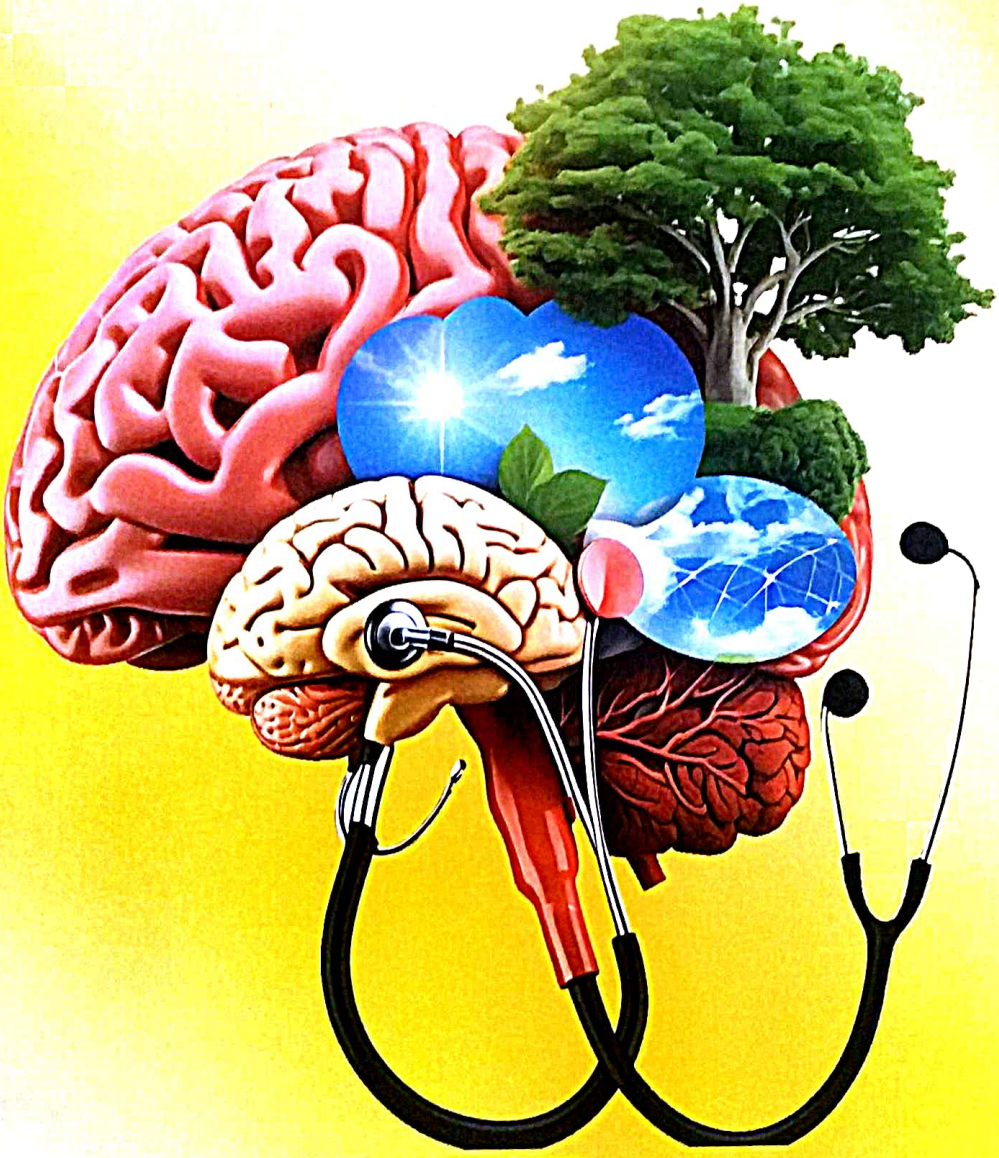
पर्यावरण और मानव स्वास्थ्य

वैश्विक मुद्दे, चुनौतियाँ और रणनीतियाँ

Environment and Human Health

Global Issues, Challenges and Strategies

Dr. Dinesh Kumar



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2024

Siddhi Vinayak Publications

प्रकाशक

SIDDHI VINAYAK

सिद्धि विनायक पब्लिकेशन्स

कुलरान, हनुमानगढ़ (राजस्थान) 335526

94621-09470, 83063-09470

publicationssiddhivinayak@gmail.com

ISBN : 978-81-965118-6-9

प्रथम संस्करण (2024)

मूल्य : ₹ 1225.00

शब्द संयोजक एवं डिजाइन : कमल जीत सिंह (तकनीकी सहायक)

