केंद्रीय भूमि जल बोर्ड

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Ministry of Jal Shakti

Government of India

AQUIFER MAPPING AND MANAGEMENT OF GROUND WATER RESOURCES

BAGBAHARA BLOCK, MAHASAMUND DISTRICT, CHHATTISGARH

उत्तर मध्य छत्तीसगढ़ क्षेत्र, रायपुर

North Central Chhattisgarh Region, Raipur

स्वच्छ जल : स्वच्छ भारत

केन्द्रीयभूमिजलबोर्ड

उत्तर मध्य छत्तीसगढ़ क्षेत्र

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AQUIFER MAPS AND MANAGEMENT PLANS
BAGBAHARA BLOCK, MAHASAMUND DISTRICT

1. Salient Information:

About the area: Bagbahara Block is situated in the southern part of Mahasamund district of Chhattisgarh and is bounded on the north and north-west by Mahasamund and Pithora block, in the south-west by Raipur district of Chhattisgarh, in the south by Gariaband district and in the west by Odisha state. The area lies between 20.83 and 21.12 N latitudes and 82.17 and 82.62 E longitudes. The geographical extension of the study area is 1379 sq.km representing around 27 % of the district's geographical area. Administrative map of the block is shown in Fig. 1. Jonknala, flowing northwards forms the western most limit of the block separating Chhattisgarh and Odisha state. Keshwainala, Kurarnala both 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 Bagbahara block as per 2011 Census is193359out of which rural population is 173830while the urban population is 19529.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
Bagbahara	193359	95401	97958	173830	19529

Source: CG Census, 2011

Growth rate: The decadal growth rate of the block is 23.98 as per 2011 census.

Rainfall: The study area receives rainfall mainly from south-west monsoon. It sets in third/fourth week of June and continues till mid-August/September with heaviest showers in the months of July and August. 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)1369.84 mm with 50 to 60 rainy days.

Table-2: Rainfall data in Bagbahara block in mm

Year	2010-11	2011-12	2012-13	2013-14	2014-15
Annual rainfall	1376.20	1434.20	1242.70	1719.20	1076.90

