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

PODI UPRORA BLOCK, KORBA DISTRICT, CHHATTISGARH

उत्तर मध्य छत्तीसगढ़ क्षेत्र, रायपुर

North Central Chhattisgarh Region, Raipur

Acknowledgement

The author is grateful to Shri G C Pati, Chairman, Central Ground Water Board for giving opportunity for preparation of Aquifer Map and Management Plan of Podi Uprora Block, Korba district of Chhattisgarh state. The author is thankful to Dr. S.K.Samanta, Head of the Office, Central Ground Water Board, NCCR, Raipur extending valuable guidance and constant encouragement during the preparation of this report. I am extremely grateful to Sh. A.K.Patre, Scientist-D, for his continuous guidance and support during preparation of this report. The author is also thankful to Sh A.K. Biswal, Sc-D and Sh. J.R.Verma, Sc.D for the guidance and suggestions. The author is also thankful to Sh Sujit Sarkar, Sc-B for geophysical survey and Sh Rakesh Dewangan, Sc-B for chemical analysis of the block. I would like to acknowledge the help rendered by Smt Prachi Gupta, Sc-B while preparing aquifer map. The efforts made by Sh. T.S. Chouhan, Draftsman, for digitization of maps are thankfully acknowledged. The author is also thankful to the state agencies for providing the various needful data. The author is thankful to Technical Section, Data Centre, Chemical Section, Report Processing Section and Library of CGWB, NCCR, Raipur for providing the various needful data.

Uddeshya Kumar

Scientist-B (JHG)

AQUIFER MAPPING AND MANAGEMENT PLAN FOR PODI UPRORA BLOCK (KORBA DISTRICT), CHHATTISGARH

CONTENTS

ABBREVIATIONS

DW	Dugwell	**m bgl**	meter below ground level
EC	Electrical Conductivity	**m2/day**	Square meter/ day
GS	Gabion structures	**m3/day**	cubic meter/day
GW/ gw	Ground Water	**MCM/mcm**	Million Cubic Meter
ha	Hectare	**mm**	Milimeter
Ham	Hectare meter	**OE**	Overexploited
HP	Handpump (Shallow)	**Sq Km**	Square Kilometer
lpm	litres per minute	**STP**	Sewage Treatment Plant
lps	liters per second	**T**	Transmissivity
m	meter	**TW**	Tubewell

BLOCK-WISE AQUIFER MAPS AND MANAGEMENT PLANS

1. Salient Information:

About the area: Podi Uprora Block is situated on the western part of Korba district of Chhattisgarh and is bounded on the north by Koriya district, west by Bilaspur district, in the east by Korba and in the south by katghora and Pali block. The block area lies between 22.45290° N and 22.99955° N latitudes and 82.13534° E and 82.83574° E longitudes. The geographical extension of the study area is 2348.81 sq.km representing around 33 % of the district's geographical area. Administrative map of the block is shown in Fig. 1. Geomorphology mainly comprises of structural plains and denudational hills on Gondwana rocks and structural plains on Proterozoic rocks and pediplain. Geomorphology map is shown in Figure 2. The major drainage of the block includes Hasdeo River and its tributary Tan Nala, Anjan Nala, Bamni Nala, Chornai Nala all of which are parts of Mahanadi Basin. Drainage map shown in Fig.3.

Population: The total population of Podi Uprora block as per 2011 Census is 188783.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
Podi Uprora	188783	95083	93700	188783	0

Source: CG Census, 2011

Growth rate: The decadal growth rate of the district is 19.25 % as per 2011 census. Data for the block is not available.

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. 2012 to 2017) 1007.4 mm with 50 to 60 rainy days.

Table-2: Rainfall data in Podi Uprora block in mm

Year	2012-13	2013-14	2014-15	2015-16	2016-17
Annual rainfall	856.0	1126.80	918.00	1226.80	909.4

