केंद्रीय भूमि जल बोर्ड

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भारत सरकार

Central Ground Water Board

Department of Water Resources, River Development and Ganga Rejuvenation,

Ministry of Jal Shakti

Government of India

AQUIFER MAPPING AND MANAGEMENT OF GROUND WATER RESOURCES

BASNA 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
BASNA BLOCK, MAHASAMUND DISTRICT

1. Salient Information:

About the area: Basna Block is situated in the eastern part of Mahasamund district of Chhattisgarh and is bounded on the north by Baloda Bazar andRaigarhdistrict, in the west by Pithora block of Chhattisgarh, in the east by Saraipali block and in the south by Odisha state. The area lies between 21.15 and 21.50 N latitudes and 82.75 and 82.88 E longitudes. The geographical extension of the study area is 901 sq.km, representing around 17 % of the district's geographical area. Administrative map of the block is shown in Fig. 1. Geomorphology comprises of pediment and pediplains in the southern part, denudational hills and slopes in the northern part. Geomorphology map shown in Figure 2. Suranginala flowing eastwards is a tributary of Ong riverand Billanala flowing northwards is a tributary of Mahanadi river. Drainage map shown in Fig.3.

Population: The total population of Basna block as per 2011 Census is175617out of which rural population is 165272while the urban population is 10345.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
Basna	175617	86852	88765	165272	10345

Source: CG Census, 2011

Growth rate: The decadal growth rate of the block is 14.18 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)1212.16 mm with 50 to 60 rainy days.

Table-2: Rainfall data in Basna block in mm

Year	2010-11	2011-12	2012-13	2013-14	2014-15
Annual rainfall	1336.50	1378.70	1507.80	1468.80	1831.20