Source: IMD

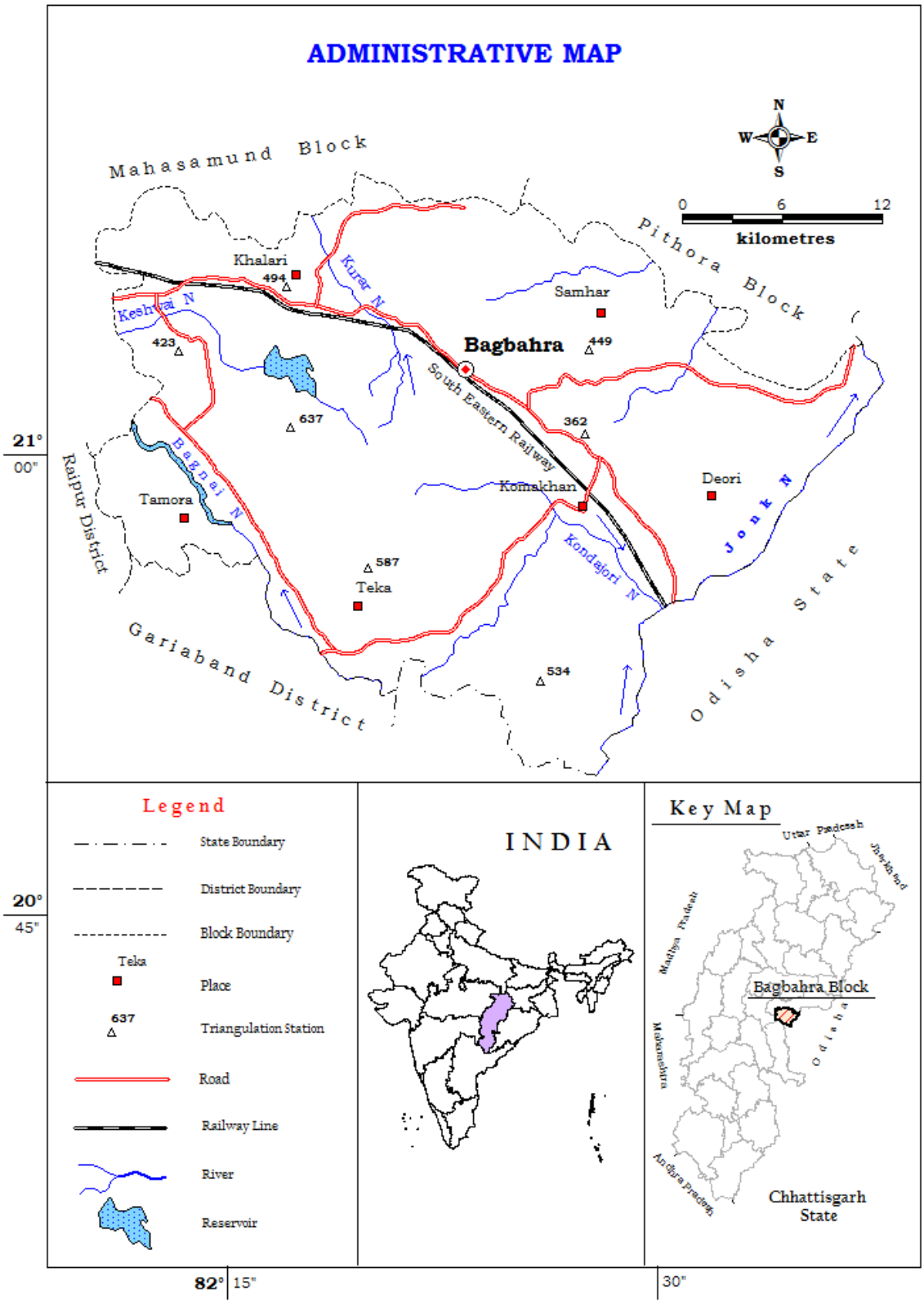

Figure: 1 Administrative Map of Bagbahara Block

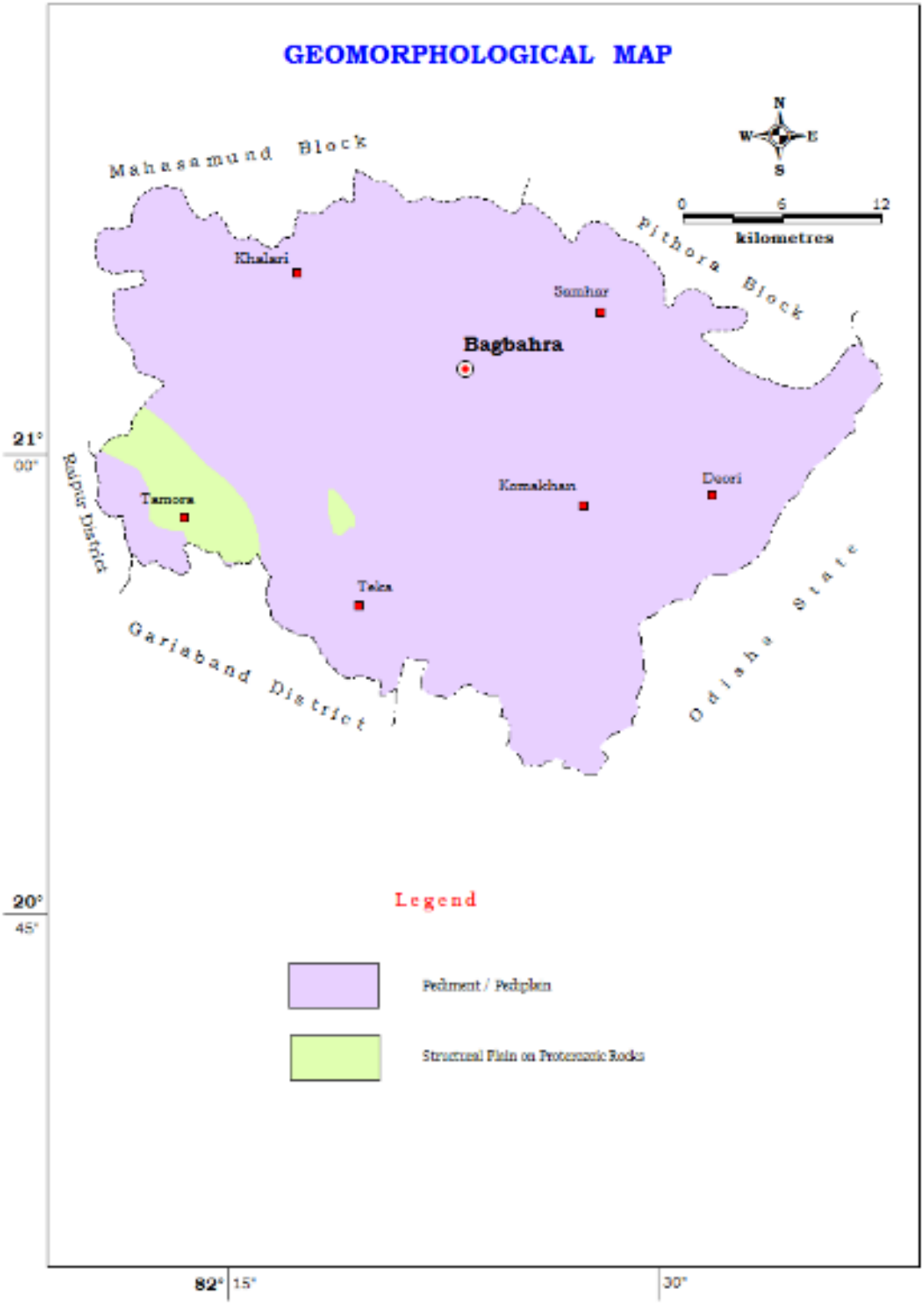

Figure 2: Geomorphology Map of Bagbahara Block

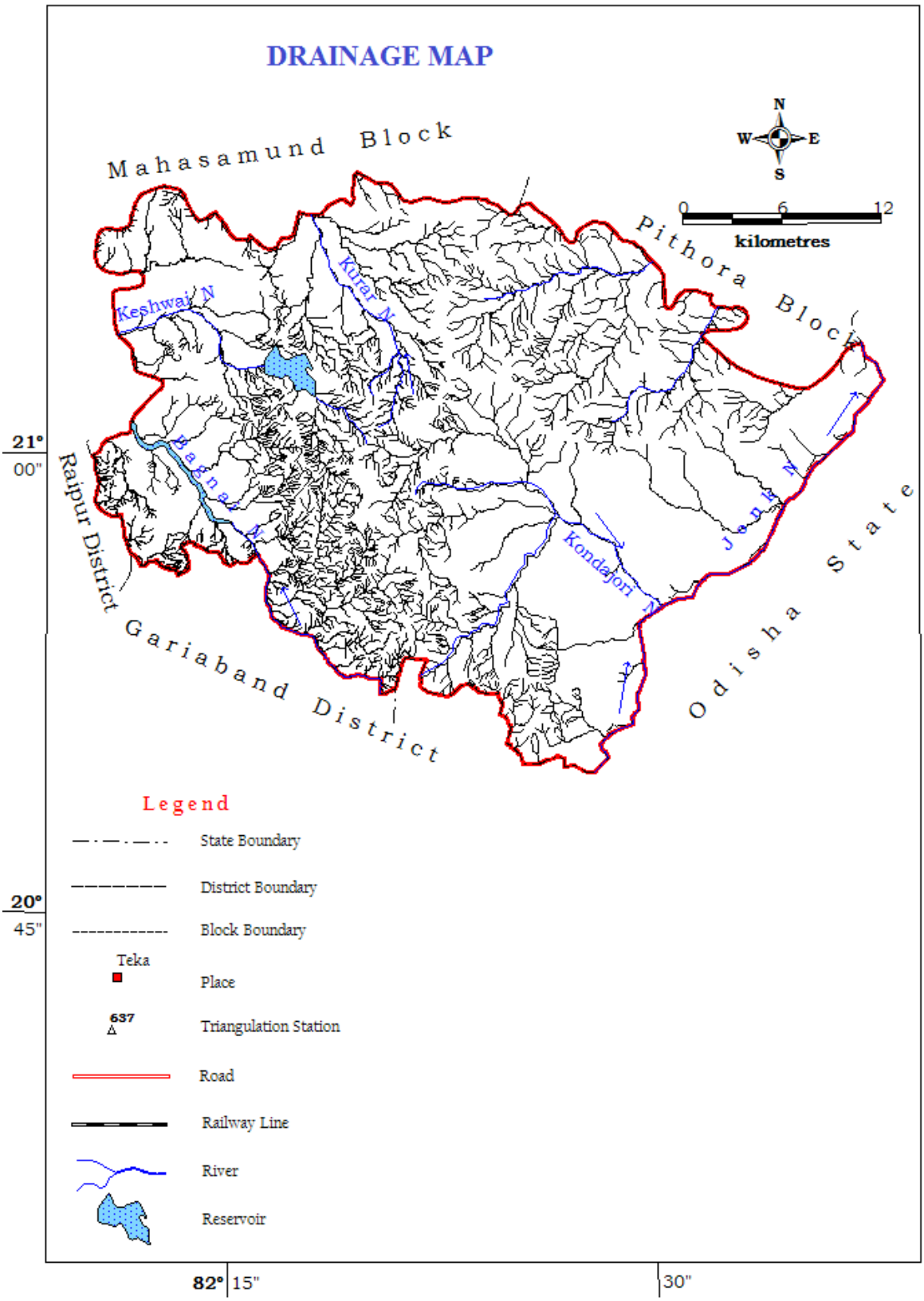

Figure 3: Drainage Map of Bagbahara Block

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 and pulses. In some areas, double cropping is also practiced. The agricultural pattern, cropping pattern and area irrigated data of Bagbaharablock 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
Bagbahara	137900	38554	10624	55309	6183	61429

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

Block	Total geographical area	Revenue forest area	Area not available for cultivation	Nonagricultural& Fallow land	Agricultural Fallow land	Net sown area	Double cropped area	Gross cropped area
Bagbahara	137900	38554	10624	2413	9269	55309	6183	61429