Source: IMD

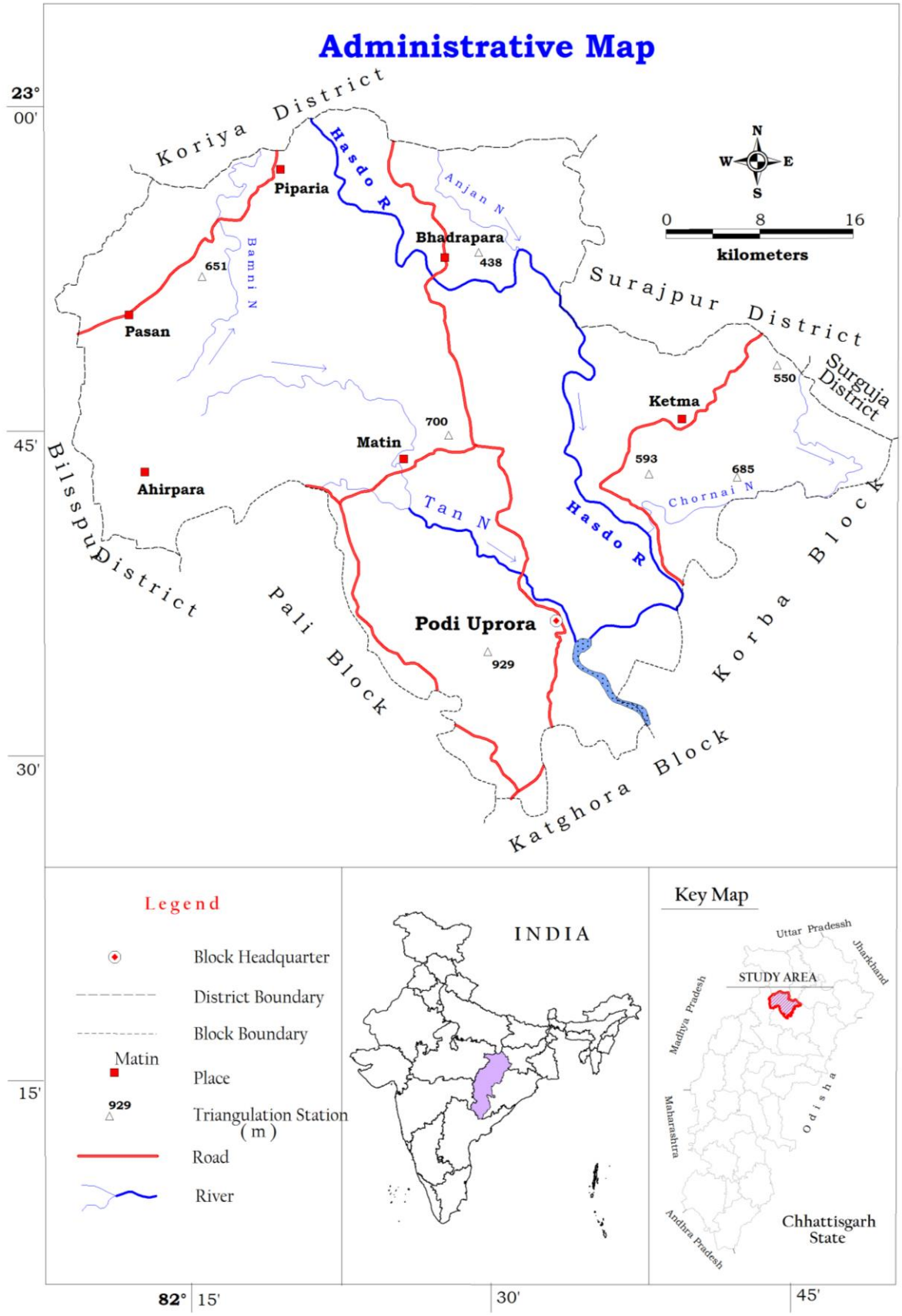


Figure 1 Administrative Map of Podi Uprora Block

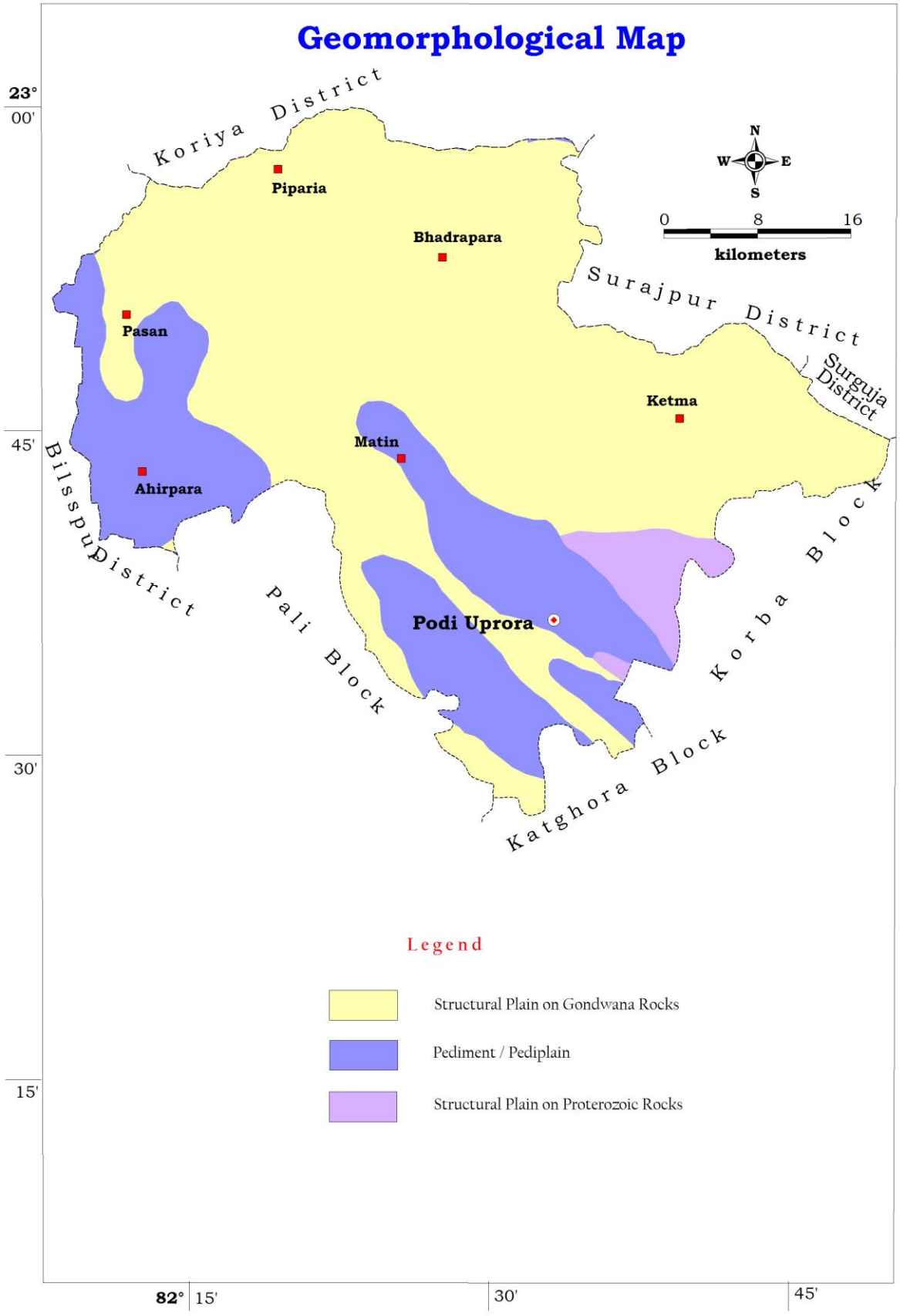


Figure 2 Geomorphology Map of Podi Uprora Block

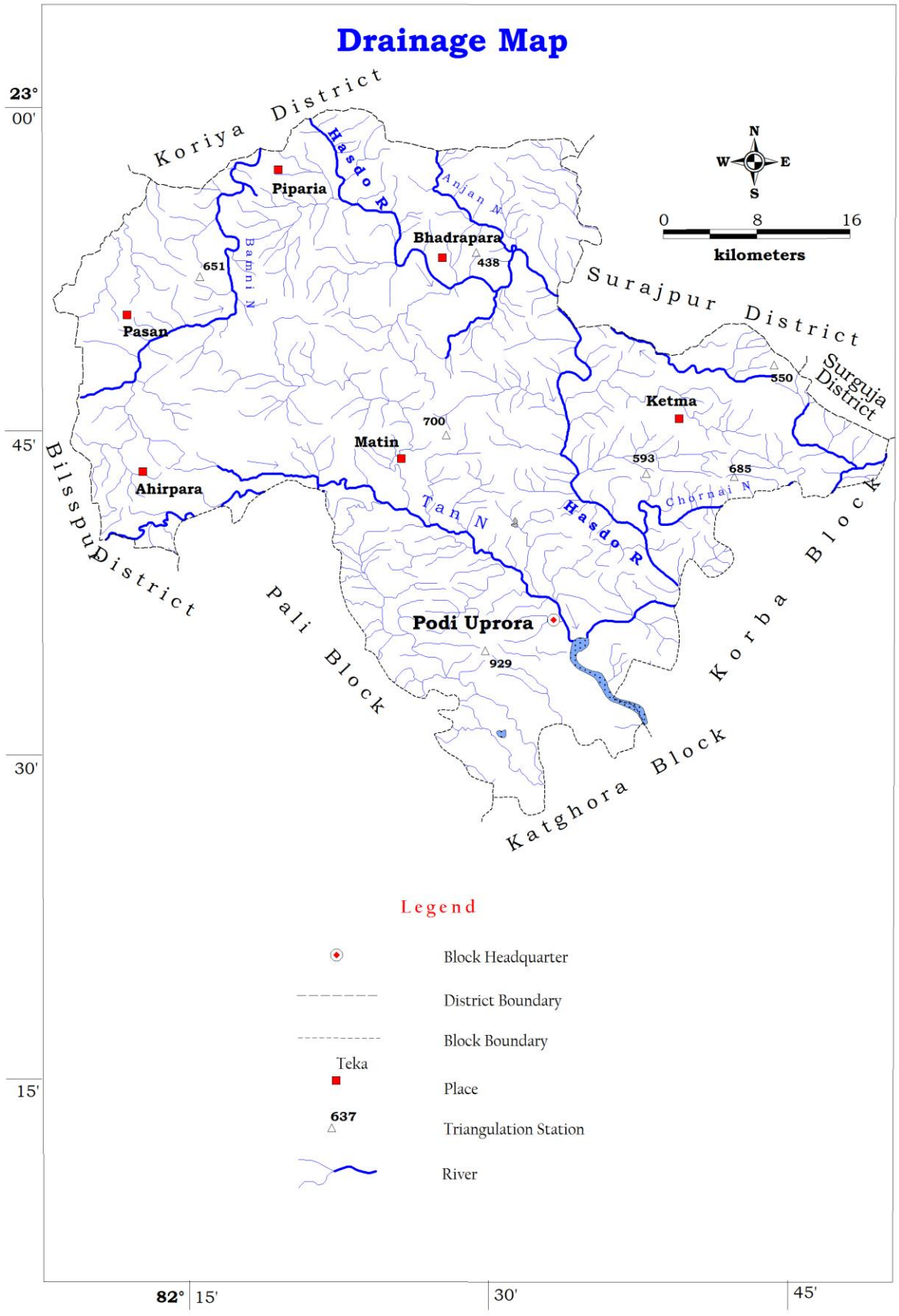


Figure 3 Drainage Map of Podi Uprora Block

Agriculture and Irrigation**:** Agriculture is practiced in the area during Kharif and 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 Podi Uprora block is given in Table 3 (A, B, C, D, E).

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

Block	Total geographical area (village record)	Revenue forest area	Area not available for cultivation	Net sown area	Double cropped area	Gross cropped area
Podi Uprora	131634	72022	18395	31377	3082	34599

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
Podi Uprora	234881	72022	18395	6381	3459	31377	3082	34599

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

Block	Kharif	Rabi	Cereal				Pulses	Tilhan	Fruits Vegetables	Reshe	Mirch Masala
			Wheat	Rice	Jowar & Maize	Others					
Podi Uprora	31365	3094	184	22596	3083	1001	4194	2648	694	10	6

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
-	114	-	-	-	40	-	5	257	416	416	1.21 %

Groundwater Resource Availability and Extraction: Based on the resource assessment made, the resource availability in aquifer wise in Podi Uprora block is given in the table-4.

Table – 4 (A): Ground Water Budget of Podi Uprora block in Ham

Assessment Unit Name	Assessment Unit code	Ground Water Recharge(Ham)				Total Annual Ground Water (Ham) Recharge	Total Natural Discharges (Ham)
		Monsoon Season		Non-monsoon season			
		Recharge from Rainfall	Recharge from Other Sources	Recharge from Rainfall	Recharge from Other Sources		
Podi Uprora	CGKO0005	9299.49	116.84	1247.89	377.87	11042.09	1103.9

Table – 4 (B): Ground Water Dynamic Resource of Podi Uprora block in Ham

Annual Extractable Ground Water Recharge (Ham)	Current Annual Ground Water Extraction(Ham)				Annual GW Allocation for for Domestic Use as on 2025	Net Ground Water Availability for future use	Stage of Ground Water Extraction (%)	Categorization (OE/Critical/Semicritical/Safe)
	Irrigation Use	Industrial Use	Domestic Use	Total Extraction				
9938.19	1768	0.00	463.18	2231.18	529.67	7640.52	22.45	Safe

Table – 4 (C): Ground Water Static Resource of Podi Uprora block in Ham

Static Resources Area	Pre-monsoon water level	Bottom of unconfined aquifer	Difference	Specific Yield	Total Static Resources
234881	8.75	100	91.25	0.002	42865.78

Existing and Future Water Demand (2020)*:* The existing draft for irrigation in the area is 1768 Ham while the total extraction for all uses is 2231.18 Ham. At present scenario to meet the future demand for water, a total quantity of 7640.52 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 Podi Uprora block, water level in dugwells (phreatic aquifer) vary between 1.3 to 10.69 mbgl with average water level of 5.64 mbgl. In semiconfined aquifer, the maximum water level is 40.5 mbgl, the average water level is 14.46 mbgl.

