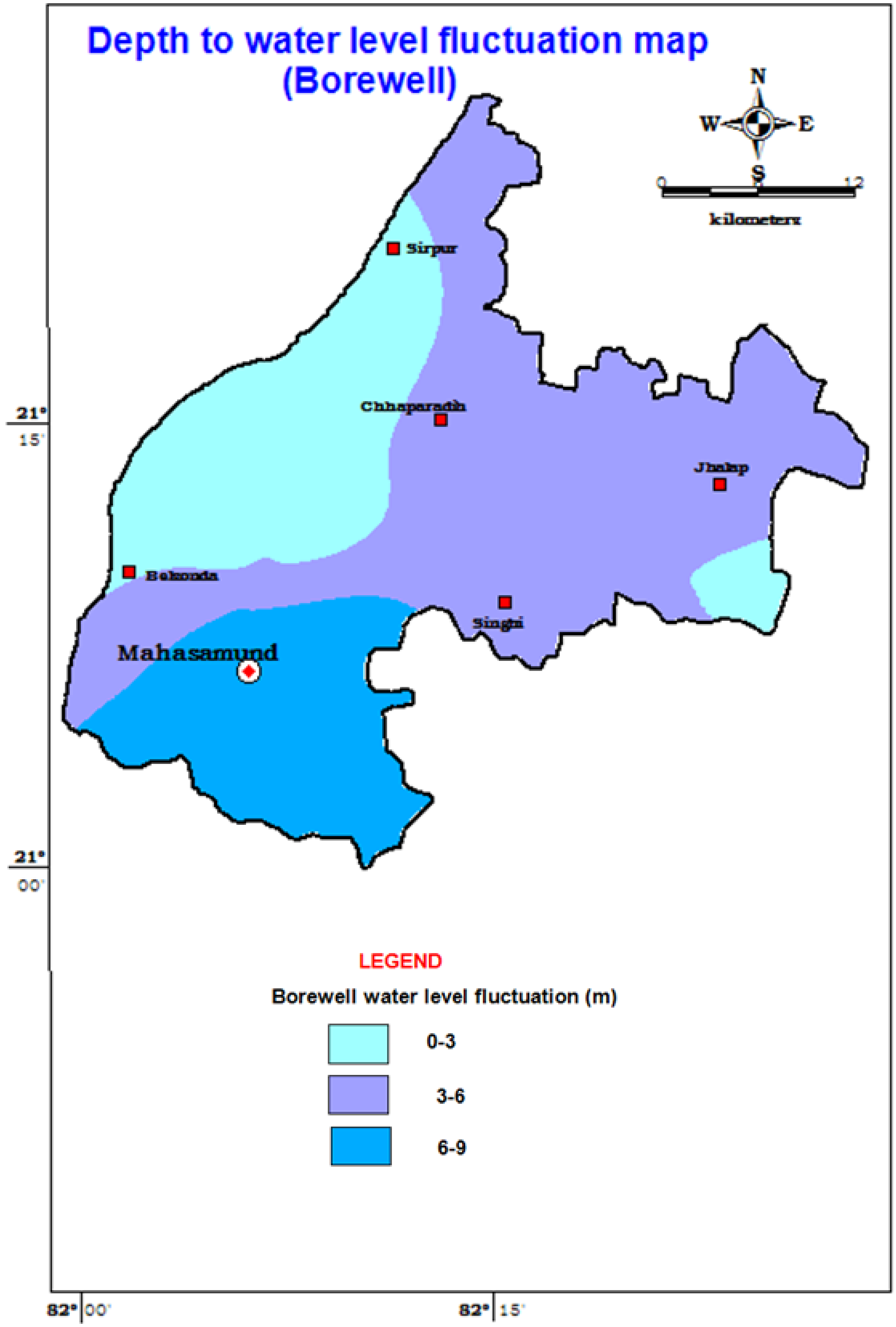

Figure 9: Depth to water level fluctuation map of Fractured Aquifer

(iv) <u>The long-term water level trend</u>: During pre-monsoon period, there is decline in water level (as indicated by dotted red trend line), about 5m over a 10 year period.