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						
Bagbahara	55309	6171	92	55614	13	16	4065	846	680	nil	93	1

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	Irrigate d area	Irrigated area by other sources	Net Irri-gated area	Gross irrigat ed area	% of irrigated area wrt. Net sown area
32	7776	2757	10778	932	400	626	826	934	15657	20714	34 %

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
Bagbahara	15657	10778	68.84

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

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

Block	**Dongargarh granite and gneiss**			
	Phreatic		Fractured	Total resource
	Dynamic	Static	In-storage	
Bagbahara	14311.47	6370.98	551.6	**21234.05**

Existing and Future Water Demand (2025)*:* The existing demand for irrigation in the area is 5780 Ham while the same for domestic and industrial field is 428.93 Ham. To meet the future demand for ground water, a total quantity of 8070.48 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 Bagbaharablock, dugwellsdry up in phreaticgranite-gneiss. In deeper fractured granite-gneiss, the maximum water level is 24.17mbgl, the average water level is 12.31mbgl.

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

Block Name	PhreaticGranite-gneiss		
	Min	Max	Avg
Bagbahara	5.16	8.51	7.09

Water Level (in mbgl)

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

Block Name	Fractured Granite-gneiss		
	Min	Max	Avg
Bagbahara	5.3	24.17	12.31

(ii) Post- monsoon water level**:** In the post-monsoon period, it has been observed that the water level varies from 2.33 to 6.81mbgl with an average of 4.56mbglin phreatic granitic gneiss area. Infracturedformation, the post monsoon water level variation range is 3.08 to 7.16mbgl with average of 4.85mbgl.

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

Block Name	Phreatic Granite-gneiss		
	Min	Max	Avg
Bagbahara	2.33	6.81	4.56

Water Level (in mbgl)

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

Block Name	Fractured Granite-gneiss		
	Min	Max	Avg
Bagbahara	3.08	7.16	4.85

(iii) Seasonal water level fluctuation: The water level fluctuation data indicates that in Bagbaharablock, water level fluctuationin phreaticgranitic gneissvaries from 0.92 to 10.65 m with an average fluctuation of 6.25 m. Water level fluctuationin fracturedgranite gneissvaries from 2.54 to 7.52 m with an average fluctuation of 4.79 m.

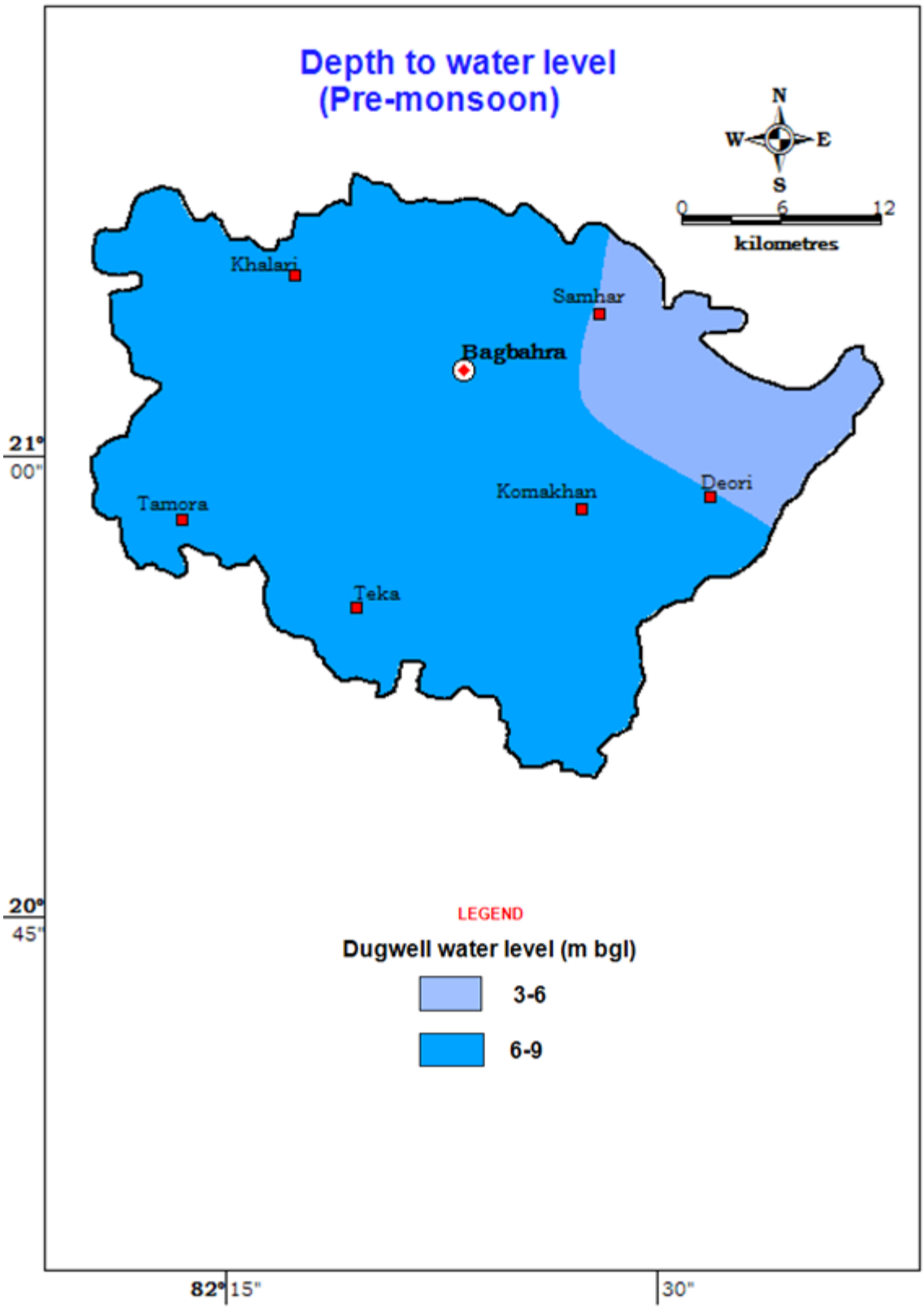

Figure-4: Depth to water level map Phreatic Aquifer (Pre-monsoon)