Source: IMD

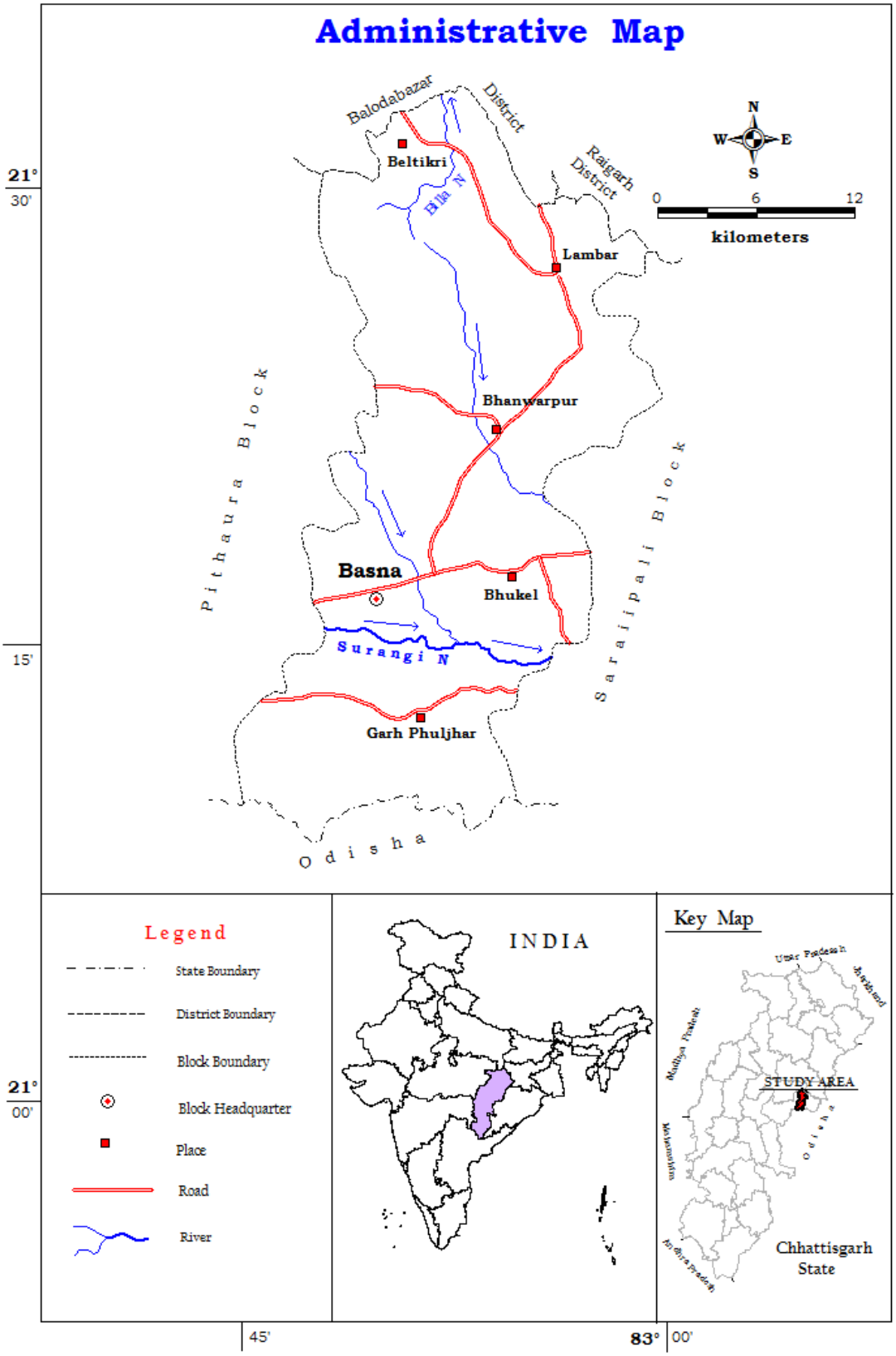


Figure: 1 Administrative Map of Basna Block

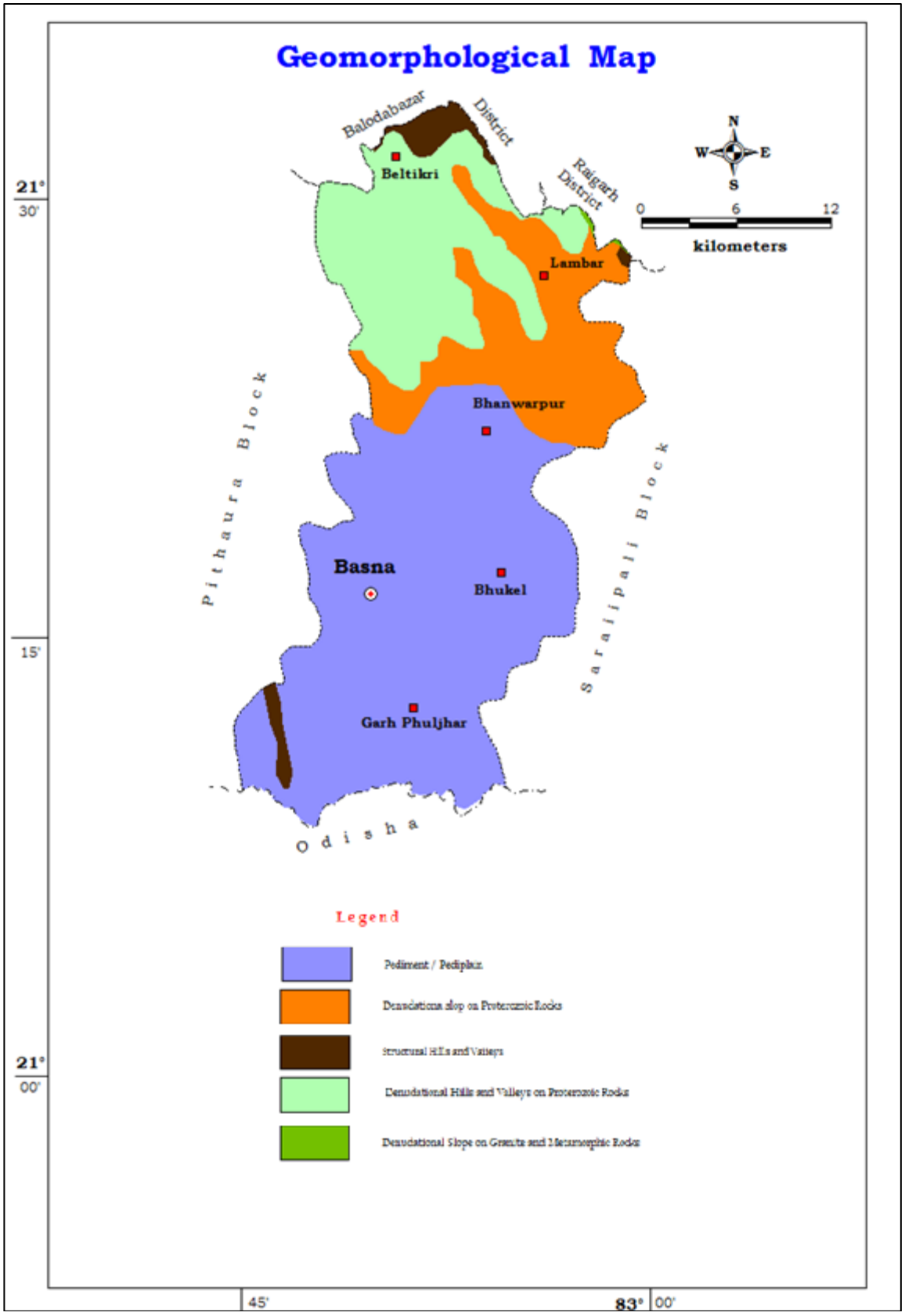


Figure 2: Geomorphology Map of Basna Block

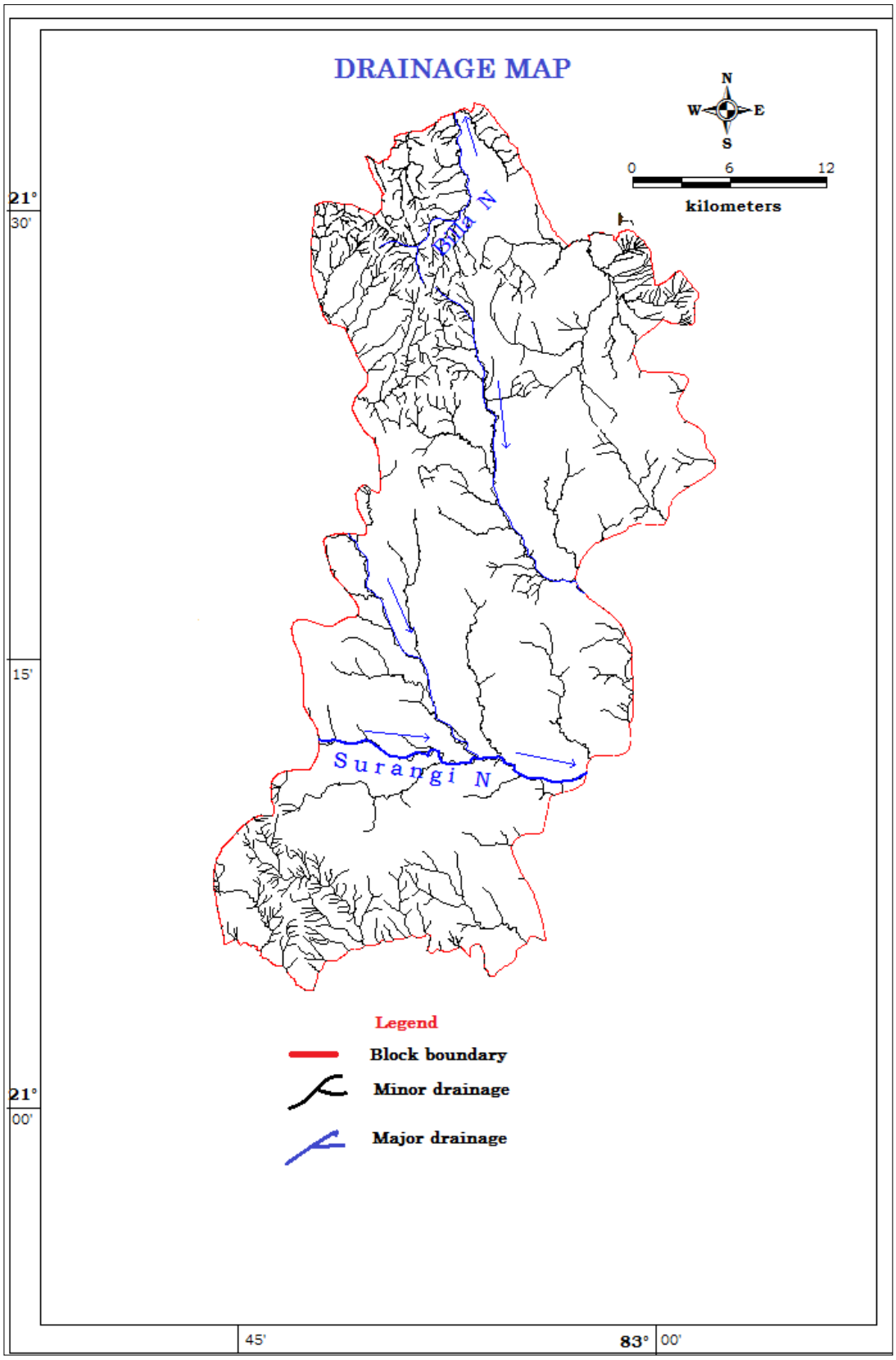


Figure 3: Drainage Map of Basna Block

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, pulsesand vegetables.

In some areas, double cropping is also practiced. The agricultural pattern, cropping pattern and area irrigated data of Basnablock 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
Basna	90100	6899	5080	48174	7526	55700

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
Basna	90100	6899	5080	2844	931	48174	7526	55700

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						
Basna	48171	7612	208	49002	48	11	4266	1498	539	60	68	1

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

No. of canals (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
8	1789	5347	12810	1571	128	747	330	525	15582	15582	36 %

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
Basna	15582	12938	83.03

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

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

Block	Dongargarh granite and gneiss			
	Phreatic		Fractured	Total resource
	Dynamic	Static	In-storage	
Basna	5682.59	1803	60.1	7491.69

Block	Basalt/Amphibolite gneiss			
	Phreatic		Fractured	Total resource
	Dynamic	Static	In-storage	
Basna	2809.61	615	30	3454.61

Existing and Future Water Demand (2025)*:* The existing demand for irrigation in the area is 7468 Ham while the same for domestic and industrial field is 418.47 Ham. To meet the future demand for ground water, a total quantity of 5147.07 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 the water level varies from 4.45 to 10.74mbgl with an average of 7.78mbglin phreatic aquifer. In fracturedformation, the pre monsoon water level variation range is 4.00 to 34.2mbgl with average of 13.97mbgl.

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

Block Name	Phreatic		
	Min	Max	Avg
Basna	4.45	10.74	7.78

Water Level (in mbgl)

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

Block Name	Fractured		
	Min	Max	Avg
Basna	4.00	34.2	13.97

(ii) Post- monsoon water level**:** In the post-monsoon period, it has been observed that the water level varies from 1.5 to 4.8mbgl with an average of 2.67mbglin phreatic aquifer. Infracturedformation, the post monsoon water level variation range is 2.8 to 17.44mbgl with average of 10.32mbgl.