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

Block Name	Phreatic Aquifer		
	Min	Max	Avg
Podi Uprora	1.3	10.69	5.64

Water Level (in mbgl)

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

Block Name	Semiconfined Aquifer		
	Min	Max	Avg
Podi Uprora	5.5	40.5	14.46

(ii) Post- monsoon water level**:** In the post-monsoon period, it has been observed that the water level varies from 1.7 to 11.2 mbgl with an average of 4.62 mbgl in phreatic aquifer. In semiconfined/ formation, the post monsoon water level variation range is 1.80 to 20.50 mbgl with average of 9.09 mbgl.

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

Block Name	Phreatic Aquifer		
	Min	Max	Avg
Podi Uprora	0.78	9.03	4.14

Water Level (in mbgl)

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

Block Name	Semiconfined Aquifer		
	Min	Max	Avg
Podi Uprora	3.55	33.73	10.94

(iii) Seasonal water level fluctuation: The water level fluctuation data indicates that in Podi Uprora block, water level fluctuation in phreatic aquifer varies from 0.67 to 4.45 m with an average fluctuation of 1.94 m. Water level fluctuation in semiconfined Aquifer varies from 0.15 to 7.04 m with an average fluctuation of 2.81 m.

Table 5E: Aquifer wise Depth to Water Level Fluctuation

Block Name	Phreatic Aquifer		
	Min	Max	Avg
Podi Uprora	-3.3	5.18	1.50

Table 5F: Aquifer wise Depth to Water Level Fluctuation

Block Name	Semiconfined Aquifer		
	Min	Max	Avg
Podi Uprora	-2.54	26.35	3.51

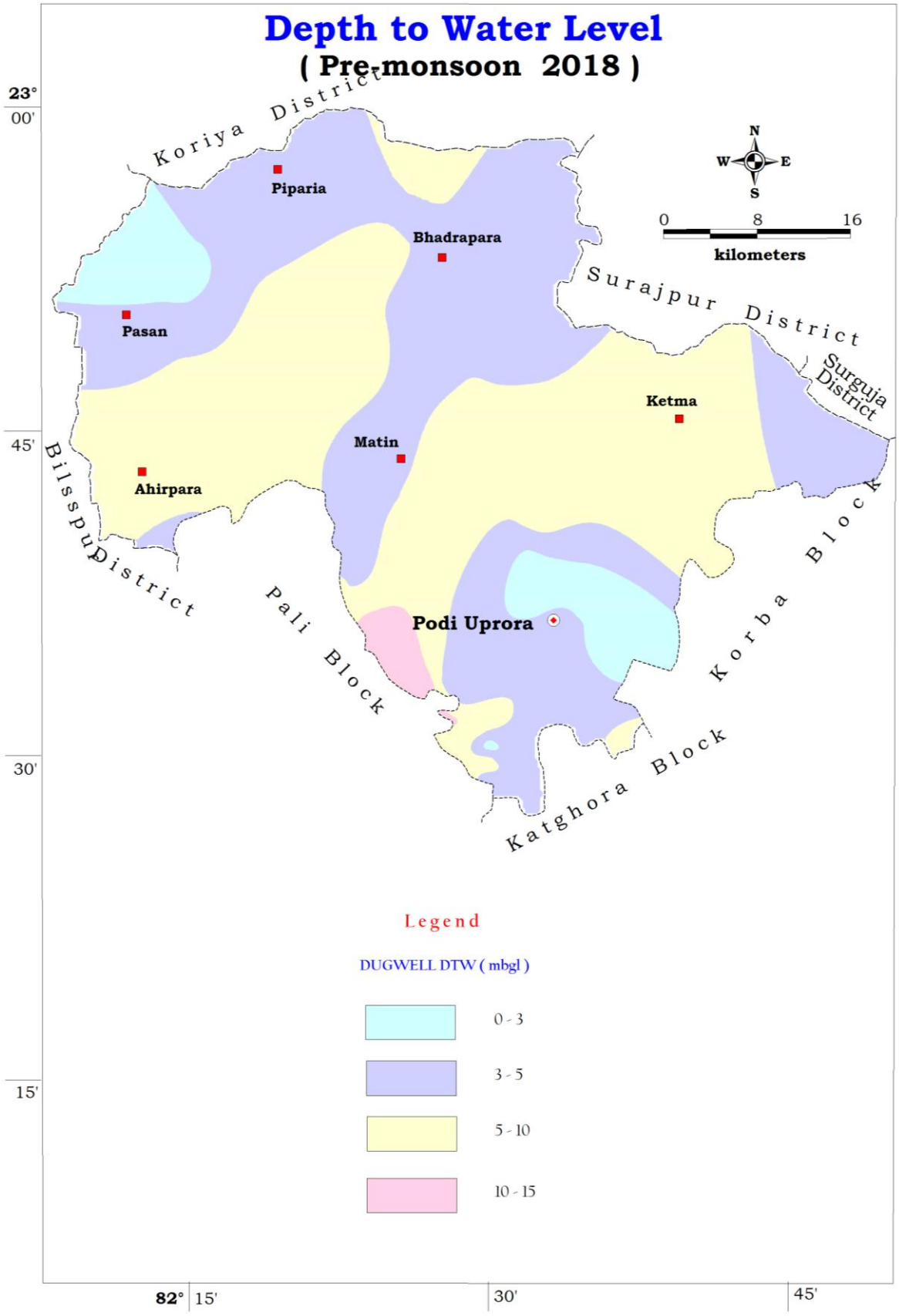


Figure 4 Depth to water level map Phreatic Aquifer (Pre-monsoon)

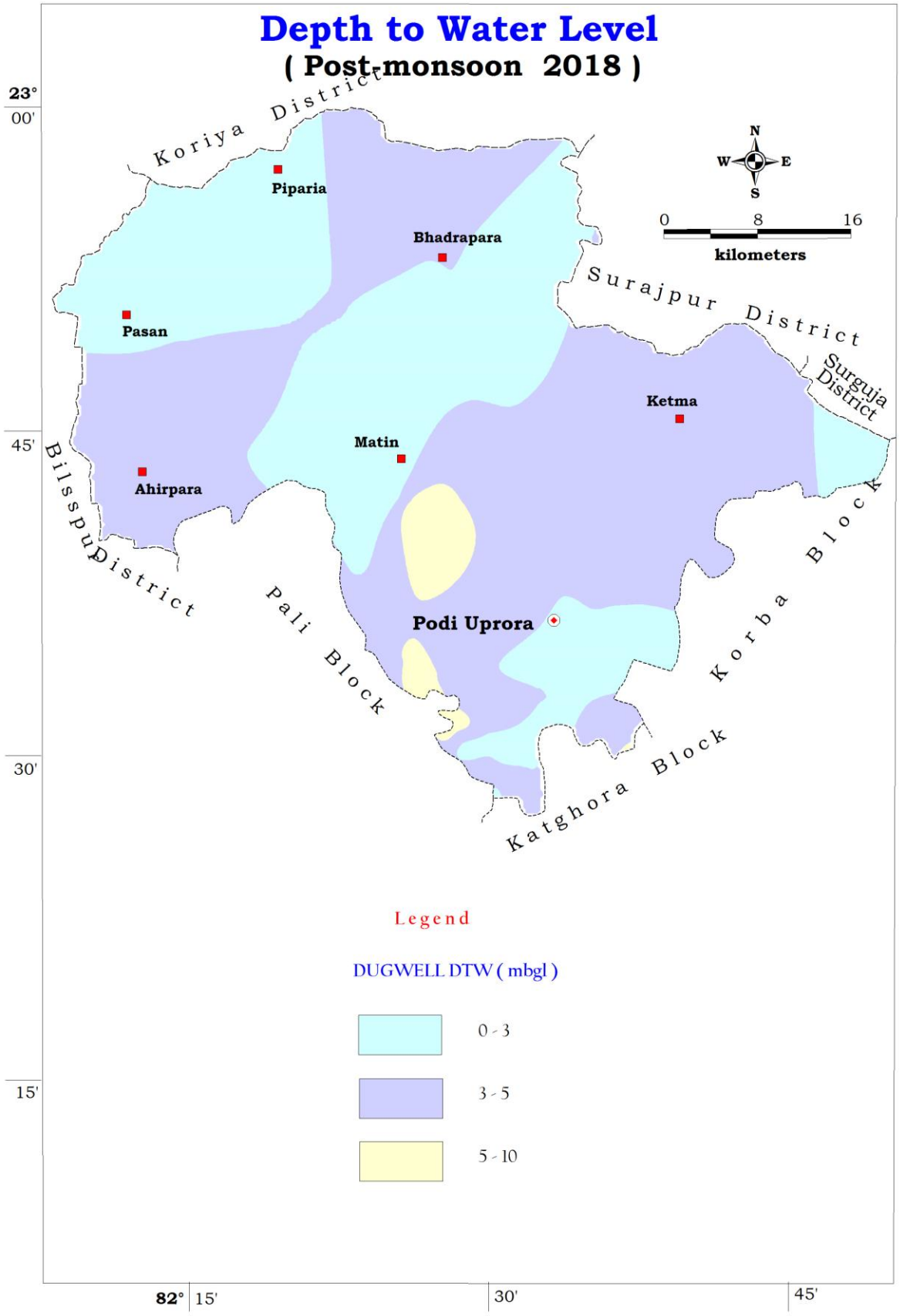


Figure 5 Depth to water level map Phreatic Aquifer (Post-monsoon)