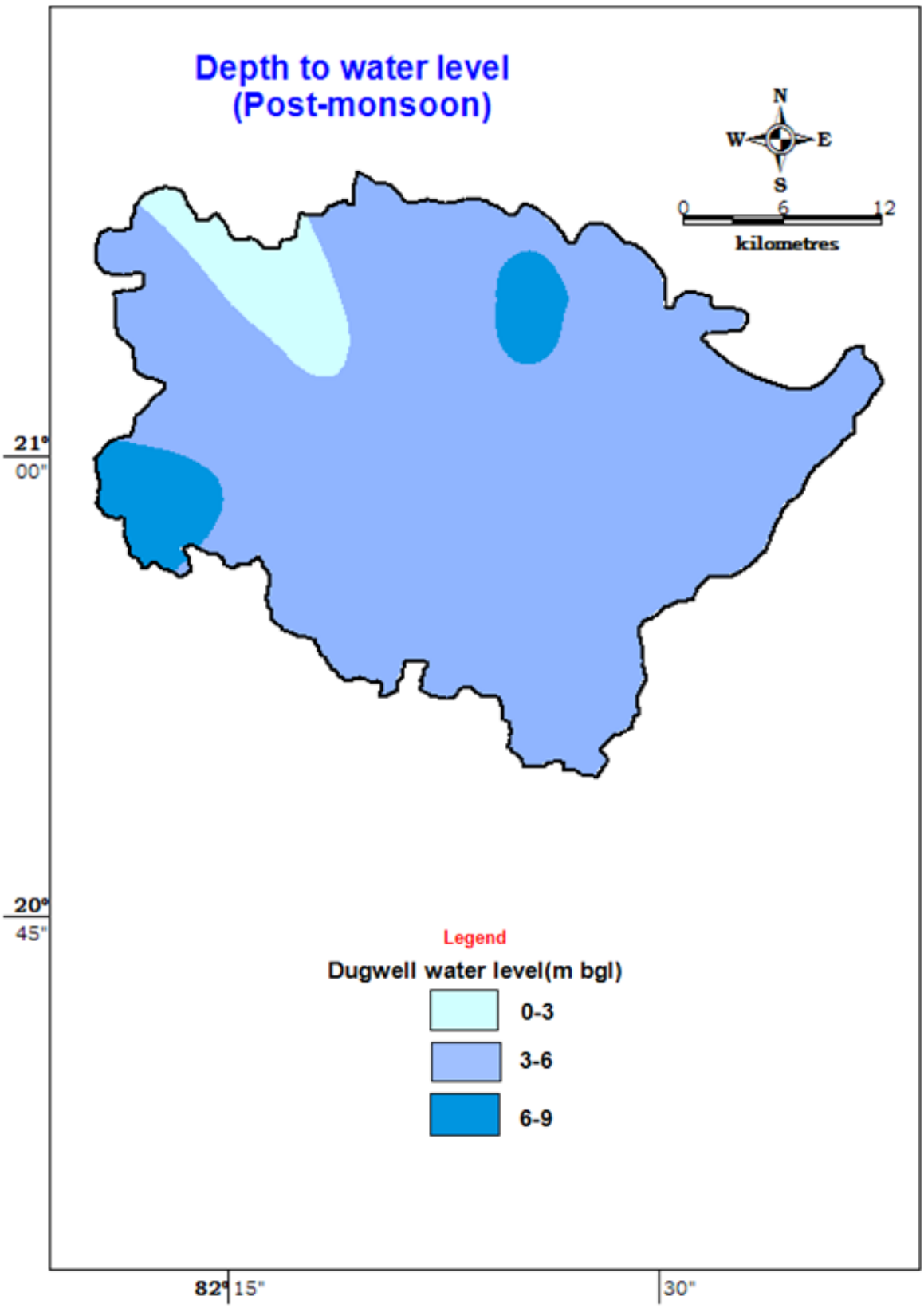

Figure 5: Depth to water level map Phreatic Aquifer (Post-monsoon)