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

Block Name	Phreatic		
	Min	Max	Avg
Basna	1.5	4.8	2.67

Water Level (in mbgl)

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

Block Name	Fractured		
	Min	Max	Avg
Basna	2.8	17.44	10.32

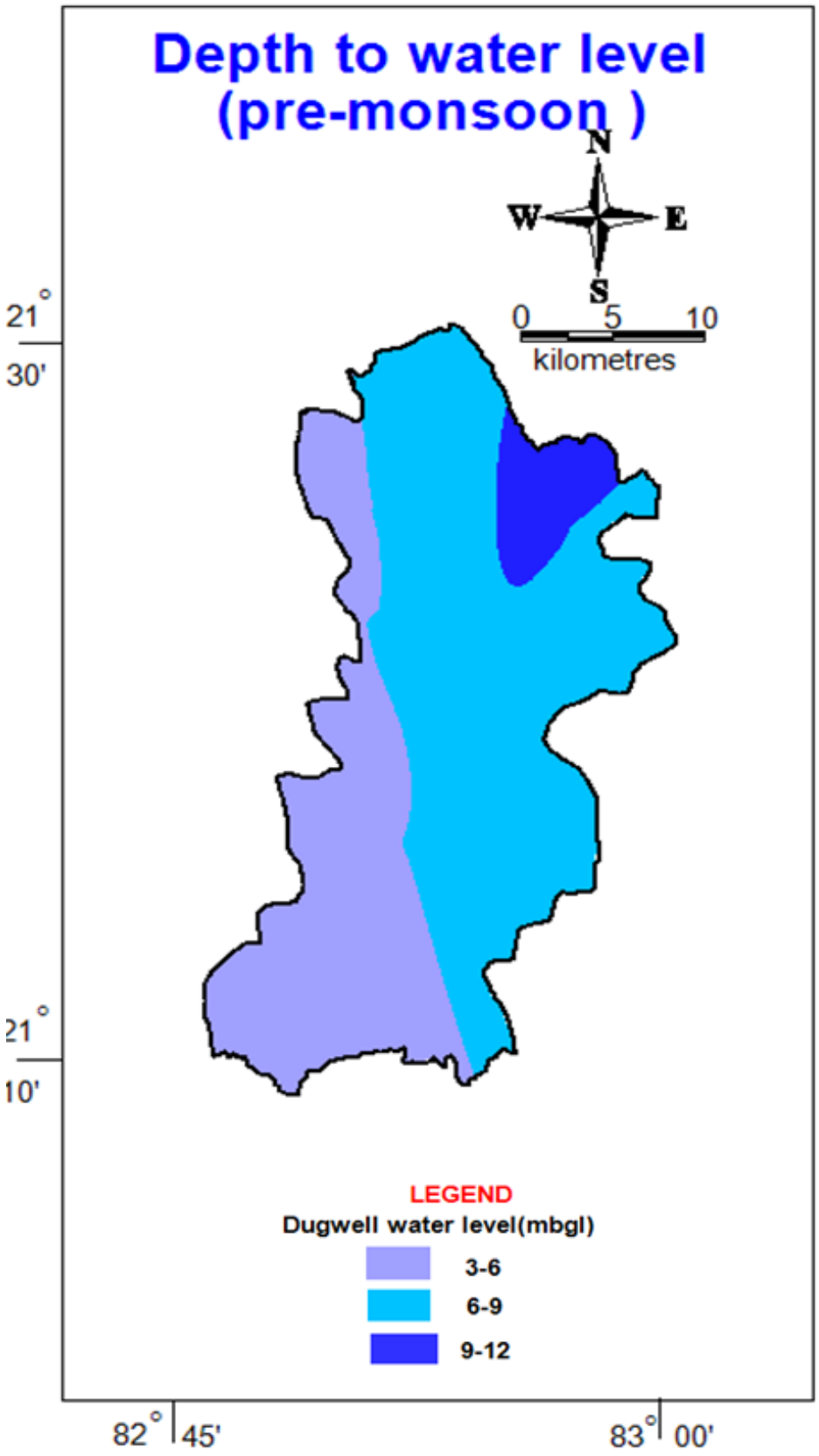


Figure-4: Depth to water level map Phreatic Aquifer (Pre-monsoon)

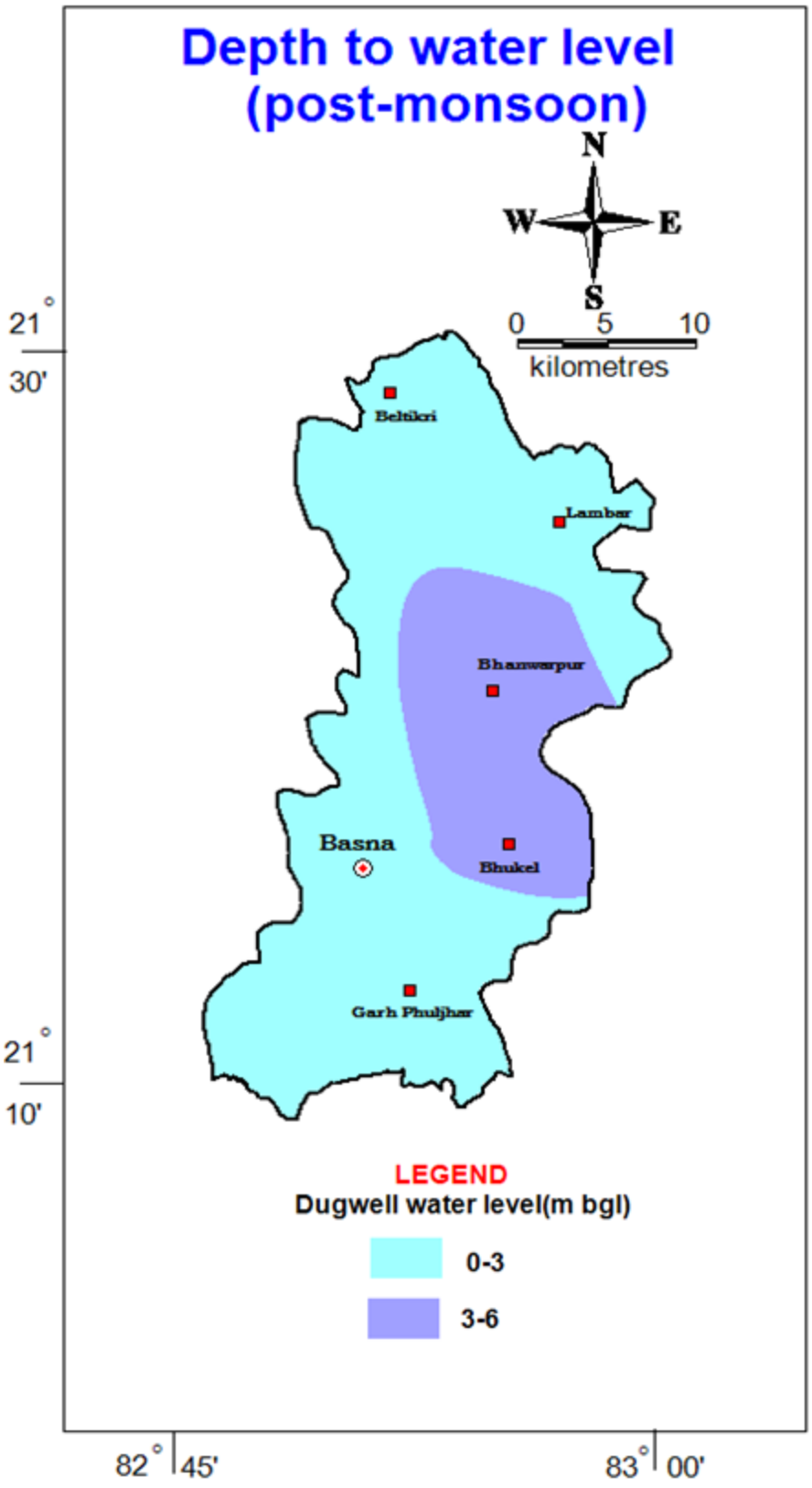


Figure 5: Depth to water level map Phreatic Aquifer (Post-monsoon)