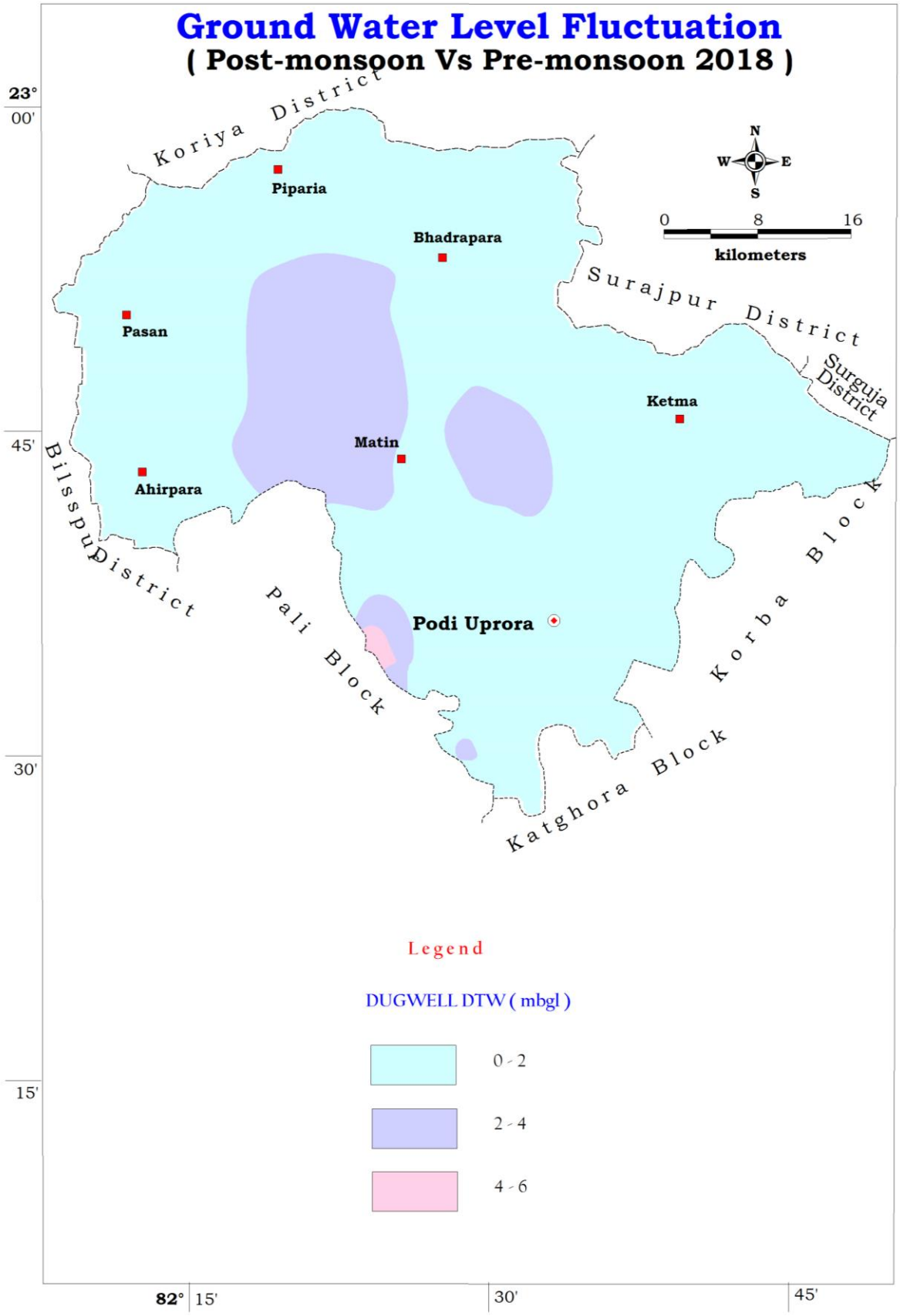


Figure 6 Depth to water level fluctuation map of Phreatic Aquifer

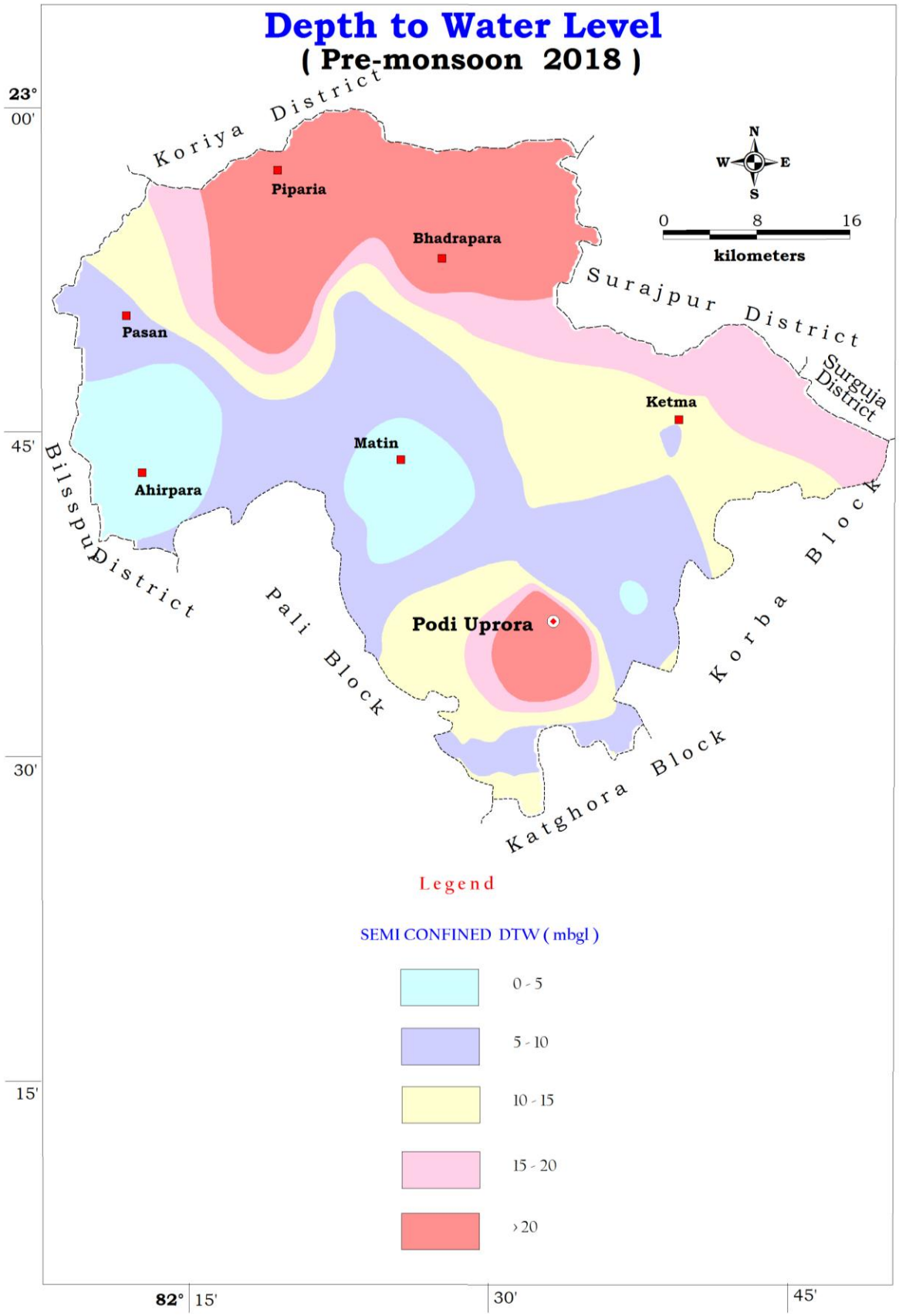


Figure 7 Depth to water level map Semiconfined Aquifer (Pre-monsoon)