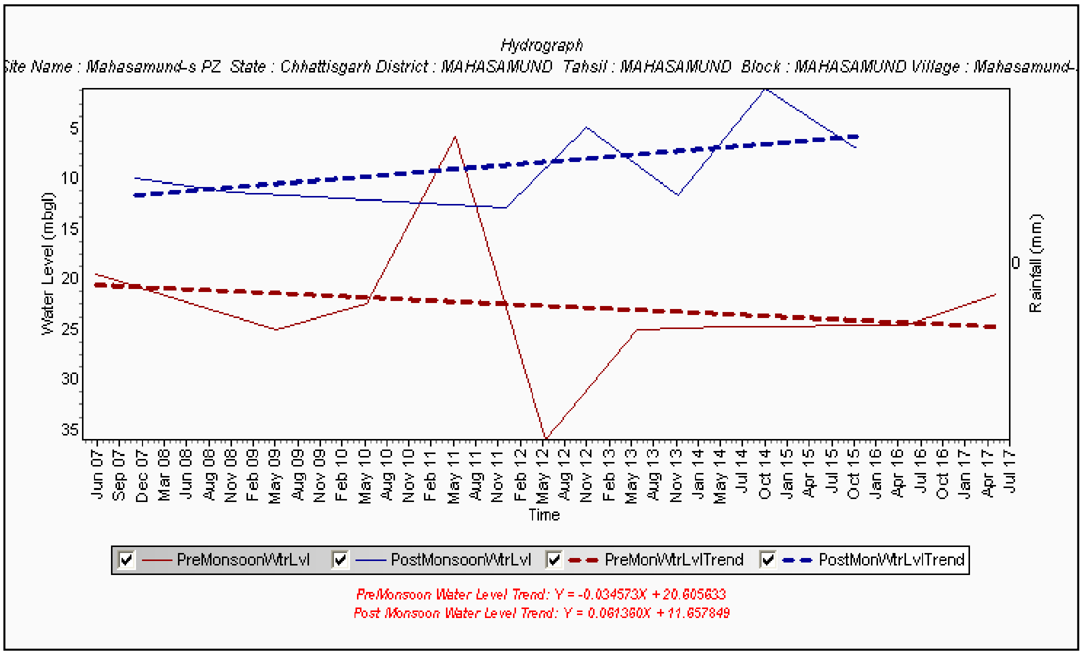

Figure 10: Hydrograph of Mahasamund town, Mahasamund block

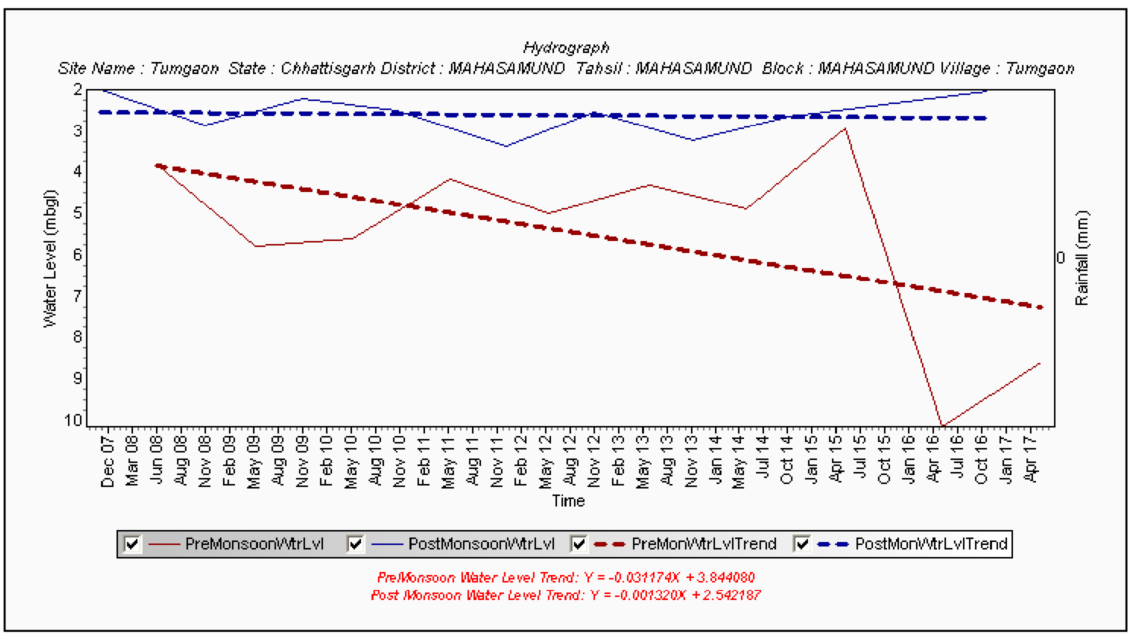

Figure 11: Hydrograph of Tumgaon village, Mahasamund block

2. Aquifer Disposition:

<u>Number of Aquifers</u>: There arethree major aquifersviz. Argillaceous limestone (Raipur group), sandstone (Chandrapur group) and granitic gneiss (Dongargarh Supergroup), which in phreatic and fractured condition serve as major aquifer system in the block.

3-d aquifer disposition and basic characteristics of each aquifer:

Geology: Geologically the block exhibits lithology of Meso to Neo Proterozoic agedominated by Argillaceous limestone (Raipur group), sandstone (Chandrapur group) and granitic gneiss (Dongargarh Supergroup).