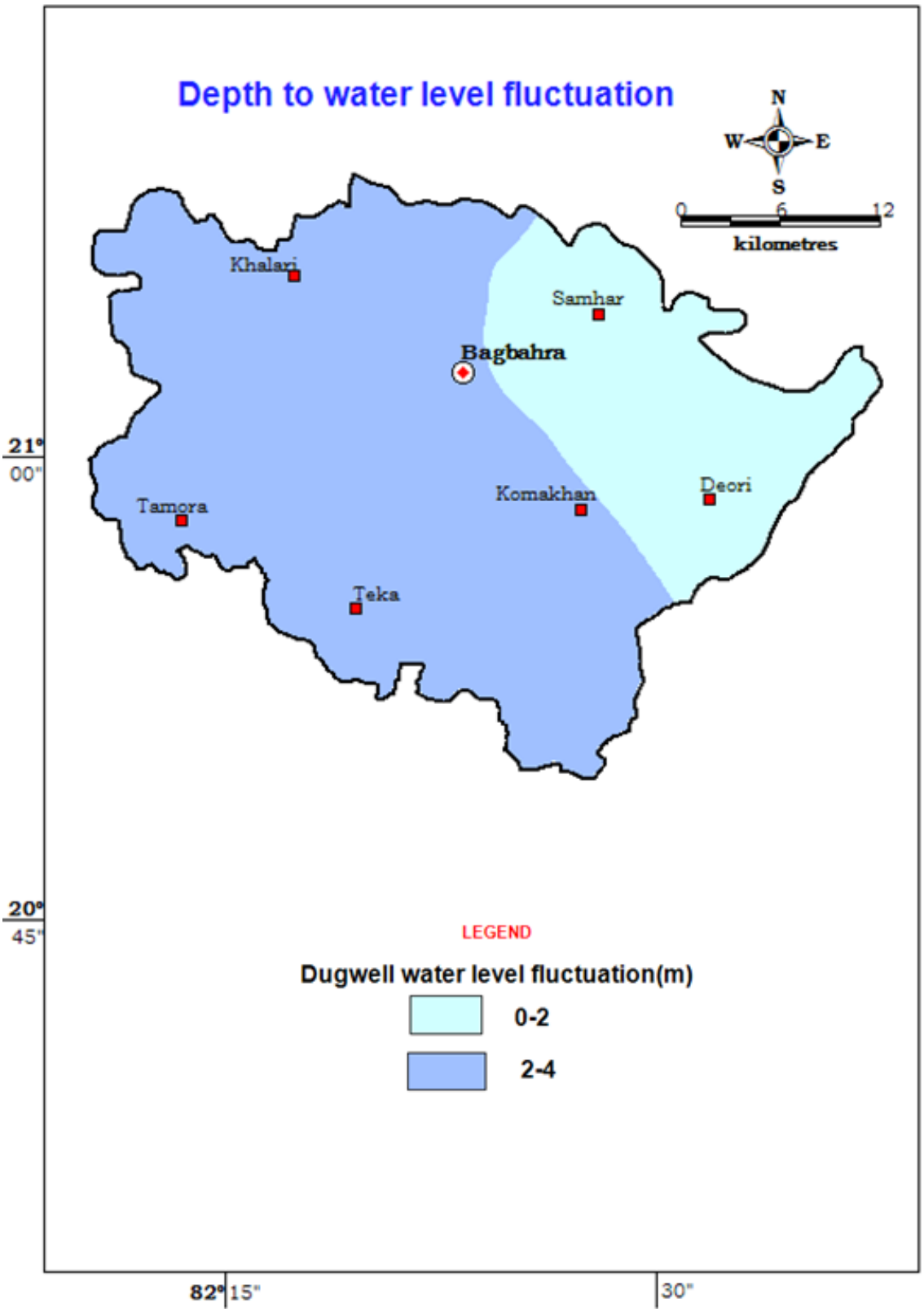

Figure 6: Depth to water level fluctuation map of Phreatic Aquifer

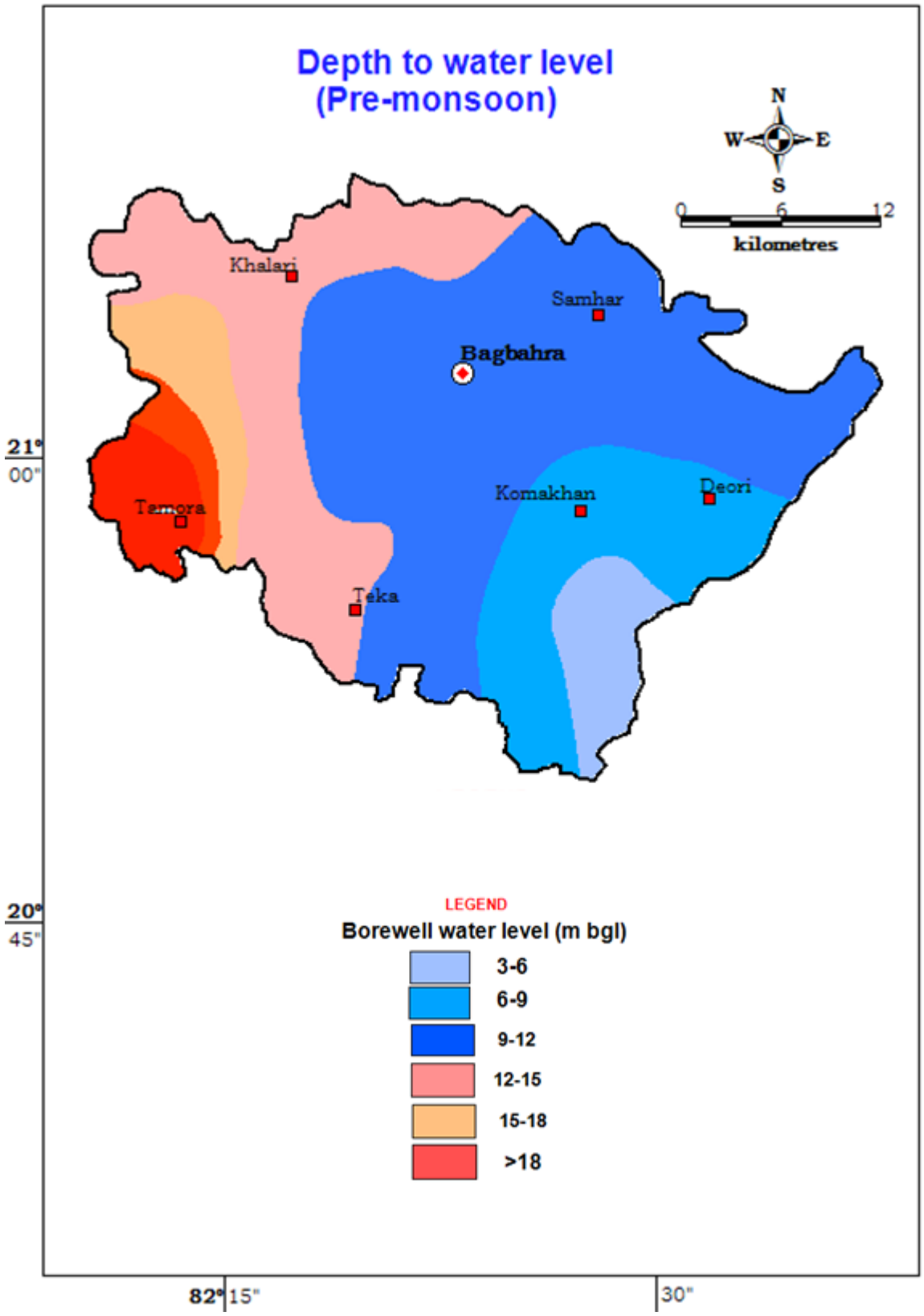

Figure-7: Depth to water level map Fractured Aquifer (Pre-monsoon)

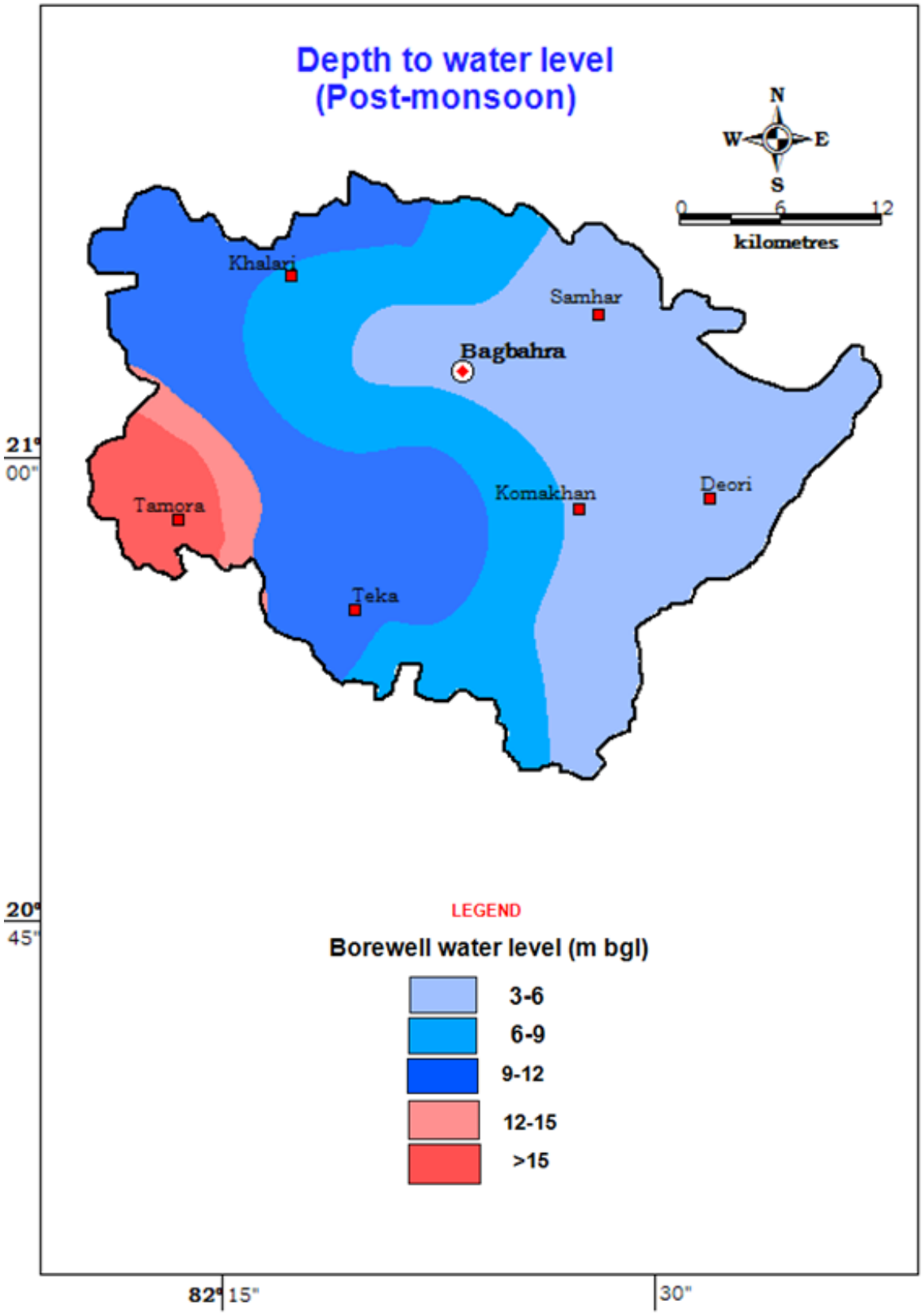

Figure-8: Depth to water level map Fractured Aquifer (Post-monsoon)