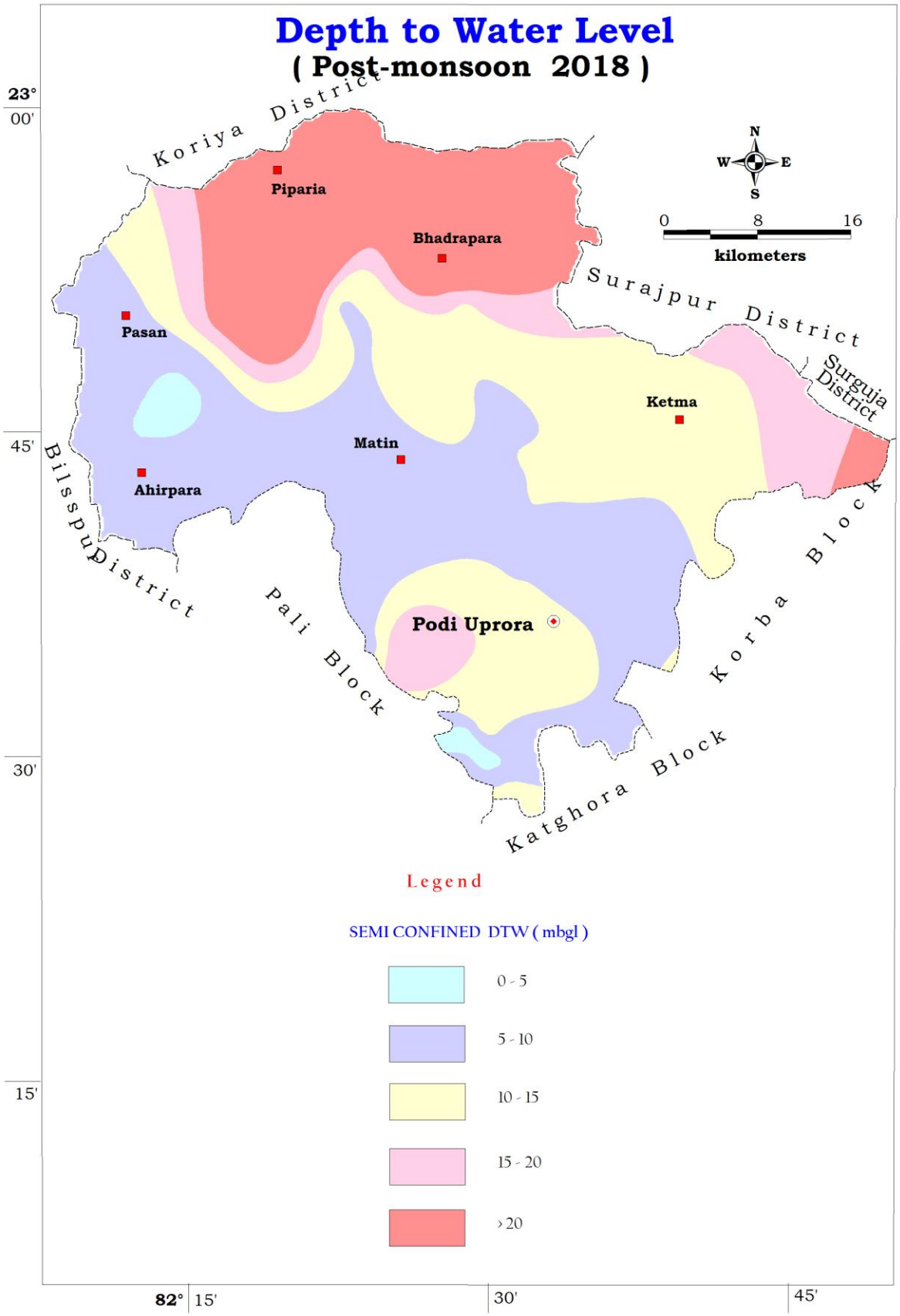


Figure 8 Depth to water level map Semiconfined Aquifer (Post-monsoon)

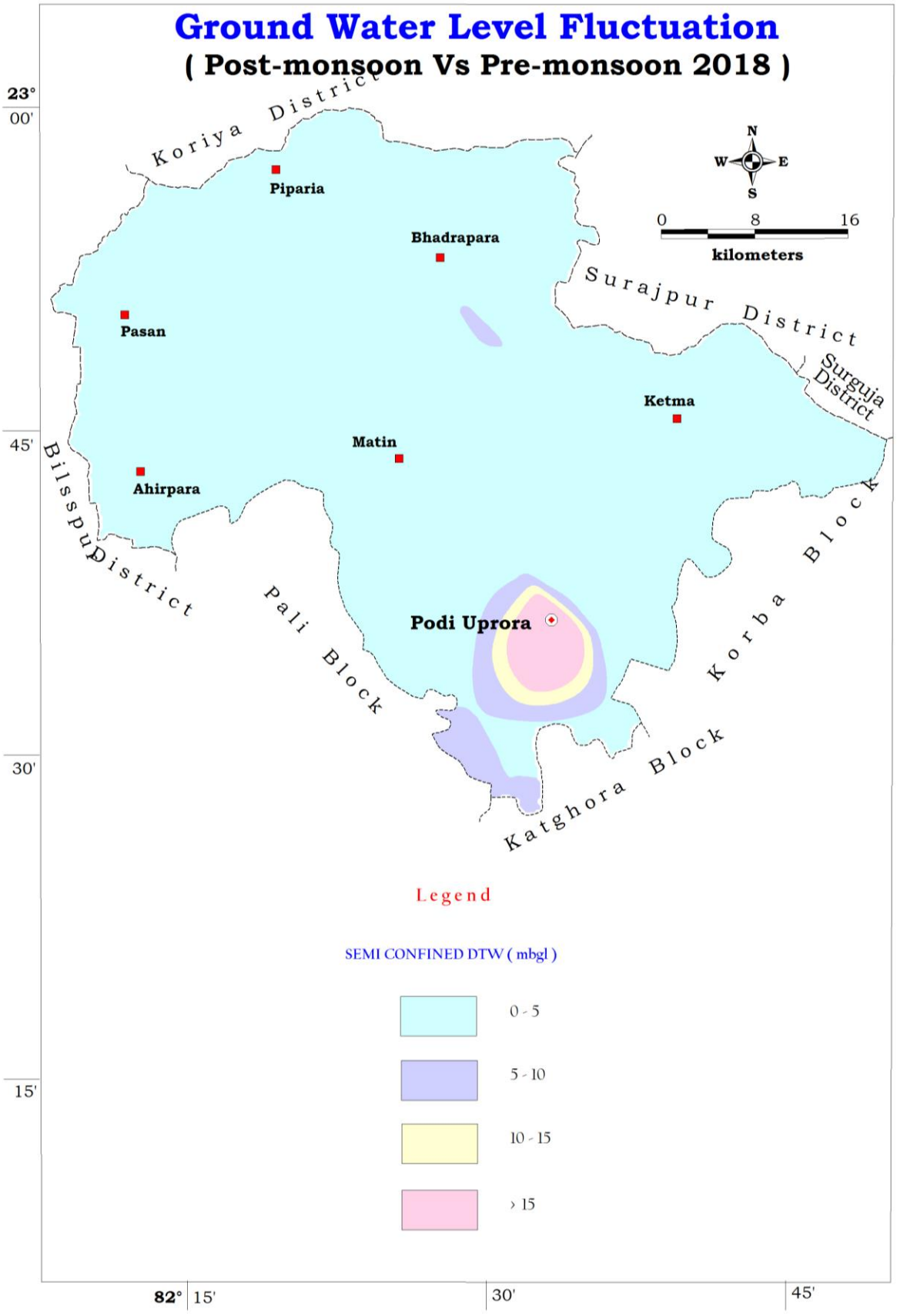


Figure 9 Depth to water level fluctuation map of Semiconfined Aquifer

(iv) <u>The long term water level trend</u>: There is no significant decline in water level in pre and post monsoon period in all observed NHS networks.