I. Argillaceous limestone (Raipur group): The average thickness of the weathered portion in the area is around 18.5 m. The occurrences of fractures at depth in the area are not common and whenever occur are less potential in ground water point of view. Fractures are mostly confined to 100m depth. In general, the discharge varies from negligible to 3 lps with an average yield of 1.5 lps. The development in these formations is mostly by way of dug wells. Theaverage drawdown of the formation is around 20.1 m. The thickness of fractured aquifer is around 0.2 m.
II. Sandstone (Chandrapur group): The average thickness of the weathered portion in the area is around 19.02 m. The occurrences of fractures at depth in the area are not common and whenever occur are less potential in ground water point of view. Fractures are mostly confined to 100m depth. The potential zones are present from 60 to 100 m depth below ground level. In general, the discharge varies from negligible to 2 lps. The development in these formations is mostly by way of dug wells and shallow tube wells. The average drawdown is 24.06 m. The thickness of fractured aquifer is around 0.2 m.
III. Granitic gneiss (Dongargarh Supergroup): The average thickness of the weathered portion in the area is around 18 m. The occurrences of fractures at depth in the area are not common and whenever occur are less potential in ground water point of view. Generally, 1 to 2 sets of fractures are encountered within 60 m depth and 2 to 3 sets of fractures are encountered within 60 to 200 m depth. The potential zones are present from 60 to 100 m depth below ground level. In general, the discharge varies from negligible to 3 lps with an average yield of 1.5 lps. The development in these formations is mostly by way of dug wells. The transmissivity of the formation is around 0.07 -1 m^2 per day with an average drawdown of 27 m. The thickness of fractured aquifer is around 0.2 m.

Table 6: Distribution of Principal Aquifer Systems in Mahasamund

Mahasamund	Phreatic and fractured argillaceous limestone	
	230	24% of total area
	Phreatic and fractured sandstone	
	288	31% of total area
	Phreatic and fractured granite gneiss	
	426	45% of total area