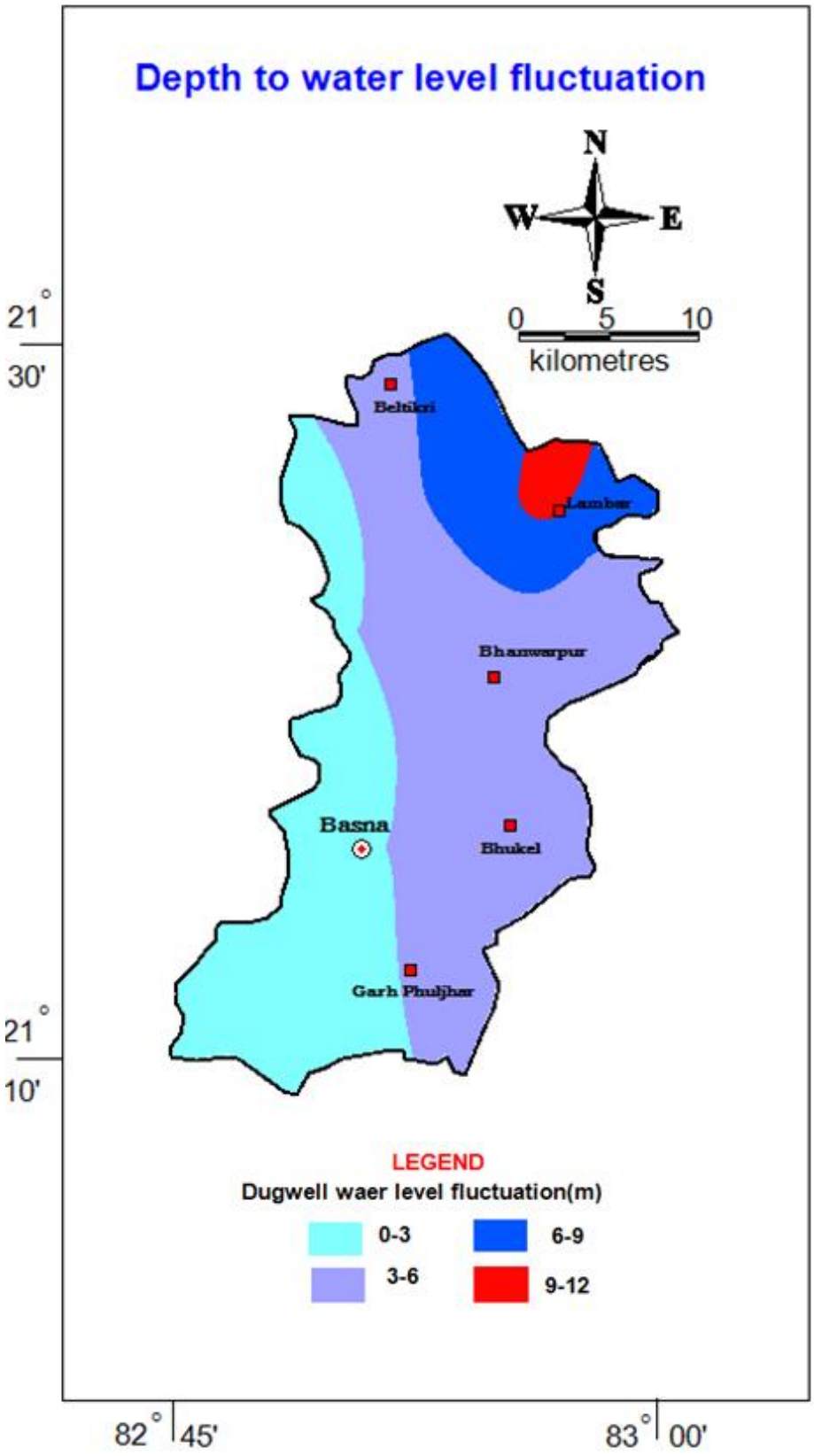


Figure 6: Depth to water level fluctuation map of Phreatic Aquifer

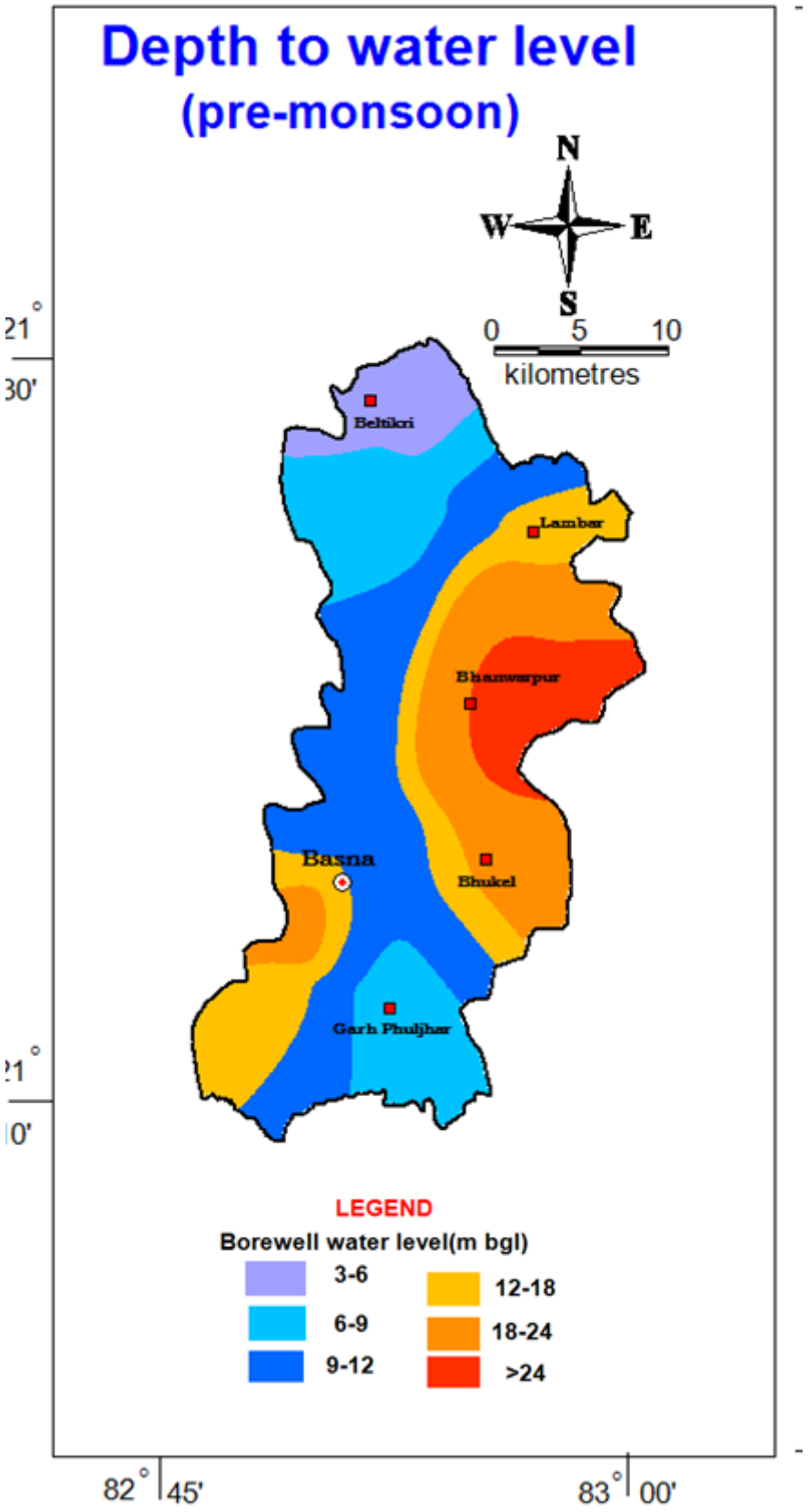


Figure-7: Depth to water level map Fractured Aquifer (Pre-monsoon)