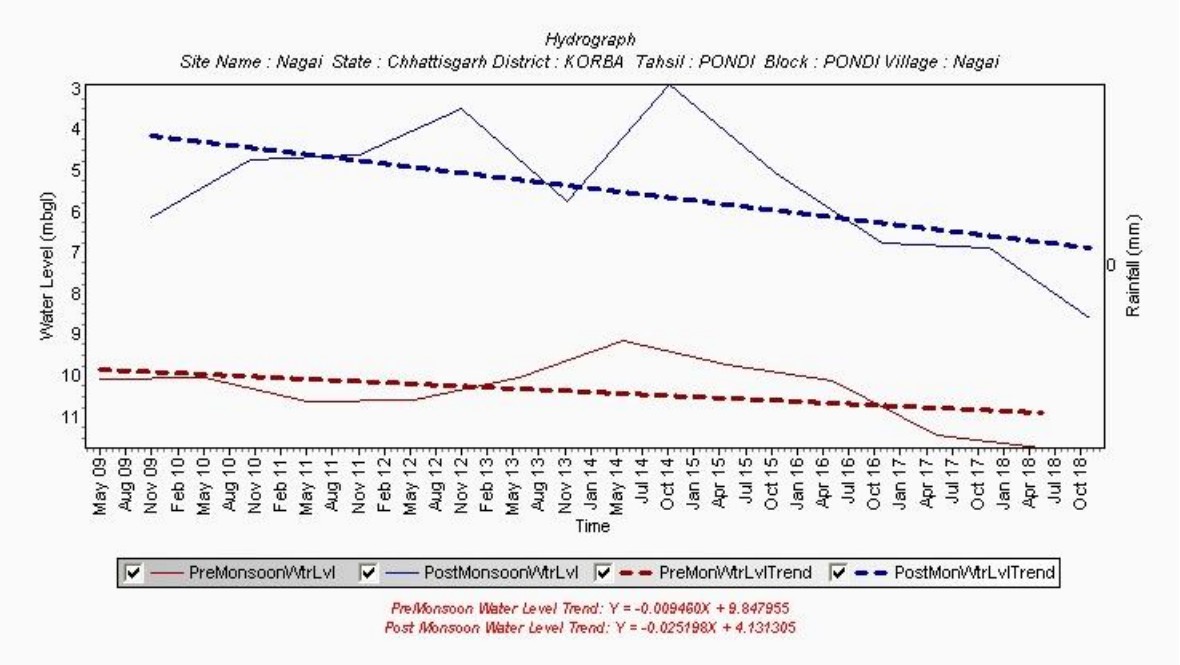


Figure 10 a: Hydrograph of Nagai village, Podi Uprora block

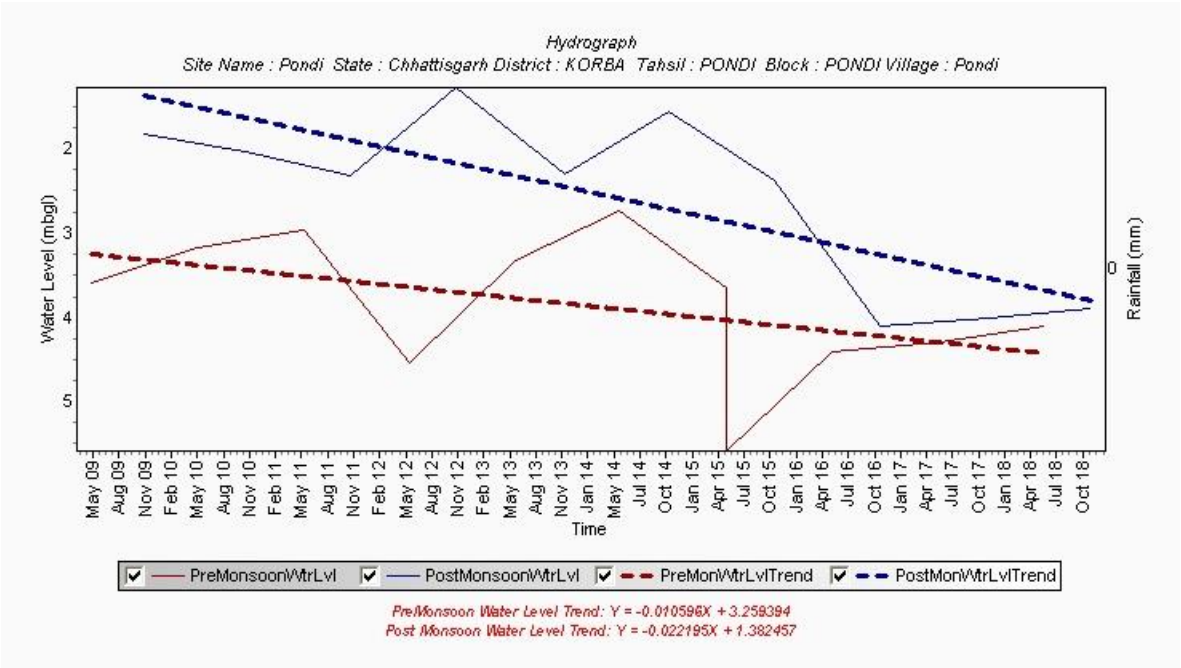


Figure 10 b: Hydrograph of Pondi, Podi Uprora block

2. Aquifer Disposition:

Number of Aquifers: There are two major aquifer system viz. Granite Aquifer system and Sandstone Aquifer system. Both the aquifer system have the shallow aquifer and deeper aquifer which occurs in phreatic and Semiconfined condition respectively. Although there are few patches of Laterite, Deccan basalt, unclassified metamorphic, biotite schist and other rocks.

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

Sandstone Aquifer System: The average thickness of the weathered portion in the area is around 18 m. In general, the discharge varies from negligible to 3.35 lps with an average yield of 1.71 lps. The average drawdown of the formation is around 20 m. rotary drilling technique is preferred in Barakar sandstone aquifer where well construction is required depending upon the water zone and formation encountered while in Talchir sandstone DTH drilling technique is more suitable. Water zone has been encountered up to 145 meter. Transmissivity range observed is 3.74 to 115.28 sq meter/day with average of 21.86 sqm /day.

Granite Aquifer System: The average thickness of the weathered portion in the area is around 18 m. In general, the discharge varies from negligible to 3.5 lps. The average drawdown of the formation is around 20 m. DTH drilling technique is preferred in Granite aquifer where well construction is required depending upon the thickness of weathered zone. Water zone has been encountered up to 100 meter in the block. Transmissivity range observed is upto 7.38 sq meter/day.