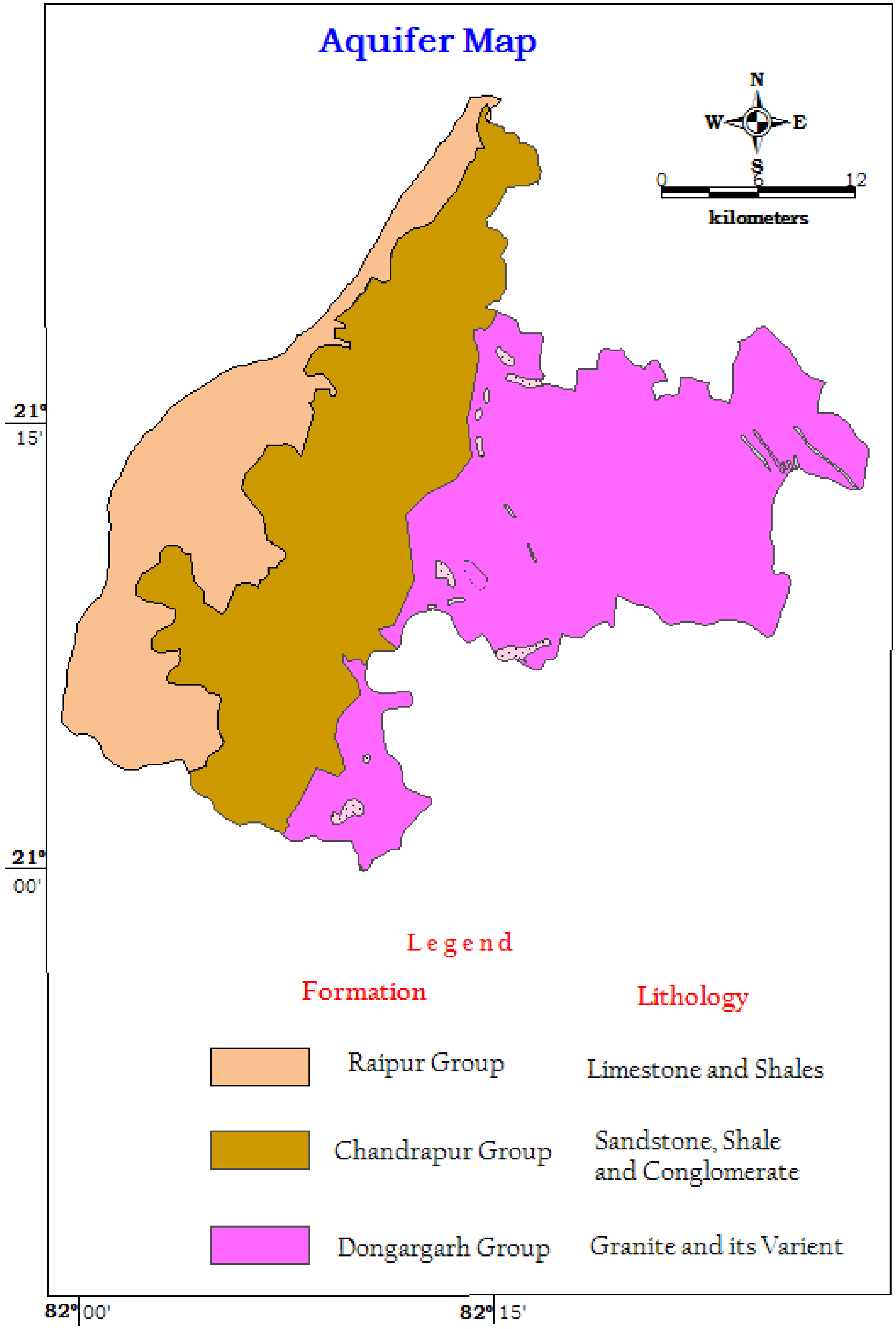

Figure 12: Aquifer map of Mahasamund block

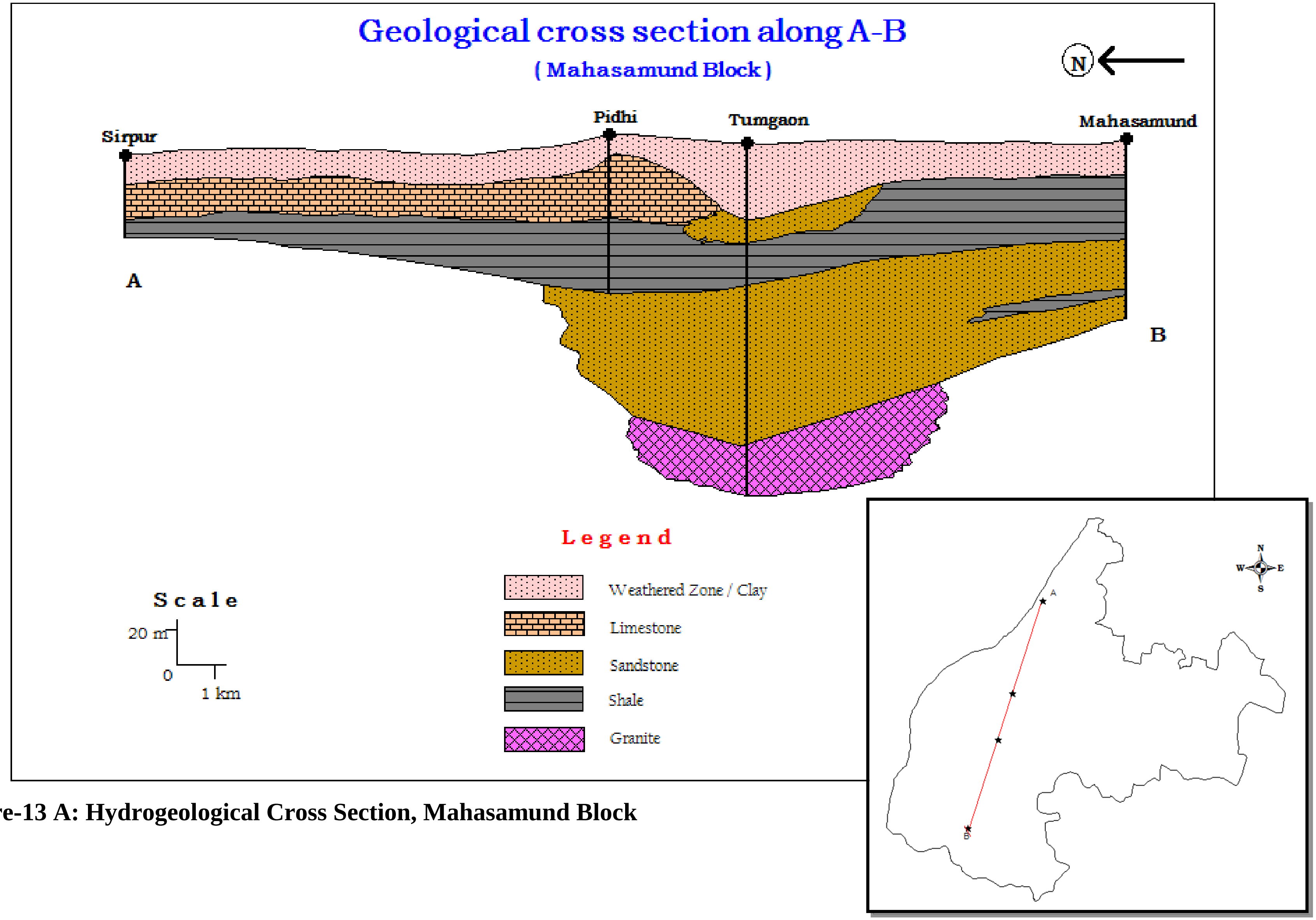

Figure-13 A: Hydrogeological Cross Section, Mahasamund Block

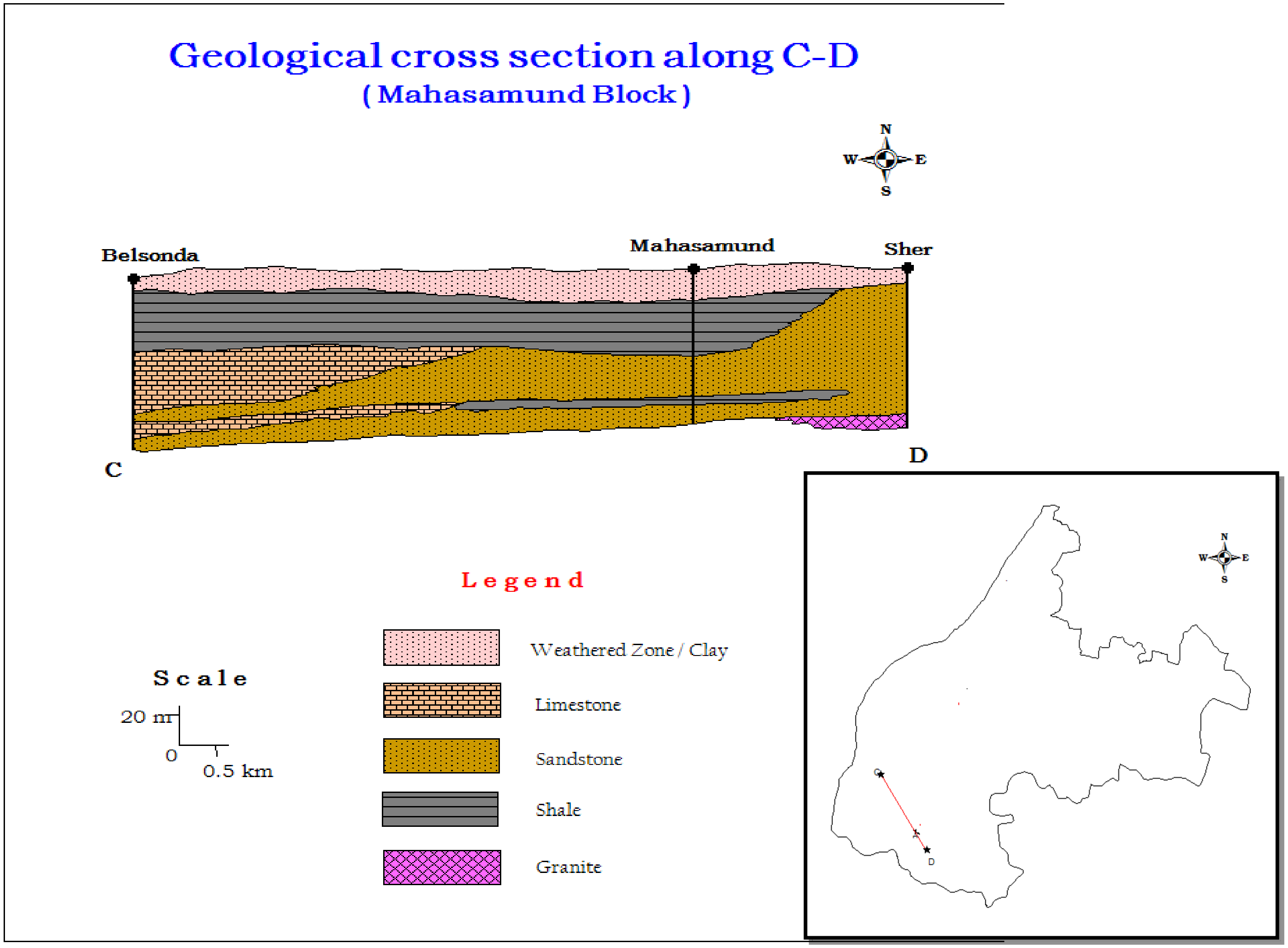

Figure-13 B: Hydrogeological Cross Section, Mahasamund Block

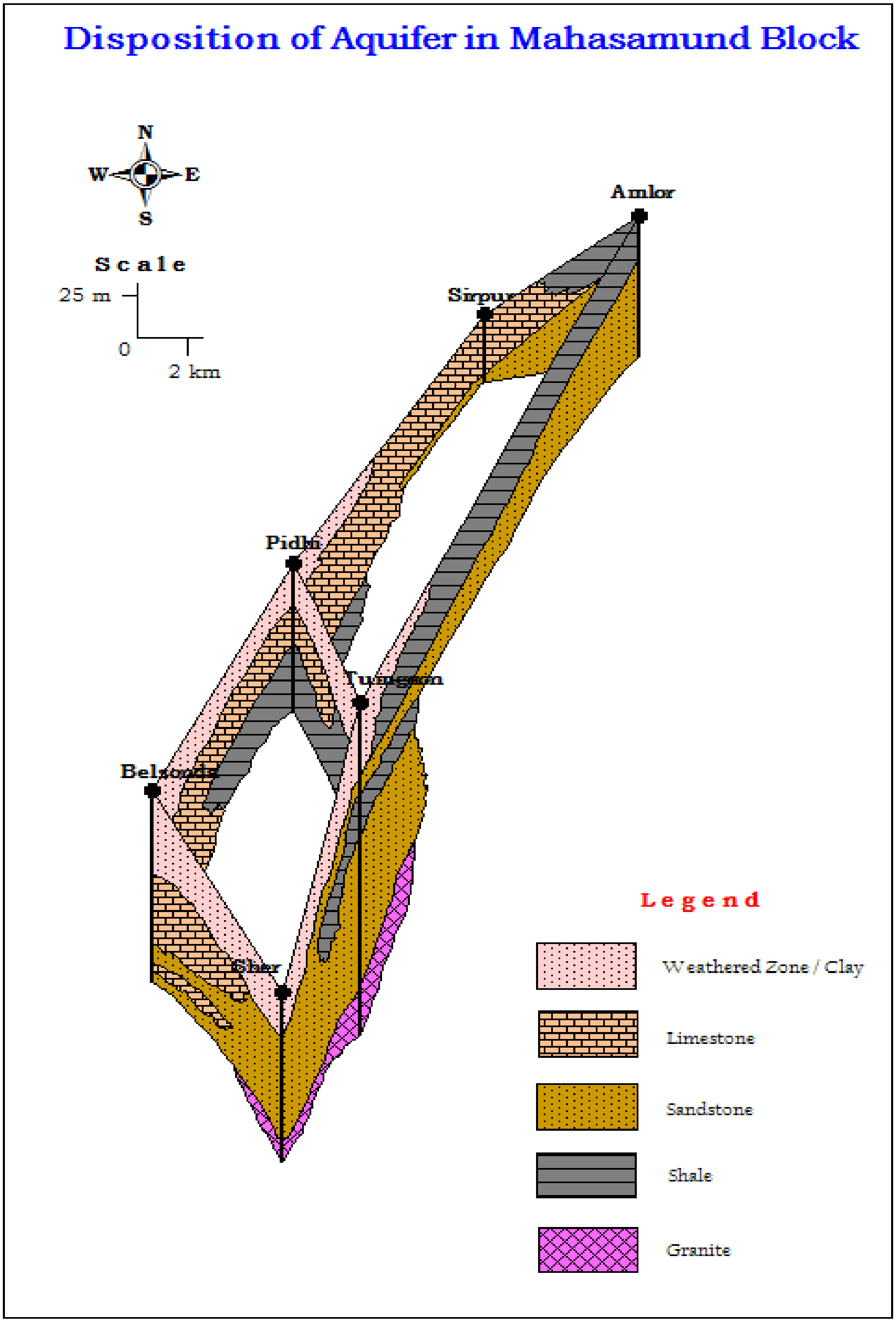

Figure-13 C, Disposition of Aquifer, Mahasamund Block

3. Ground water Resource, extraction, contamination and other issues:

Aquifer wise resource availability is given in the table -4 where the total resource available in Mahasamund block is 13214. 30ham.The extraction details and the future scenario (2025) along with the categorisation is depicted in the table-7 & 8.

Table-7: Ground water Resources of Mahasamund block

District	Assessment Unit / Block	Net Ground Water Availability in Ham	Existing Gross Ground Water Draft for Irrigation in Ham	Existing Gross Ground Water Draft for Domestic & Industrial Water Supply in Ham	Existing Gross Ground Water Draft for All Uses in Ham	Allocation for Domestic & Industrial Water Supply in Ham (2025)	Net Ground Water Availability for Future Irrigation Development in Ham (2025)
Mahasamund	Mahasamund	13214.30	6607.10	2507.34	9114.44	2828.61	3778.59

Table 8 Categorization of Assessment Unit

District	Block	Stage of Ground water development (%)	Categorization
Mahasamund	Mahasamund	68.97	Safe

Categorization: Mahasamund block falls in safe category. The stage of Ground water development is 68.97%. The Net Ground water availability is 13214.30 ham. The Ground water draft for all uses is 9114.44 Ham. The Ground water resources for future uses for Mahasamund Block is6607.20Ham.

Chemical Quality of Ground water and Contamination**:** Throughout the study area, the water quality (phreatic aquifer) is good and all the parameters are within permissible limit. In conclusion it may be said that the groundwater in the block is suitable for drinking as well as for irrigation purposes.