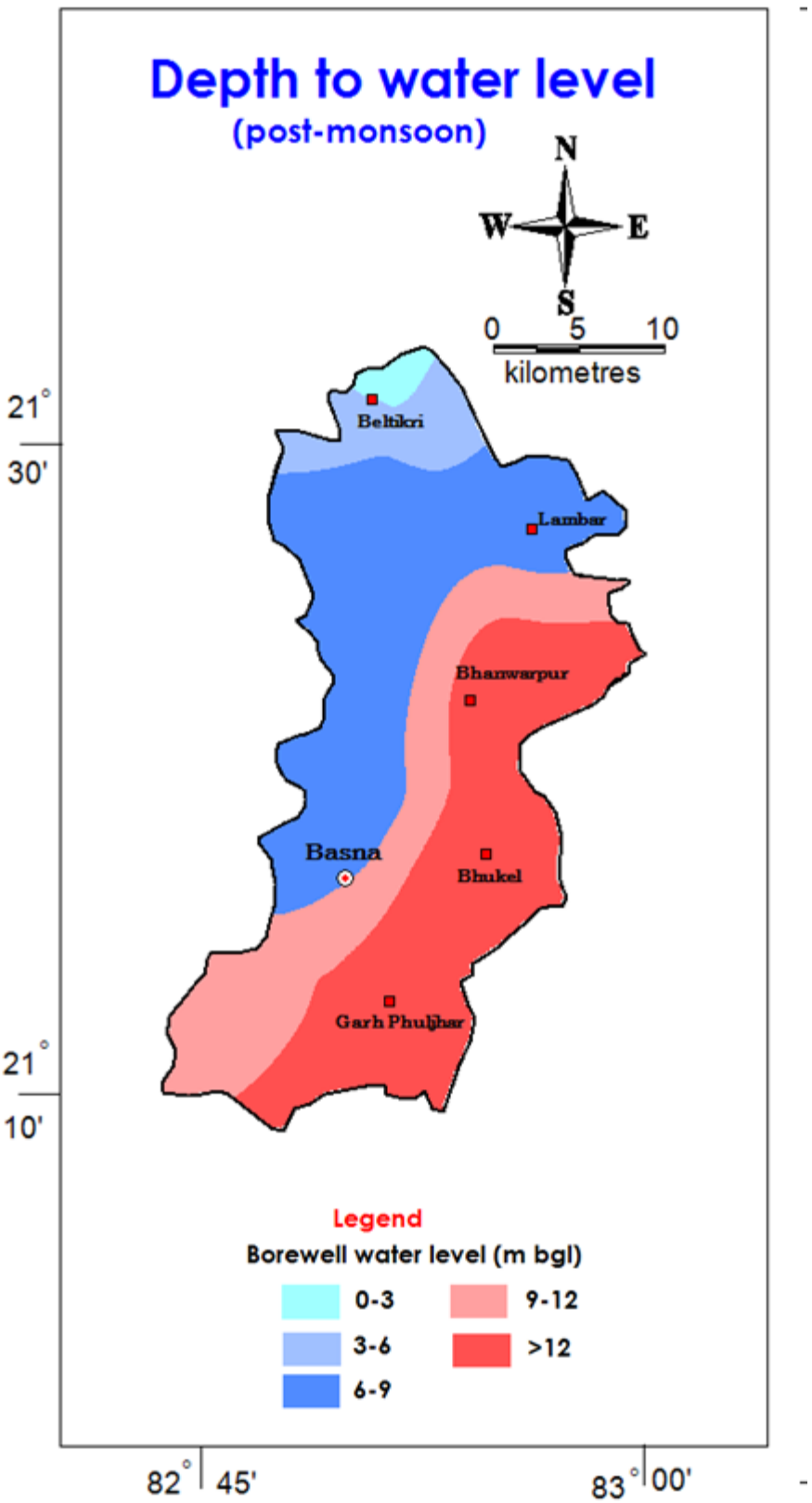


Figure-8: Depth to water level map Fractured Aquifer (Post-monsoon)

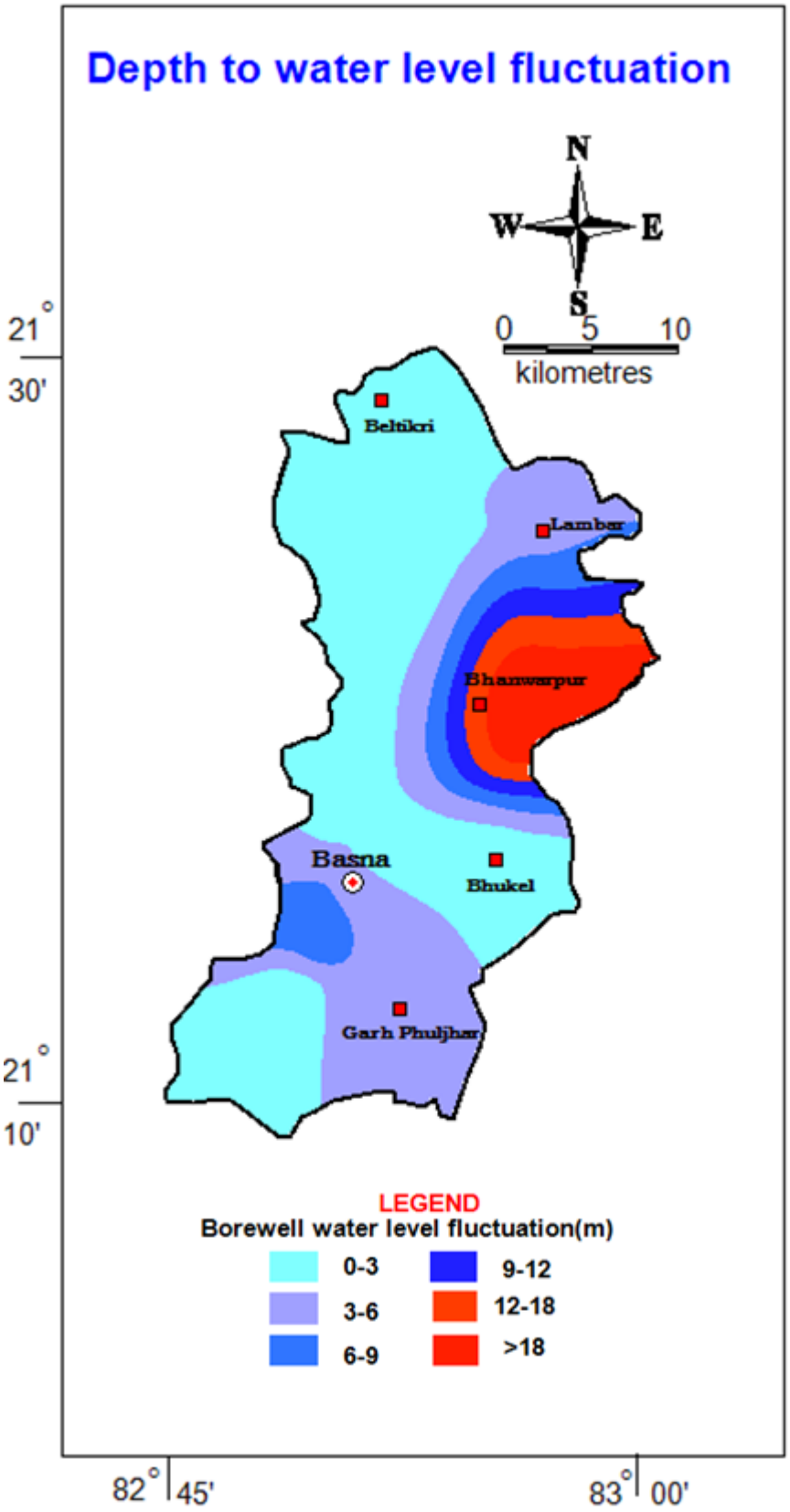


Figure 9: Depth to water level fluctuation map of Fractured Aquifer

(iii) Seasonal water level fluctuation: The water level fluctuation data indicates that in Basnablock, water level fluctuationin phreaticaquifervaries from 2.47 to 9.24 m with an average fluctuation of 5.10m. Water level fluctuationin fracturedaquifervaries from 0.6 to 18.4 m with an average fluctuation of 4.77 m.