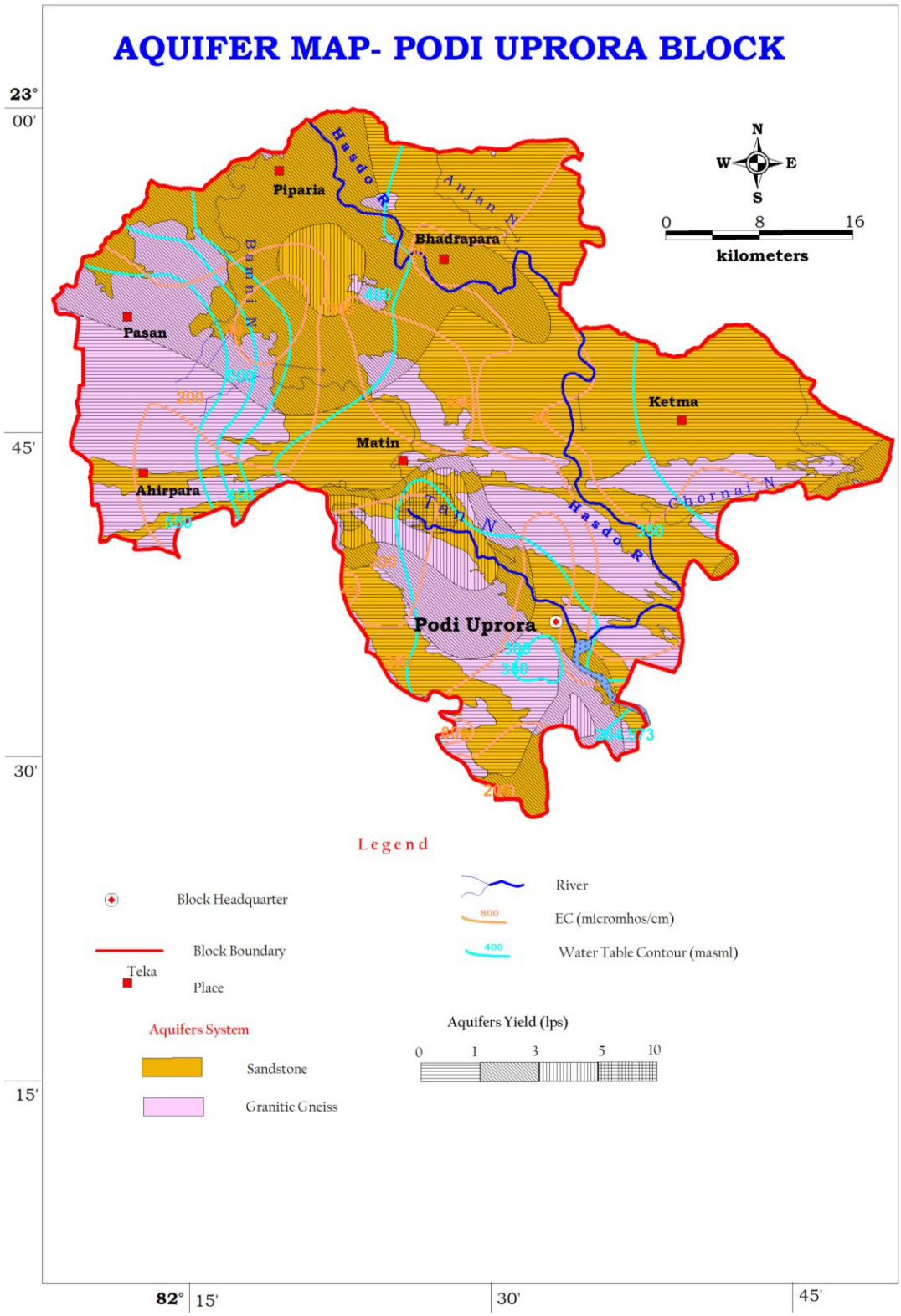
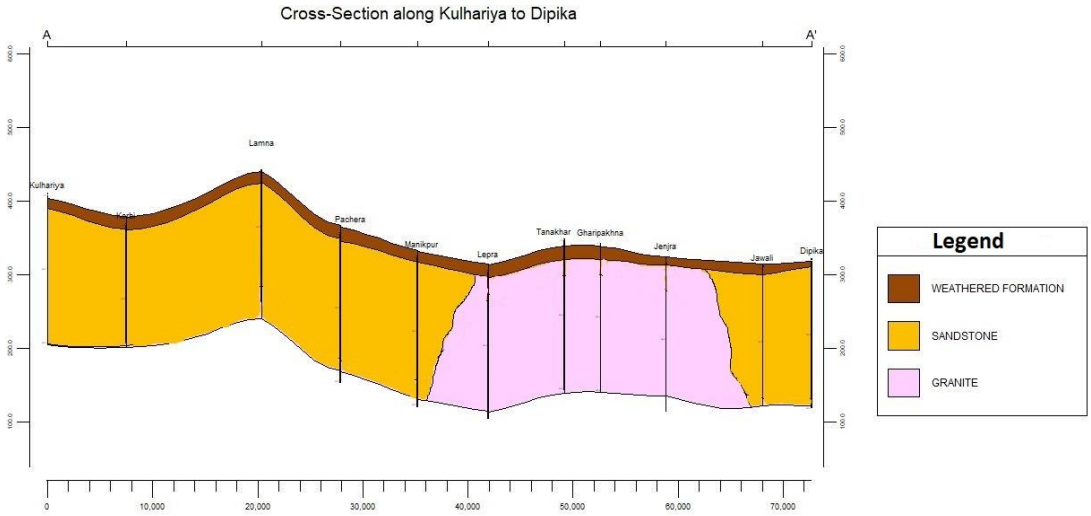
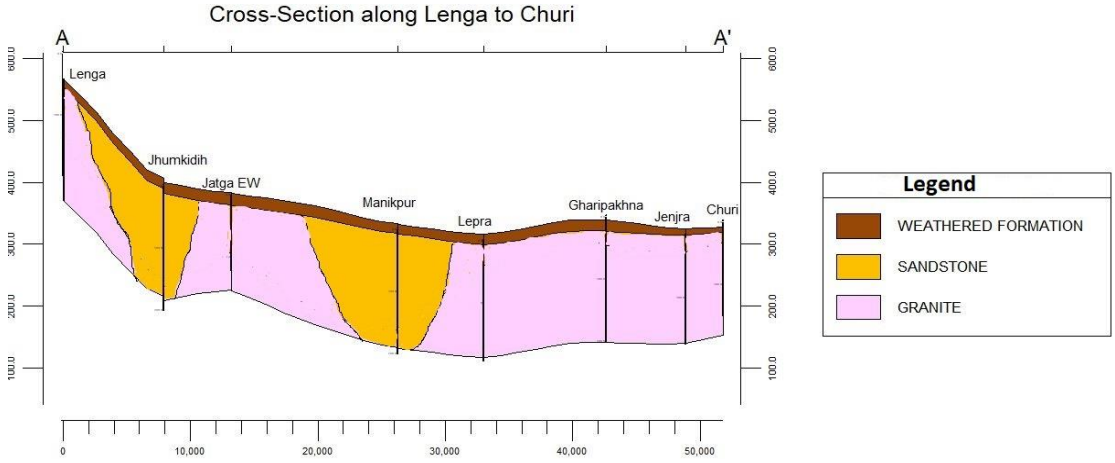
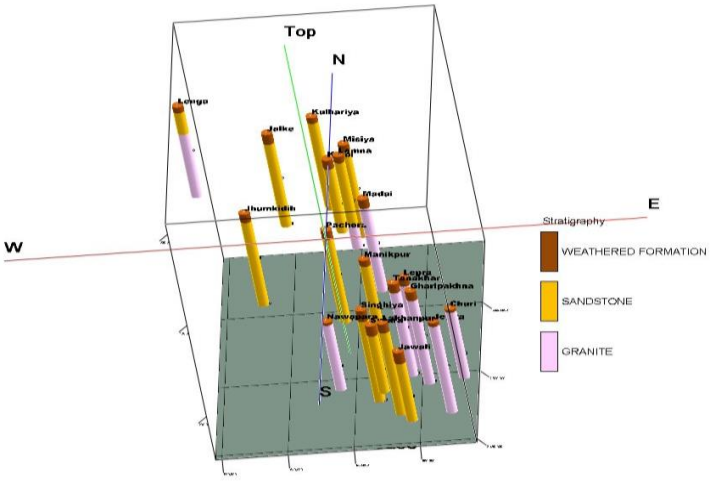


Figure 11: Aquifer map of Podi Uprora block







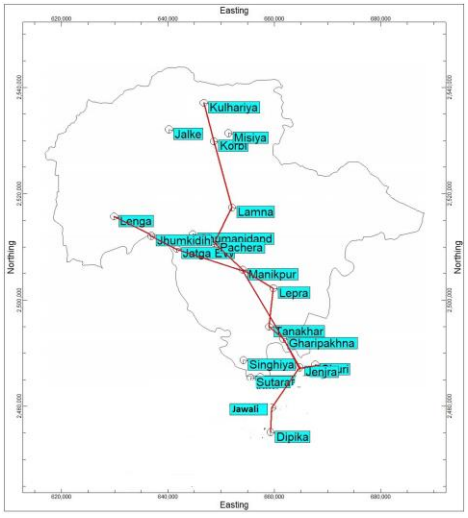


Figure-12, Disposition of Aquifer, Podi Uprora Block

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

Resource availability of Podi Uprora block is given in the table -4 where net ground water availability for future use is 7640.52 ham. The extraction details and the future scenario (2025) along with the categorisation is also depicted in the table-4.

Table 7 Categorization of Assessment Unit

District	Block	Stage of Ground water development (%)	Categorisation
Korba	Podi Uprora	22.45	Safe

Categorisation: Podi Uprora block falls in safe category. The stage of Ground water development is 22.45 %. The Annual Extractable Ground Water availability is 9938.19 ham. The Ground water draft for all uses is 2231.18 Ham. The Ground water resources for future uses for Korba Block is 7640.52 Ham.

Chemical Quality of Ground water and Contamination**:** Throughout the study area, the water samples from both dugwell and handpumps were collected and chemical analysis has been completed. (Annexure I). Floride value is above permissible limit in Bandhapara, Jhinpuri and Parla village.
Overall ground water of the study area is suitable for the drinking, agriculture and industrial purpose.

4. Ground Water Resource enhancement:

Aquifer wise space available for recharge and proposed interventions:

Table -8: Summarised detail of Volume of porous space available for recharge (Aquifer wise)

Aquifer	Area Identified for Artificial Recharge (Sq Km)	Sp. Yield for the formation	Volume of unsaturated space available for recharge (MCM)
Granite and sandstone	1240	0.002	2.935

5. Issues:

(i) 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.

(ii) High value of Fluoride and Iron has been reported from several locations (annexure I).

6. Management Plan

6.1 Supply side interventions:

(i) 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 dug borewells/ existing handpump of about 150-200 feet 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 aware people about the importance community participation in saving water.

(ii) 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 (Annexure I).

(iii) It has been observed that the demand of ground water is increasing for irrigation, industrial and domestic uses. At location near urban areas water level is declining, 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-9.

Table-9: Types of Artificial Recharge structures feasible

Name of Block	Area Feasible for recharge (sq.km)	Volume of Sub Surface Potential for Artificial recharge (MCM)	Types of Structures Feasible and their Numbers			
			Percolation tank	Check dam	RS	G
Podi Uprora	1240	2.935	10	32	58	88
	Recharge Capacity (MCM)		2	0.32	0.58	0.44