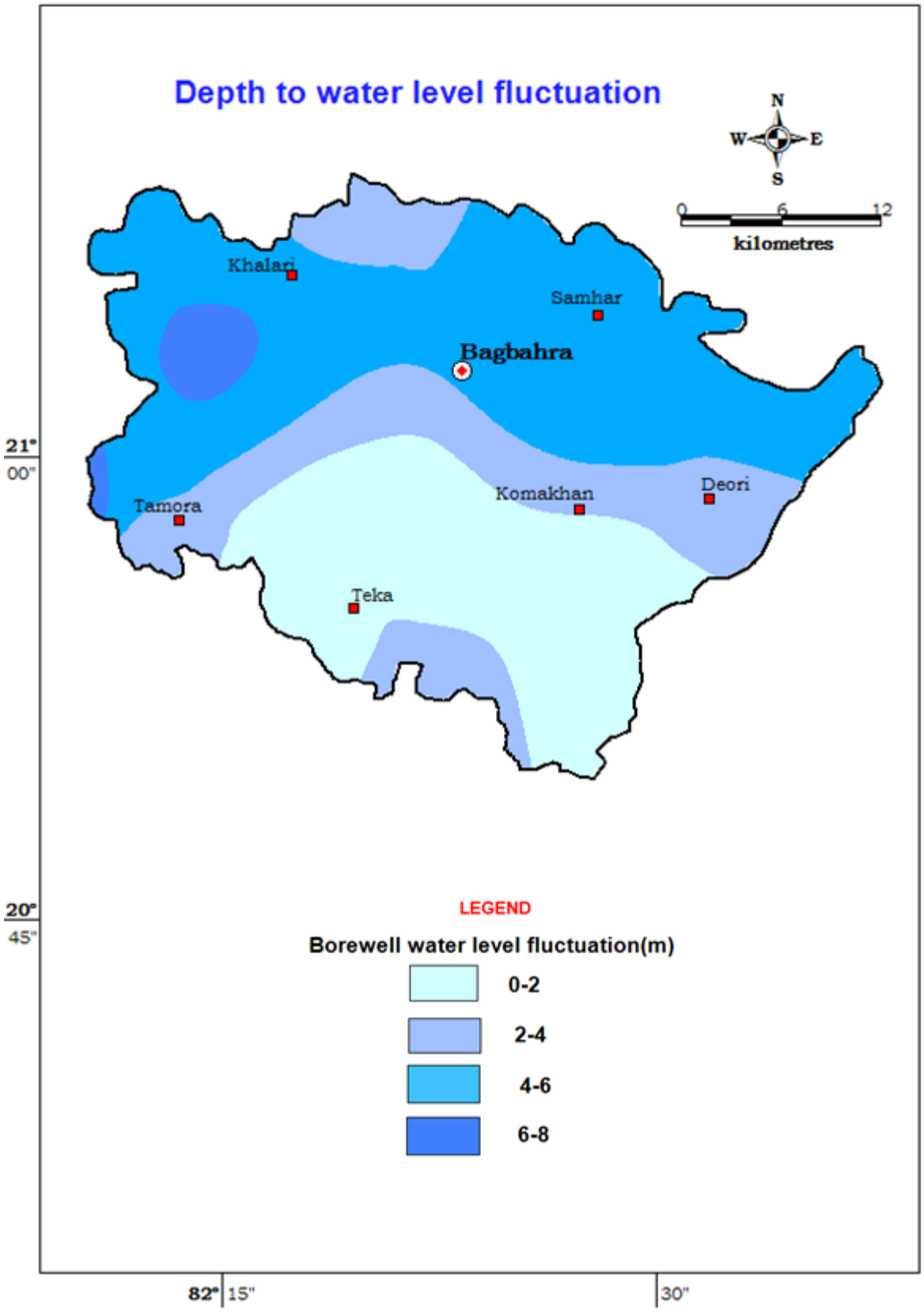

Figure 9: Depth to water level fluctuation map of Fractured Aquifer

Table 5E: Aquifer wise Depth to Water Level Fluctuation

Block Name	Phreatic Granite-gneiss		
	Min	Max	Avg
Bagbahara	0.92	10.65	6.25

Table 5F: Aquifer wise Depth to Water Level Fluctuation

Block Name	Fractured Granite-gneiss		
	Min	Max	Avg
Bagbahara	2.54	7.52	4.79

(iv) <u>The long term water level trend</u>: It indicates that there is no significant decline in water level in pre-monsoon as well as post-mosoon period.