Table 5E: Aquifer wise Depth to Water Level Fluctuation

Block Name	Phreatic		
	Min	Max	Avg
Basna	2.47	9.24	5.10

Water Level (in m)

Table 5F: Aquifer wise Depth to Water Level Fluctuation

Block Name	Fractured		
	Min	Max	Avg
Basna	0.6	18.4	4.77

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

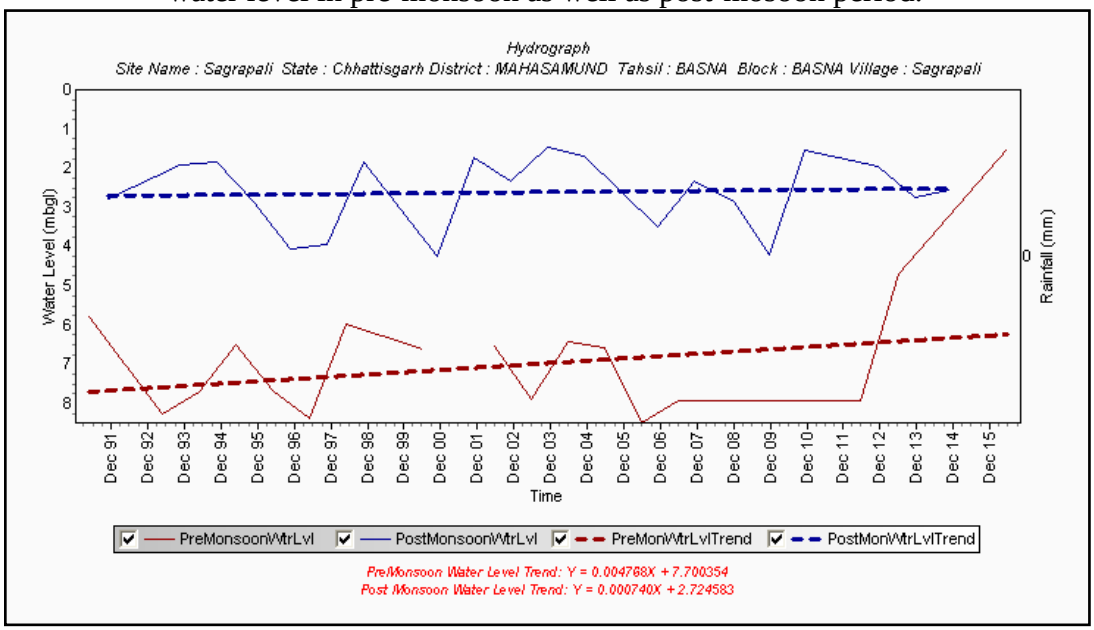


Figure 11: Hydrograph of Sagrapali village, Basna block

2. Aquifer Disposition:

Number of Aquifers: There aretwo major aquifers, viz. Dongargarh granite and granitic gneiss and Sonakhan group basalt and amphibolite, 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 Dongargarh granite and granitic gneiss and Sonakhan groupbasalt and amphibolites gneiss.

I. 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 average thickness of the weathered portion in the area is around 10.30 m. 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 in less than 50 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 and shallow tubewells. The average drawdown is 27 m. The thickness of fractured aquifer is around 0.2 m.

II. Sonakhan group of Archean to Proterozoic age consists of basalt and amphibolite and metasediments. 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 12.75 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 1 to 2sets of fractures are encountered within 60 to 200 m depth. The discharge is negligible (<1lps). The development in these formations is mostly by way of dug wells.

Table 6: Distribution of Principal aquifer systems in Basna

Block	Phreaticand fractured granite gneiss (sq.km.)	Phreaticand fractured basalt, amphibolite(sq.km.)
Basna	601	300

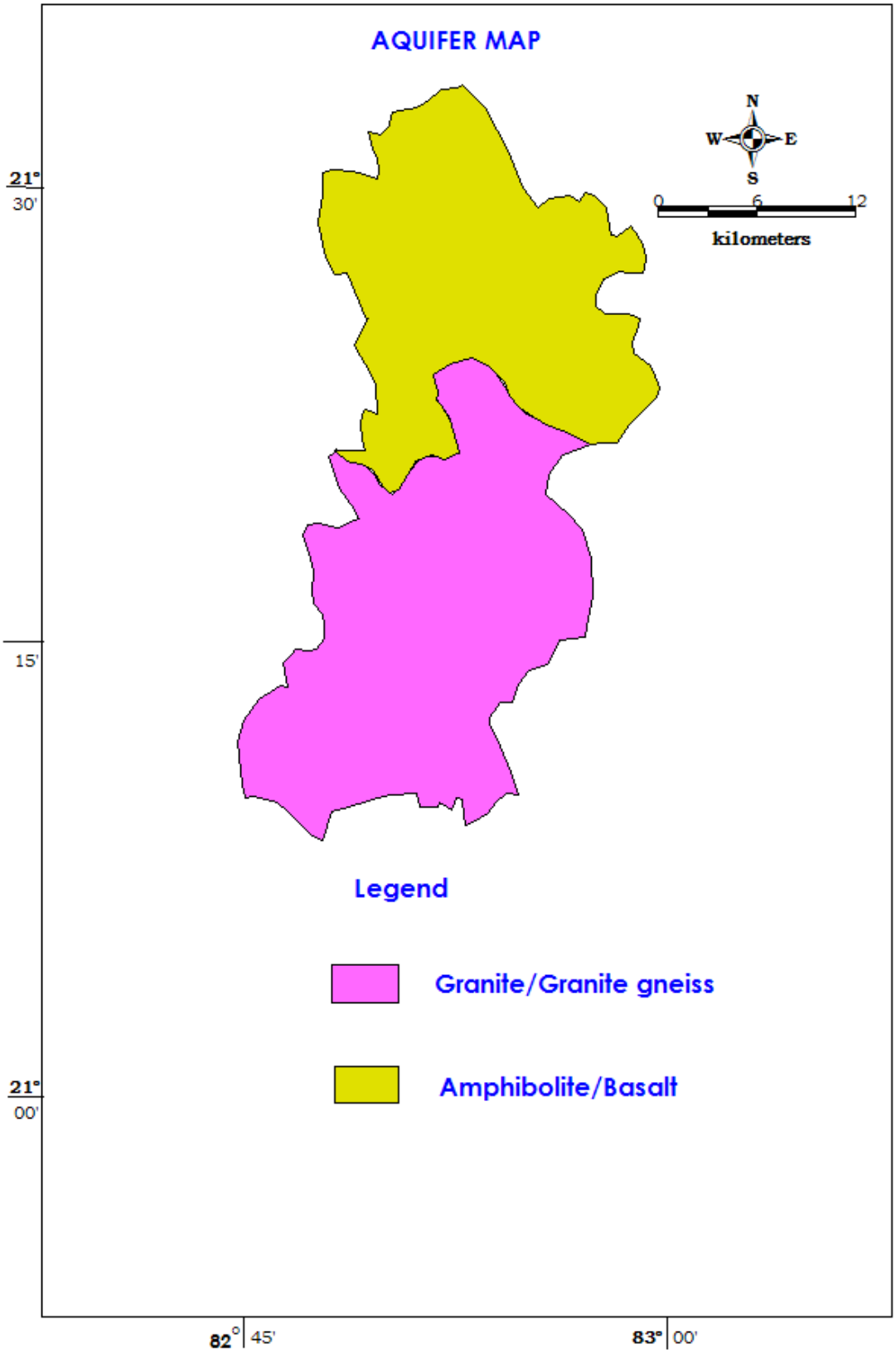
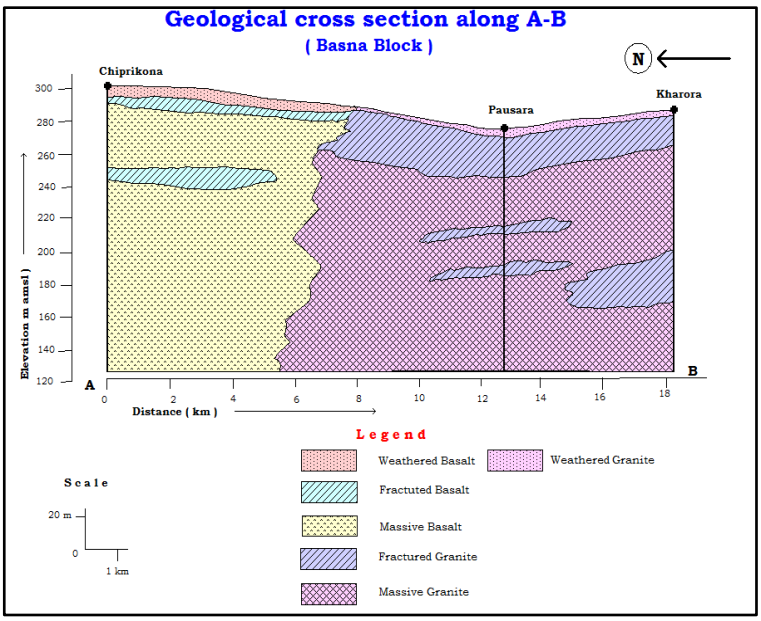