मुद्रक : Kavi Technosolutions

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1

Groundwater Resources Assessment : Use and Conservation

(A Study of Surguja District, Chhattisgarh State)

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Introduction

Groundwater is a vital water supply for humanity. Groundwater provides drinking water entirely or in part for as much as 50% of the global population and accounts for 43% of all of water used for irrigation. Worldwide, 2.5 billion people depend solely on groundwater resources to satisfy their basic daily water needs. The Earth's population of nearly 8 billion in 2020 is expected to reach 11 billion by 2100. Humans will have to learn to produce sufficient food without destroying the soil, water and climate. This has been called the greatest challenge humanity has faced. Sustainable management of groundwater is at the heart of the solution. Scientific understanding and proper management of groundwater is essential, because groundwater can alleviate the problem if we seek its responsible use and replenishment. The groundwater is the most valuable resource for the country. However, due to rapid and uneven development, this resource has come under stress in several parts of the country.

Key words- Groundwater, Geomorphology, Aquifer, Post Monsoon, Artificial Recharge.

ISBN : 978-81-965118-6-9

Table 1: Water resources in India

Parameter	Unit (Billion Cubic Meter/Year)
Annual water availability	1,869
Usable water	1,123
Surface water	690
Ground water	433

Sources: Water and Related Statistics, April 2015, Central Water Commission; PRS.

The water resource potential or annual water availability i India terms of natural runoff (flow) in rivers is about 1,869 Billio Cubic Meter (BCM)/year. However, the usable water resources of th country have been estimated as 1,123 BCM/year. This is due t constraints of topography and uneven distribution of the resource i various river basins, which makes it difficult to extract the entir available 1,869 BCM/year.

Study Area

Geographically, the latitudinal location of Surguja District between 22°37'36" to 23°16'33" North and the longitudinal extension between 82°45'27" to 83°41'51" East. Surguja district is situated in th northern part of the Chhattisgarh state and surrounded by Surajpur ar Balrampur districts in the north, Koriya district in the west, Korba ar Raigarh districts in the south and Jashpur district in the east. The distri has a well-developed road network and district headquarter Ambikapur connected to rail network. The total population of the study area as p 2011 Census is 8,40,352 out of which rural population is 7,03,650 & th urban population is only 1,36,702.The study area experiences sul tropical climate. The average annual rainfall for the study area is arour 998 mm (Average of the last five years i.e. 2013 to 201 Geomorphologically the study area displays Structural Plains, Pediplai Denudational Hills and Valleys with an elevation ranging from 440 t 1116 above mean sea level. The net sown area is 1,55,004 hectares, whil double-cropped area is 20,832 hectares. Rice is sown in nearly 75% o the net sown area. Percentage of Area Irrigated by ground water wit respect to net irrigated area is 33.75%. About 90% area with respect t

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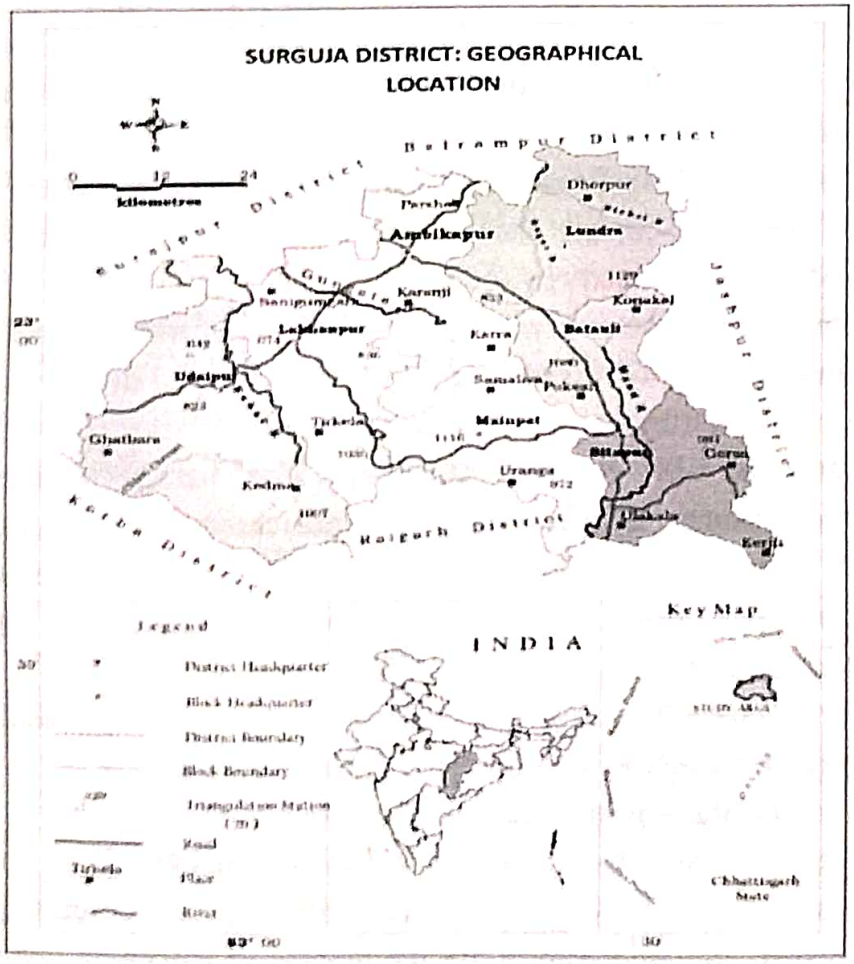
net sown area is dependent on rain only. Surguja district has 568 villages and for administrative convenience these villages are grouped into 7 of development blocks. Ambikakur is the districts headquarter. The block headquarters are at Ambikapur, Lakhanpur Udaipur, Lundra, Sitapur, Batauli and Mainpat.