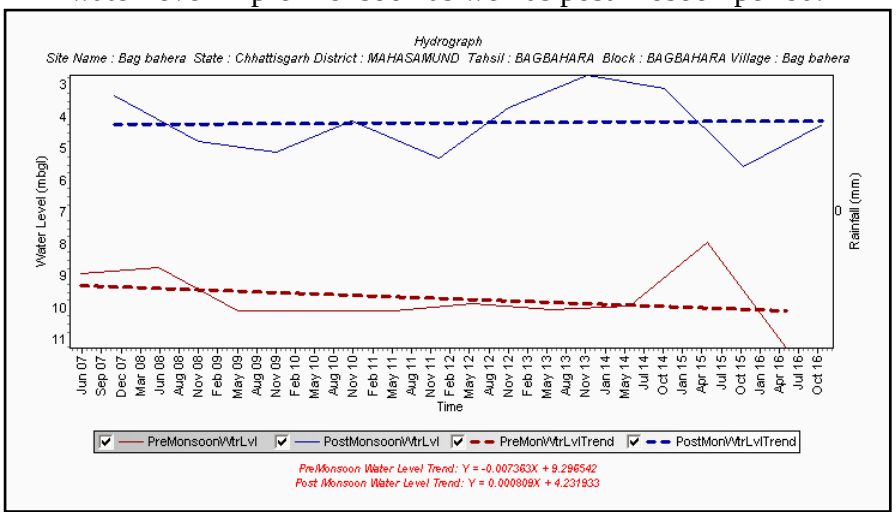

Figure 10: Hydrograph of Bagbaharatown, Bagbahara block

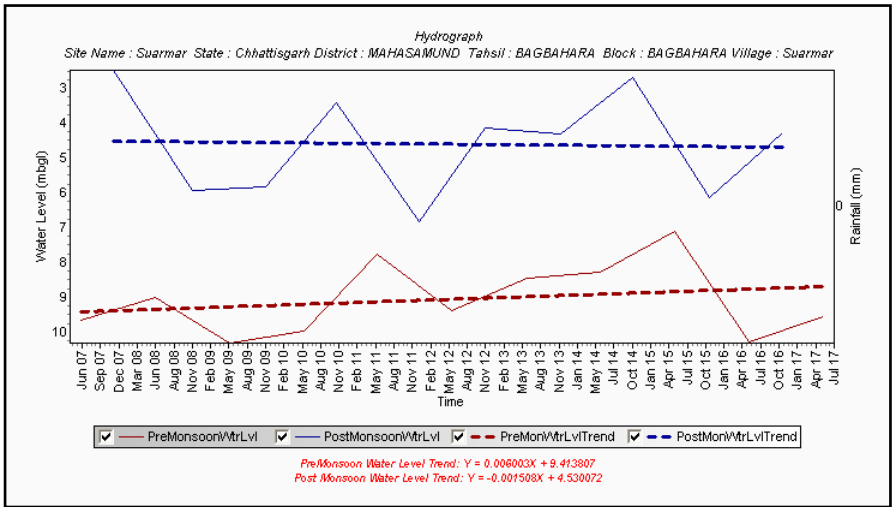

Figure 11: Hydrograph of Suarmar village, Bagbahara block

2. Aquifer Disposition:

Number of Aquifers: There isone major aquiferviz. Dongargarh granite and granitic gneiss, which in phreatic and fractured condition serves as major aquifer system in the block. There is also Bengpal group granitic gneiss, but it is minor. Entire granite and granitic gneiss is treated as single hydrostatic unit since it is not possible to differentiate them on the basis of hydrogeological characteristics.

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

(B) Geology: Geologically the block exhibits lithology of Meso to Neo Proterozoic agedominated by Dongargarh granite and granitic gneiss.

(iii)The Gneissic Complex of Archean to Proterozoic age consists of granite gneiss and granitoids, containing enclaves of metasedimentary and meta-igneous suites comprising schists, quartzites, amphibolites and dolomitic marbles. The unclassified metamorphics are composed of quartzites, mica schists, dolomitic marbles, phyllites and biotite chlorite schists (occasionally associated with quartzite bands). All these rocks are intruded by metabasic bodies/dykes and quartz and pegmatite veins. The ground water in this group of rocks occurs under phreatic/water table conditions in the weathered portion while semi-confined to confined conditions in deeper part consist of fractures. 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 The development in these formations is mostly by way of dug wells. The transmisiivity of the formation is around 6 m^2 per day with an average drawdown of 27 m. The thickness of fractured aquifer is around 2 m.

Table 6: Distribution of Principal Aquifer Systems in Bagbahara

Block	Phreaticand fractured granite gneiss	%
Bagbahara	1379	100

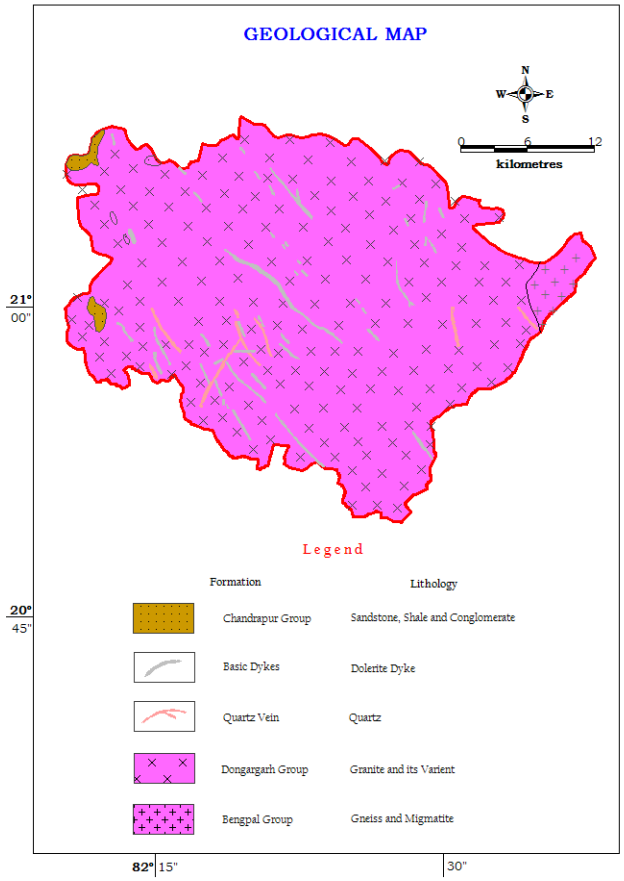

Figure 12: Aquifer map of Bagbahara block

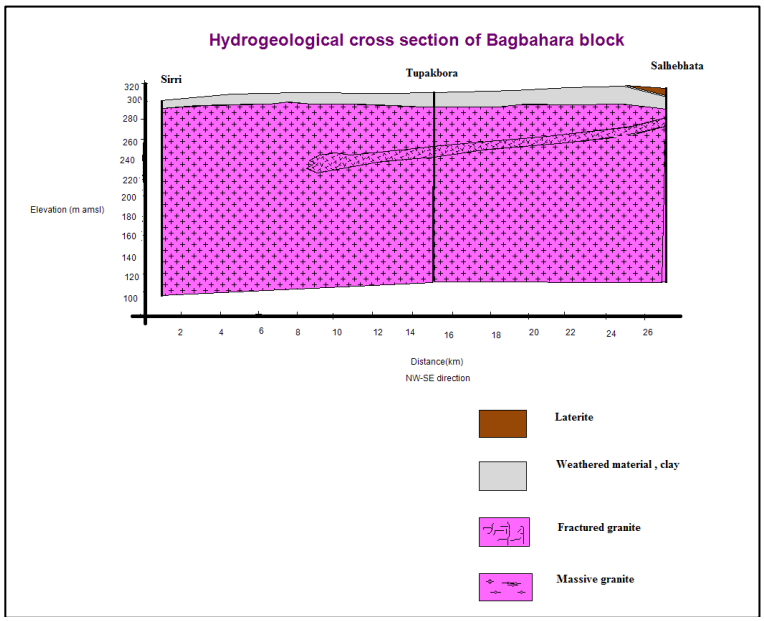

Figure-13: Hydrogeological Cross Section, Bagbahara Block

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 Bagbahara block is 14311. 47ham.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 Bagbaharablock

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	Bagbahara	14311.47	5780.00	428.93	6208.93	460.99	8070.48

Table 8Categorization of Assessment Unit

District	Block	Stage of Ground water development (%)	Categorisation
Mahasamund	Bagbahara	43.38	Safe

Categorisation: TheBagbahara block falls in safe category. The stage of Ground water development is 43.38%. The Net Ground water availability is 14311.47. The Ground water draft for all uses is 6208.93 Ham. The Ground water resources for future uses for Bagbahara Block is8070.48Ham.