Figure 12: Aquifer map of Basna block



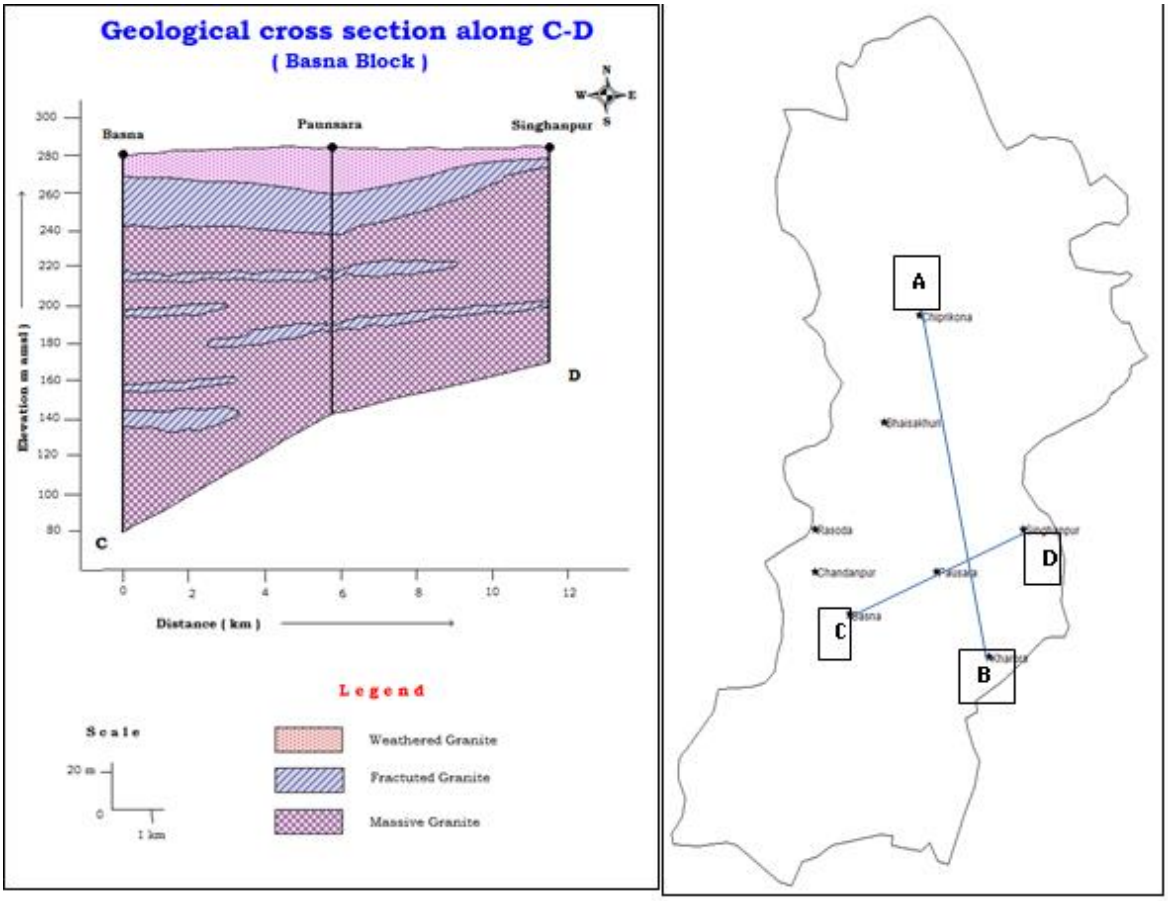


Figure-13: (a) Hydrogeological Cross Section(A-B),(b) Hydrogeological Cross Section(C-D),Basna Block

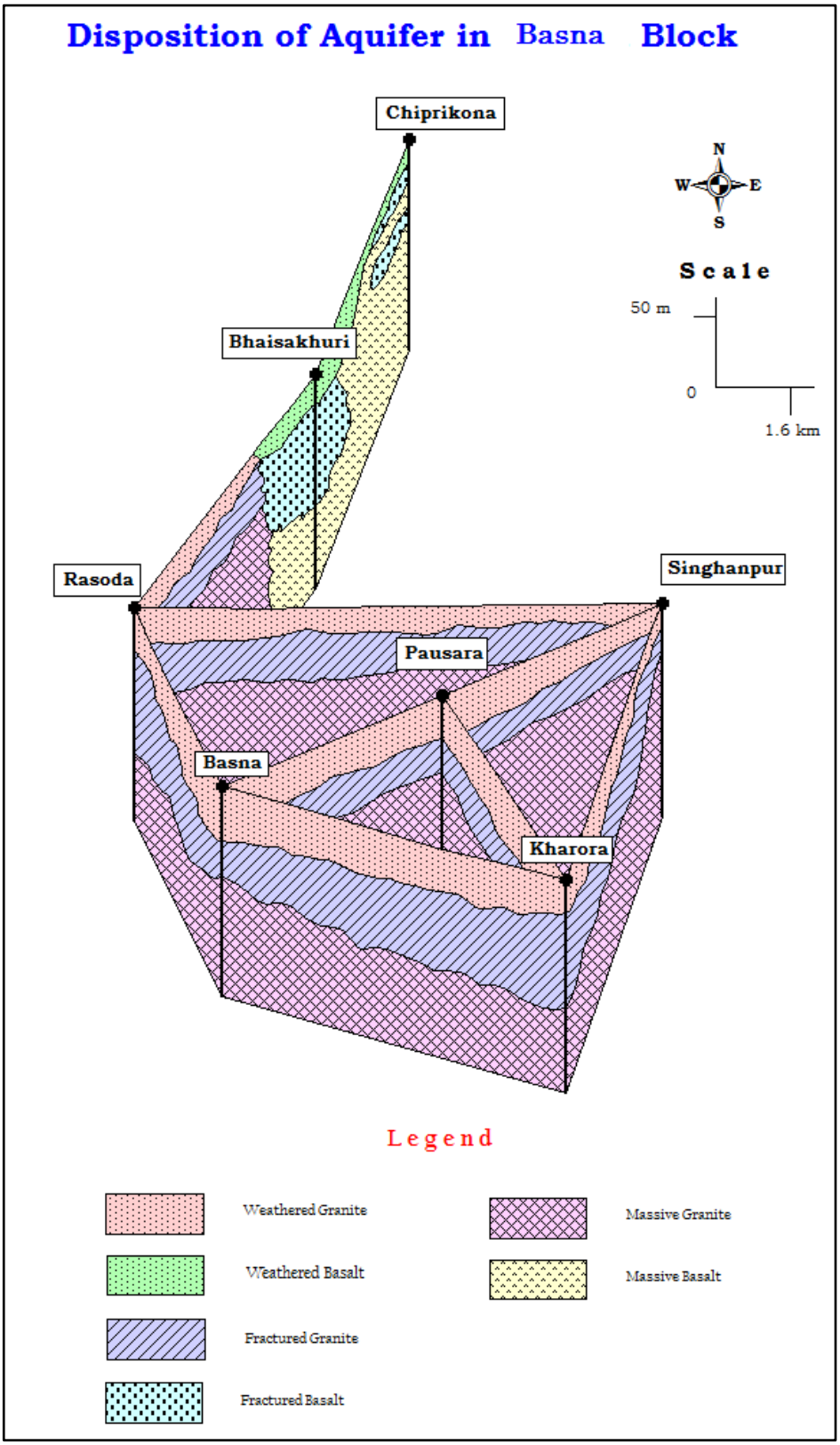


Figure-14: Disposition of aquifer in Basna block

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 Basna block is 12615. 07ham.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 Basnablock

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	Basna	12615.07	7468.0	418.47	7886.47	469.21	4677.86

Table-8: Categorization of Assessment Unit

District	Block	Stage of Ground water development (%)	Categorization
Mahasamund	Basna	65.52	Safe

Categorisation: The Basna block falls in safe category. The stage of Ground water development is 65.52%. The Net Ground water availability is 12615.07. The Ground water draft for all uses is 7886.47 Ham. The Ground water resources for future uses for Basna Block is4677.86Ham.

Chemical Quality of Ground water and Contamination**:** Throughout the study area, the water quality (phreatic and semi-confined 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 (m^3)
Granite-gneiss	$115*10^6$	1.5	0.020	3.45×10^6
Basalt/ Amphibolite gneiss	$53*10^6$	1.5	0.020	1.59×10^6

5. Issues:

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

(ii) It has been observed during fieldwork in pre-monsoon period, there is colossal wastage of groundwater through public water supply system.