4. Ground Water Resource enhancement:

Aquifer wise space available for recharge and proposed interventions:

Table -9: Summarised detail of Volume of porous space available for recharge (Aquifer wise)

Formation	Area (sq.m)	Available thickness of unsaturated zone (m)	Sp. Yield for the formation	Volume of unsaturated space available for recharge (m3)
Argillaceous limestone	153 x 106	1.5,4.5	0.020	8.68 x 106
Sandstone	205 x 106	1.5,4.5	0.020	13.68 x 106
Granite-gneiss	407x 106	1.5,4.5	0.020	15.22 x 106

5. Issues:

(iii) During summer, dugwells in villages are dry except a few locations. Several handpumps also stop yielding water. The aquifer itself is a low yielding one.

(iv) High value of Fluoride has been reported from Jogidipa village. (1.5 mg/l)

6. Supply side interventions:

I. Mahasamund block experienced drought situation because of poor monsoon. Sanctuary wells may be constructed for drinking needs as a step towards crisis management.

II. It has been observed during fieldwork in pre-monsoon period, there is colossal wastage of groundwater through public water supply system. In this state, the Government has undertaken “Nal Jal Yojana” to provide water to villages. Under this scheme, the government has dug borewells of about 150-200feet depth, lowered a pump in the well to draw out water and constructed a small tank to hold water. Unfortunately, people do not switch off the pump once the tank is full. Also, the pipes are not fitted with taps to control the flow of water.

III. So, Information, education and Communication (IEC) activities to be organized to sensitize people on the issues of depleting groundwater resource. Massive awareness campaigns are essential to understand people about the importance community participation in saving water.

IV. Desiltation of existing Tanks and Talabs to be carried out for efficient storage of rainwater. Also Rain water harvesting structures may be constructed in villages to reduce stress on groundwater.

V. It has been observed that the long-term trend lines are declining in pre-monsoon period, so we have to go for artificial recharge on a long-term sustainability basis. Artificial Recharge structures may be constructed at suitable locations especially in the areas where the water level remains more than 3m in the post-monsoon period in this block to arrest the huge non-committed run-off and augment the ground water storage in the area. The different types of artificial structures feasible in the block are described in table-10.

Table-10: Types of Artificial Recharge structures feasible

Name of Block	Area Feasible for recharge (sq.km)	Volume of Sub Surface Potential to be recharged through other methods (MCM)	Types of Structures Feasible and their Numbers			
			P	NB & CD	RS	G
Mahasamund	627	37.08	116	385	697	928
	Recharge Capacity		22.16	3.85	6.43	4.64
	Estimated cost (Appx.)		Rs. 65.1 crore			

VI. The practice of providing free electricity to operate irrigation bore wells should be strictly monitored and put to an end in case of overconsumption. After a simple calculation it has been found that Rs 16000/ hectare is the expenses of electricity (@Rs. 2.5/unit) for paddy field. So monitoring mechanism for electricity consumption should be strengthened for farmers taking summer rice. Even if farmers use solar pump or other method of ground water irrigation for summer paddy, it should not be flooding method. Proper pipes are to be used to transfer water from one plot to another.

VII. Govt. may set up network of grids to purchase electricity generated from solar panels. This will encourage the farmers not to waste electricity by extracting groundwater unnecessarily and also provide alternative income.