Chemical Quality of Ground water and Contamination**:** Throughout the study area, the water quality is suitable for irrigation purposes. At several locations there is fluoride contamination in groundwater of shallow aquifer.

location	Concentration of Fluoride
Borrabandha	1.6
Teka	2.4
Hathibahra	2.7
Keshwa	3.2
Khallari	3.2
Suarmar	1.9

4. Ground Water Resource enhancement:

Aquifer wise space available for recharge and proposed interventions:

The Volume of porous space available for recharge (m^3) in the unsaturated zone of granite-gneiss is 32.19x 10^6 m^3 assuming the specific yield of granite-gneiss as 0.020, considering the void space depthi.e. the desirable thickness of unsaturated zone as 1.5 m and 4.5m (not considering the top 3m of the average post-monsoon water level) and the area is 945 sq. km. This is summarized in Table 9.

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 (m^3)
Granite-gneiss	945x 10^6	1.5,4.5	0.020	32.19 x 10^6

5. Issues:

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

(ii) Low stage of ground water development in block.

(iii) Fluoride contamination in groundwater.

6. Supply side interventions:

(i) Bagbahara block experiences drought like 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. 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.

(iii) De-siltation 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.

(iv) In command or non-command area wherever ground water has been used for field irrigation of pulses and vegetables should be replaced with micro irrigation methods such as sprinklers, drip irrigation etc which can save upto 289.17Ham water in Bagbahara block.

(v) It has been observed that though the long-term trend lines are insignificant, still 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 ArtificialRecharge 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**
Bagbahara	945	32.19	107.3	356.236	643.8	858.4
	Recharge Capacity		21.46	3.56236	6.438	4.292

(vi) The practice of providing free electricity to operate irrigation borewells 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.

(viii) Since the stage of development in the block is only 43.38 %. So, there is ample scope of development. In order to achieve 60% stage of ground water withdrawal in theblock, development may be taken up as per the following table:

Table-11**:** Nos of structures recommended for further development

Block	Total Annual Replenishable Groundwater Resources (ham)	Stage of ground water Development (%)	Volume of ground water required to achieve 60% Withdrawal for block (ham)	Surplus ground water at present Stage of Development (ham)	No of TW Recommended in the block (Assuming unit draft as 2 ham/structure/year)
Bagbahara	15156.06	43.38	8586.88	2377.95	1189

(ix) Fluoride removing filters or plants may be set up at appropriate locations.

(x) Furthermore, in order to strike a balance between the ground water draft and the available resource, suitable artificial structures at appropriate locations be

constructed through successive phases after tentatively every 20 no.s of groundwater abstraction structures become operative.

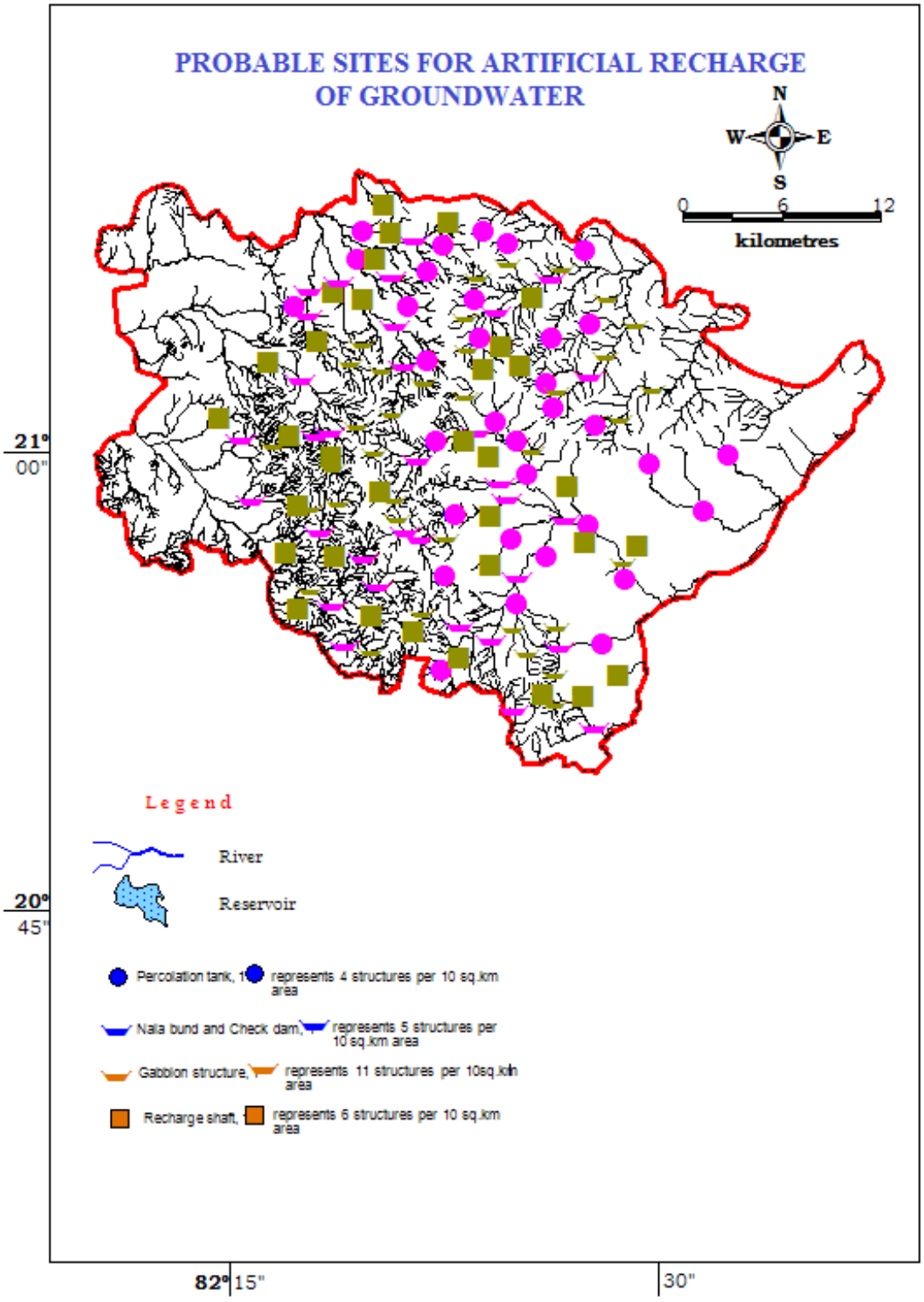

Figure 14: Map of proposed sites for artificial recharge of groundwater in Bagbahara block

7. CONCLUSIONS:

An area of 1379 sq.km of Bagbahara block of Mahasamund district has been considered for Aquifer Mapping and Management Plans. The total g.w resource is 14311.47 Ham with stage of g.w development 43.38 % and categorized as “safe”. 68.84 % of the irrigated area is uses groundwater for irrigation. Most of the ground water development has been concentrated in western part of the block and water level is deeper in south western region. The major aquifer group is Dongargarh Granite and Granite gneiss. In terms of Demand side management, by change in irrigation pattern (micro irrigation methods) 289.17 Ham water can be saved In terms of Supply side management, by constructing artificial recharge structure 32.19 MCM water can be recharged and constructing of tubewell at suitable locations, drinking water needs may be fulfilled. The block is also affected by geogenic Fluoride contamination of groundwater. So proper fluoride removal plants in those particular villages and public awareness is necessary.