6. Supply side interventions:

I. Basna block experienced drought situation in 2017 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 teach people about the importance community participation in saving water.

III. 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.

IV. 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
Basna	168	4.20	13	46	72	100
	Recharge Capacity		2.52	0.42	0.76	0.50
	Estimated cost (Appx.)		Rs. 4.9 crore			

(iii) 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.

(iv) 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.

7. Demand side interventions:

(i) Since the stage of development in the block is 65.52%. Change in cropping pattern & irrigation pattern can lead to groundwater savings, as per the following table:

Table 11: Detail of groundwater saved through change in cropping pattern

Block	Paddy cultivation area during Rabi season (ha)	Water required for cultivation (in m) per ha		Difference (m) per ha	Total saving of water (ham)	Existing gross groundwater draft for all uses in ham	Available resource (ham)	Improved status in Stage of groundwater development
		Paddy	Maize					
Basna	3956	0.9	0.5	0.4	1582.4	7886.47	12615.07	49.97

(ii) 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.

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

Block	Irrigated Crop Area Under Rabi 2016(Ha)	Water Required For cultivation ofPulses(M)	30 % Groundwater Saved Through Micro irrigation	Water Saved Through Microirrigation (Ham)
Basna	5354	0.3	0.3	481.86

Table 13: Probable sites for artificial recharge structures in Basna block

ID	Name	Block	AR Structure	ID	Name	Block	AR Structure
1	Mungadih	Basna	Percolation Tank	19	Bhanwarpur	Basna	Nala Bund/ Check Dam
2	Bhawarchuwa	Basna	Percolation Tank	20	Chandarpuri	Basna	Nala Bund/ Check Dam
3	Karnapali	Basna	Percolation Tank	21	Bhaisakhuri	Basna	Nala Bund/ Check Dam
4	Bhuneswarpur	Basna	Percolation Tank	22	Pitaipali	Basna	Recharge Shaft
5	Madhopali	Basna	Percolation Tank	23	Nawagaon	Basna	Recharge Shaft
6	Dhalan	Basna	Percolation Tank	24	Jagat	Basna	Recharge Shaft
7	Ghutikona	Basna	Percolation Tank	25	Bargaon	Basna	Recharge Shaft
8	Lalitpur	Basna	Percolation Tank	26	Bhuneswarpur	Basna	Recharge Shaft
9	Kusmur	Basna	Percolation Tank	27	Ghutikona	Basna	Recharge Shaft
10	Gayatripur	Basna	Percolation Tank	28	Gayatripur	Basna	Gabion Structure
11	Paserlewa	Basna	Percolation Tank	29	Rohina	Basna	Gabion Structure
12	Khogasa	Basna	Percolation Tank	30	Santpali	Basna	Gabion Structure
13	Rohina	Basna	Percolation Tank	31	Bhanwarpur	Basna	Gabion Structure
14	Jamnidih	Basna	Nala Bund/ Check Dam	32	Bhaisakhuri	Basna	Gabion Structure
15	Santpali	Basna	Nala Bund/ Check Dam	33	Nawagaon	Basna	Gabion Structure
16	Lohadipur	Basna	Nala Bund/ Check Dam	34	Jagat	Basna	Gabion Structure
17	Chipari Kona	Basna	Nala Bund/ Check Dam	35	Bargaon	Basna	Gabion Structure
18	Chapiya	Basna	Nala Bund/ Check Dam				

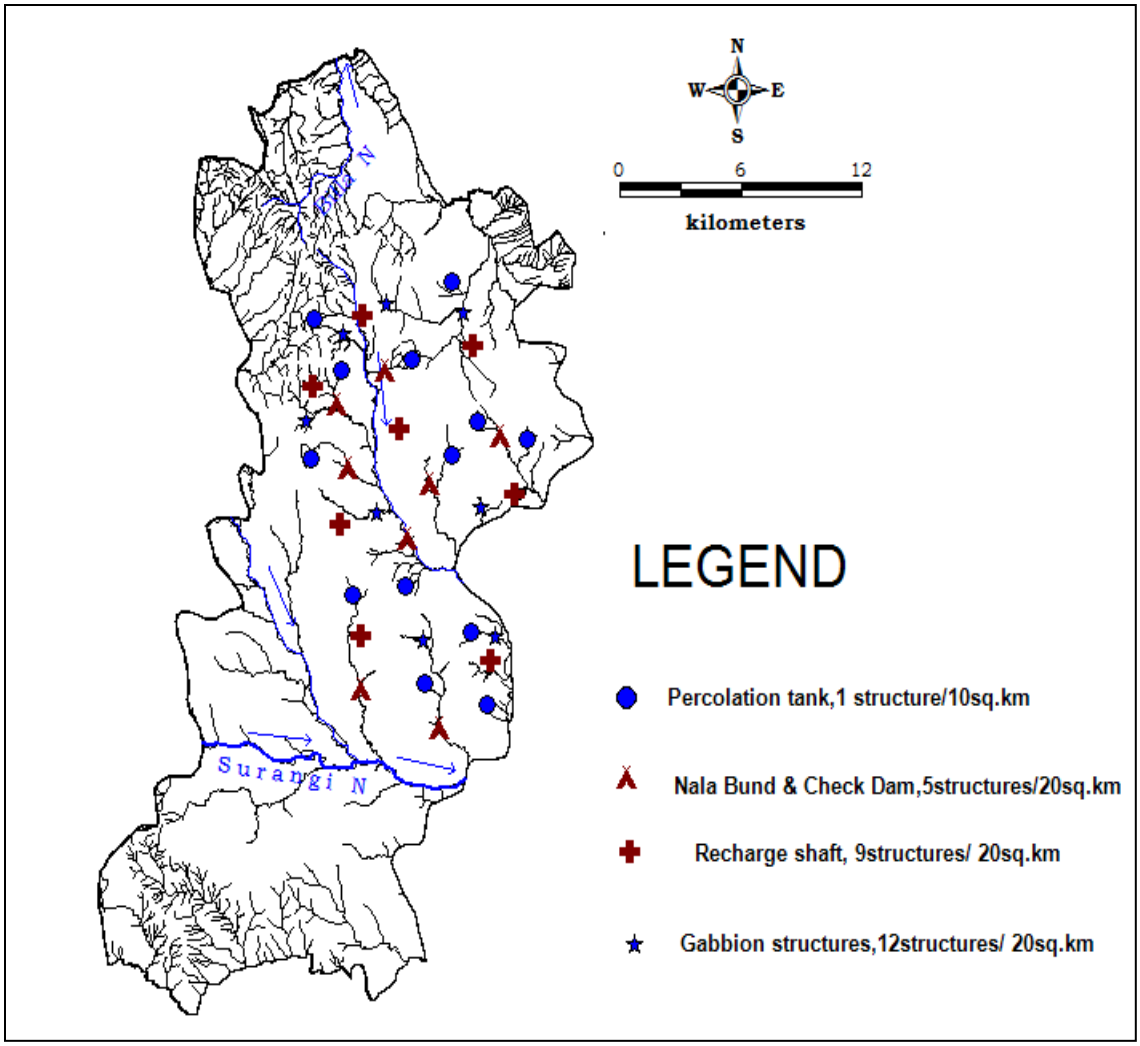


Figure 15: Map of proposed sites for artificial recharge of groundwater in Basna block

8. CONCLUSIONS:

An area of 901 sq.km of Basna block of Mahasamund district has been considered for Aquifer Mapping and Management Plans. The total G.W resource is 12615.07 Ham with stage of G.W development 65.52 % and categorized as “safe”. 83.03 % of the irrigated area is uses groundwater for irrigation. The major aquifer groupsareSonakhan Group amphibolite gneiss, basalt and Dongargarh Granite and Granite gneiss. In terms of Demand side management, by change in cropping and irrigation pattern (micro irrigation methods) 1582.4Ham and 481.86 Ham water can be saved respectively. In terms of Supply side management, by constructing artificial recharge structure 4.20 MCM water can be recharged.