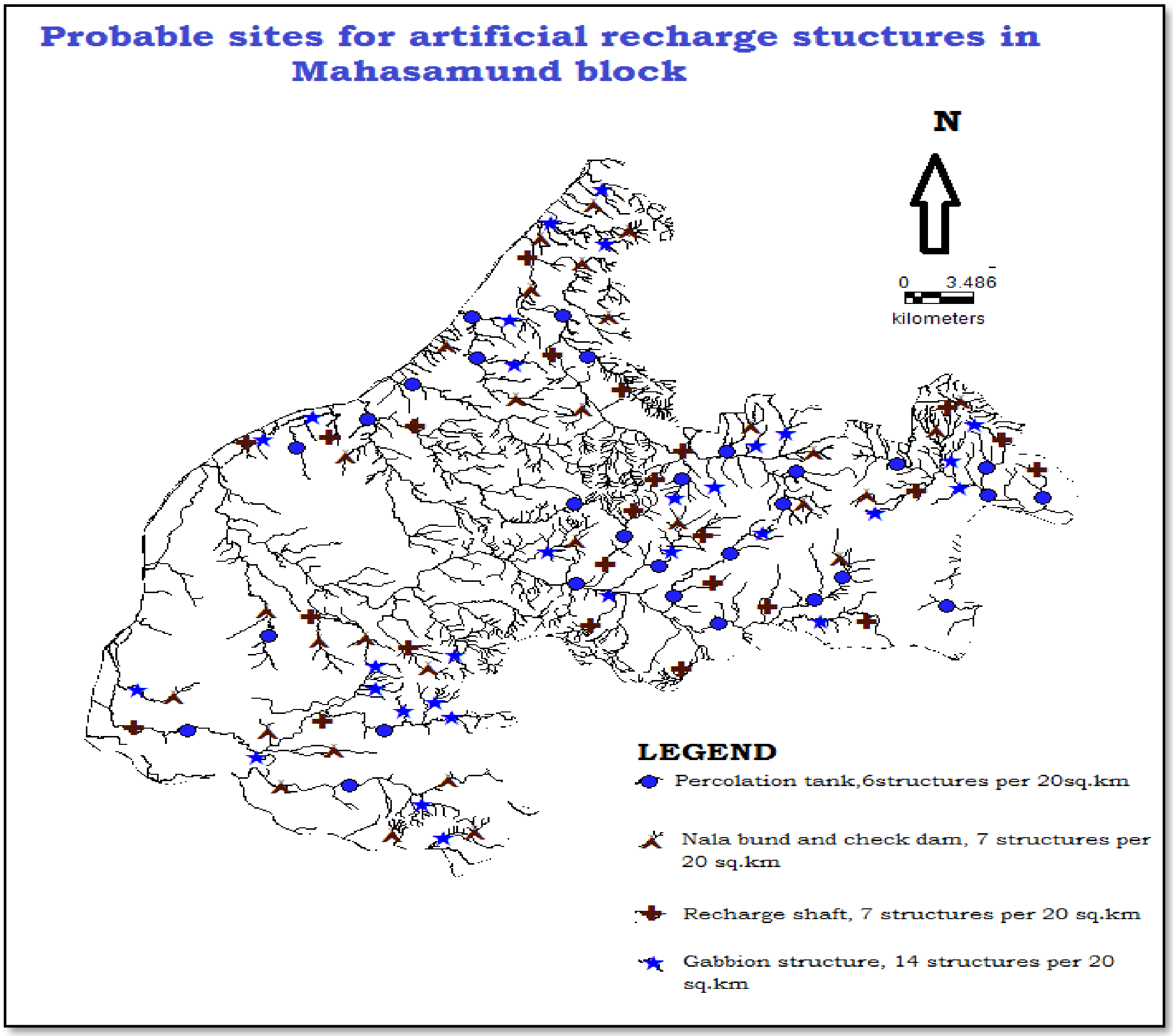

Figure 14: Map of proposed sites for artificial recharge of groundwater in Mahasamund block

Table-11: Probable sites of Artificial Recharge structures

PT (Percolation tank)	NB & CD (Nala bund & Check dam)	RS (Recharge Shaft)	GB (Gabbion structure)
Parsadih	Nawapara	Garhshivni	Rumekel
Achanakpur	Sher	Joba	Pasid
Borid	Singhrupali	Bamhani	Borid
Rumekel	Marod	Patewa	Sher
Pachri	Singhi	Chirko	Pachera
Nartora	Jhara	Bemcha	Kurrubhata
Ramkhera	Amurda	Lohardih	Dhank
Khatta	Pali	Kaundkera	Bansiwni
Nawagaon	Kaundkera	Banskurha	
Laphinkhurd		Raitum	
Nandgaon		Phusera	

7. Demand Side Interventions

Since the stage of development in the block is 68.97%. Change in cropping pattern & irrigation pattern can lead to groundwater savings, as per the following table:

Table 12: Detail of groundwater saved through change in cropping pattern

Detail of groundwater saved through change in cropping pattern								
Block	Paddy cultivation area in Rabi season (ha)	Water required (m) per ha (m)		Difference (m per ha)	Total saving of water (ham)	Existing Gross Ground Water Draft for All Uses in Ham	Available Resource (ham)	Improved Status of Stage of groundwater Development
		Paddy	Maize					
Mahasamund	8600	0.9	0.5	0.4	3440.0	9114.44	13214.30	42.94

In command or non-command area wherever ground water has been used for field irrigation should be replaced with micro irrigation methods such as sprinklers, drip irrigation etc. which may save 30 to 40% ground water.

Detail of groundwater saved through change in irrigation pattern	
Water saved through micro irrigation	154 Ham

8. CONCLUSIONS:

An area of 944 sq.km of Mahasamund block of Mahasamund district has been considered for Aquifer Mapping and Management Plans. The total G.W resource is 13214.30 Ham with stage of G.W development 68.97 % and categorized as “safe”. 35.81 % of the area is irrigated by groundwater. The groundwater level is deeper in south-western part and showing declining trend. The major aquifer groups are Raipur Group limestone & shale, Chandrapur Groupsandstone, Dongargarh granite and granitic gneiss. In terms of Demand side management, by change in cropping pattern and irrigation pattern (micro irrigation methods) 3440.0Ham and 611 Ham water can be saved respectively. In terms of Supply side management, by constructing artificial recharge structure 37.08 MCM water can be recharged.