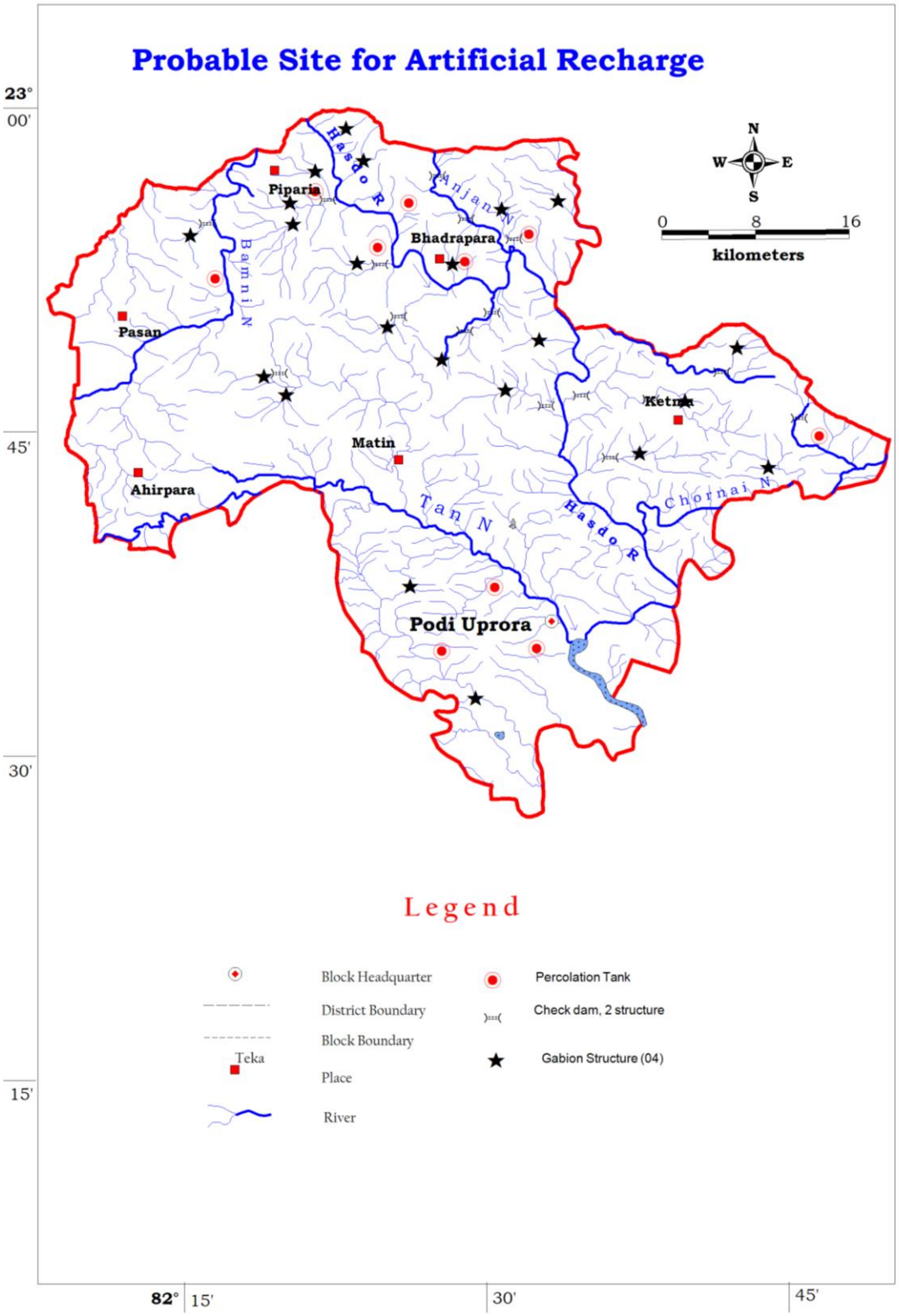


Figure 13 Map of proposed sites for artificial recharge of groundwater in Podi Uprora block

(iv) Fluoride and Iron filter plant may be installed in the villages having higher value of contaminants.

6.2 Demand Side Interventions

Since the stage of development in the block is 22.45 %. There is scope of utilizing more ground water for future irrigation purpose. Additional number of Ground water abstraction structure may be developed for the effective utilization of ground water resources in the block

Table 10: Potential of Additional GW abstraction structure creation

Net Groundwater availability (ham)	Stage of ground water Development (%)	Present ground water draft (HaM)	Ground water draft at 70% stage of development (ham)	Surplus ground water at present Stage of Development (ham)	Number of TW Recommended in each block (Assuming unit draft as 1.6 ham/structure/year)	Number of DW Recommended in each block (Assuming unit draft as 0.72 ham/structure/year)
9938.19	22.45	2231.18	6956.733	4725.553	1772	2625

7. Conclusion:

For effective utilization of Ground water existing draft for irrigation may be coupled with micro irrigation system. Change in irrigation pattern, optimum use of available resource, use of ground water potential created after artificial recharge can lead to groundwater savings and increase in gross cropped area of the block (Table: 11).

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

Block	Existing Gross Ground Water Draft for Irrigation in Ham	Additional Saving of GW after using Micro Irrigation methods in Ham	GW Potential created after Artificial recharge structure in Ham	Development by new GW abstraction structure	Additional GW irrigation Potential created in Ham	Additional Irrigation potential creation for Maize/ wheat in winter season in Ha (Assuming 500 mm water requirement)	Percent increase in Crop area compare to Gross cropped area
Podi Uprora	-	-	293.5	4725.55	5019.05	10038	23.01%

Annexure I Chemical Analysis of Ground water during NAQUIM study in Podi Uprora block

Sl No	Location	Source of Sample	pH	EC at 25°C (µS/cm)	CO3	HCO3	Cl	F	SO4	TH	Ca	Mg	Na	K	Si	PO4
					Concentration in mg/l											
1	Singhiya	dw	6.82	147	Nil	30.5	21.3	0.01	1.6949	35	8	3.6	13.4	3.2	10.97	0.002
2	Sirakikala	hp	7.36	750	Nil	189	92.3	1.12	53.814	170	48	12	109.8	1.4	13.67	0.011
3	Tanakhar	hp	7.37	652	Nil	268	42.6	0.66	30	255	78	14.4	20.6	1.8	18.98	0.079
4	Machadoli	hp	7.1	298	Nil	136	14.2	0.51	9.661	85	22	7.2	36.1	1.2	24.8	0.036
5	Bandhakhar	hp	7.02	791	Nil	299	71	0.41	30.593	270	72	21.6	59.1	0.6	13.98	0.022
6	Binjhara	hp	7.35	829	Nil	426	35.5	0.8	29.237	205	40	25	149	2.8	15.82	0.021
7	Tuman	hp	7.49	399	Nil	222	7.1	0.77	2.7119	110	30	8.4	43.3	9.3	16.17	0.0382
8	Khodri	hp	7.73	463	Nil	268	10.7	1.43	2.6271	140	46	6	58.4	2.3	33.42	0.001
9	Rawa	hp	7.43	182	Nil	97.6	10.7	0.88	2.1186	70	16	7.2	16.3	0.8	28.62	0.001
10	Pachera	hp	7.61	393	Nil	220	14.2	0.96	15.339	100	10	18	42.8	0.9	14.23	0.002
11	Bandhapara	hp	7.65	450	Nil	153	42.6	1.98	21.695	45	10	4.8	88	0.8	21.38	0.003
12	Amalikunda	hp	7.55	395	Nil	207	21.3	0.97	58.814	135	40	8.4	24.9	2.5	23.16	0.003
13	Semra	hp	7.58	434	Nil	189	24.9	0.82	8.7288	140	40	9.6	31.5	1.3	24.69	0.001
14	Pasan	hp	7.63	343	Nil	177	17.8	0.8	4.322	130	36	9.6	21.8	1	25.05	0.009
15	Podi Kalan	hp	7.35	548	Nil	281	14.2	0.47	16.271	175	48	13.2	53.7	0.9	12.55	0.003
16	Gursia	hp	7.24	568	Nil	267	14.5	0.74	18.373	100	30	6	105.8	0.5	9.745	0
17	Madai	hp	7.42	539	Nil	238	39.1	1.07	22.288	190	40	21.6	47.2	2.3	18.37	0.054
18	Buka	hp	7.53	441	Nil	238	17.8	0.47	16.102	200	44	21.6	22.6	0.3	34.03	0.001
19	Chotia Mode	hp	7.5	802	Nil	281	74.6	1.2	36.864	270	68	24	52.7	5.5	13.98	0.003
20	Lad	hp	7.53	468	Nil	221	14.2	0.63	6.4407	120	36	7.2	55.2	1.4	11.33	0.002
21	Tanera	hp	7.23	606	Nil	256	49.7	1.14	14.831	320	48	48	54.1	1.7	11.02	0.002
22	Bijadand	hp	6.9	122	Nil	48.8	17.7	0.47	1.3559	55	12	6	2.6	4.5	9.745	0.005
23	Jhinpuri	hp	7.86	317	Nil	73.2	32	2.11	25.254	20	4	2.4	90.2	0.3	10	0.002
24	karmipara	hp	7.54	566	Nil	153	42.6	1.21	66.525	50	14	3.6	148.4	1.1	7.449	0.005
25	Morga	hp	6.65	151	Nil	18.3	17.8	0.47	2.1186	45	8	6	6.3	9.9	11.84	0
26	Madanpur	hp	6.81	112	Nil	36.6	10.7	0.19	0.8475	50	10	6	2.5	4.2	14.8	0.001
27	Kendai	hp	6.78	98	Nil	24	7	0.27	18.898	30	6	3.6	4.3	7.1	5.612	0.027
28	Parla	hp	7.28	227	Nil	54.9	14.2	1.6	5.2712	85	20	8.4	6.1	7	6.429	0.029
29	Suttara	hp	7.55	398	Nil	128	42.6	0.53	6.5254	130	36	9.6	18.4	7.2	13.72	0.002