Aim of the Study

The present study aims to analyze the possibilities of availability of underground water in Surguja district located in the northern plateau region of Chhattisgarh state. Underground water is an indicator of socio-economic development of any area. The foundation of economic activities is laid on its availability The demand for ground water for various types of use is increasing day by day; consequently,



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indiscriminate development of ground water has taken place and th ground water resource has come under stress in several parts of th country. On the other hand, there are also areas where adequa development of ground water resources has not taken place. These fac underscore the need for micro- level study of the aquifer systems of th country. The water resource managers and planners to develop an implement effective long term as well as short term aquifer manageme strategies, a host of scientific questions must be answered.

Factors Affecting Groundwater Availability

1- **Over-extraction of Groundwater for Irrigation:** Irrigation accounts for around **80% of total water use in India,** and much of this water is sourced from groundwater.
2- As **demand for food continues to grow,** more and more groundwater is being extracted for irrigation, leading to depletion.
3- **Climate change:** Rising temperatures and changing precipitation patterns **can alter the recharge rates of** groundwater aquifers, making them more vulnerable to depletion.
4- **Draughts, flash floods, and** disrupted monsoon events are recent examples of climate change events that are placing pressure on India's groundwater resources.
5- **Poor Water Management:** Inefficient use of **water, leaky pipes, and inadequate infrastructure** for capturing and storing rainwater can all contribute to groundwater depletion.
6- **Decrease in Natural Recharge:** The natural recharge of groundwater aquifers can be decreased by factors such as **deforestation**, which can lead to **soil erosion and reduce the amount of water** that is able to seep into the ground and replenish the aquifers.

The Following are the factors affecting the availability o underground water in the study area Surguja District.

(I) Rainfall-spatial, temporal and secular distribution

The Surguja district receives rainfall mainly from south-wes monsoon. About 87% of the annual rainfall is received during June t September, July and August are the months of maximum precipitation some rainfall is received in June, mostly in the form of thunder shower

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and during the cold season in association with passing western disturbances. There are on an average 73 rainy days in a year in the District. The average annual rainfall for the Surguja district is around 998.6 mm (Average of the last five years i.e. 2013 to 2017)

(II) Physiography/Geomorphology

Physiographically the district is divided in three parts are Mountains (high lands), Plateaus and Hills (uplands) and Central plain. Surguja district displays structural plains in western part covering Udaipur, Lakhanpur and Ambikapur blocks. Mainpat and adjoining areas of Udaipur, Lakhanpur and Ambikapur blocks is region of Plateau. Lundra block and adjoining area with Ambikapur block and Batauli block represents denudational plateau. Eastern part of Lundra blocks represent denudational hills and valleys. Sitapur block along with adjoining blocks represent pediments. The elevation of this region ranges from 440 to 1116 meters.

(III) **Land Use**

The changes in Land use have mostly occurred locally, regionally and globally over the last few decades and will carry on in the future as well. The increase in imperviousness has a major impact on groundwater and is of major concern over the past years to those who are involved in groundwater studies. The increase in urbanization results in reduction in infiltration, which affects the groundwater recharge and storage. There is 144015.3 ha is forest area in the district. Area not available for cultivation is 25267 ha.

Table 2: Surguja District Land Use Pattern (Ha)

Total geographical area	ForestArea	Area not available for cultivation	Non agricultural& Fallow land	Agricultural Fallow land	Net sownarea	Double croppedarea	Gross croppedarea
519119	144015.3	25267	72266	30908	155004	20832	175836

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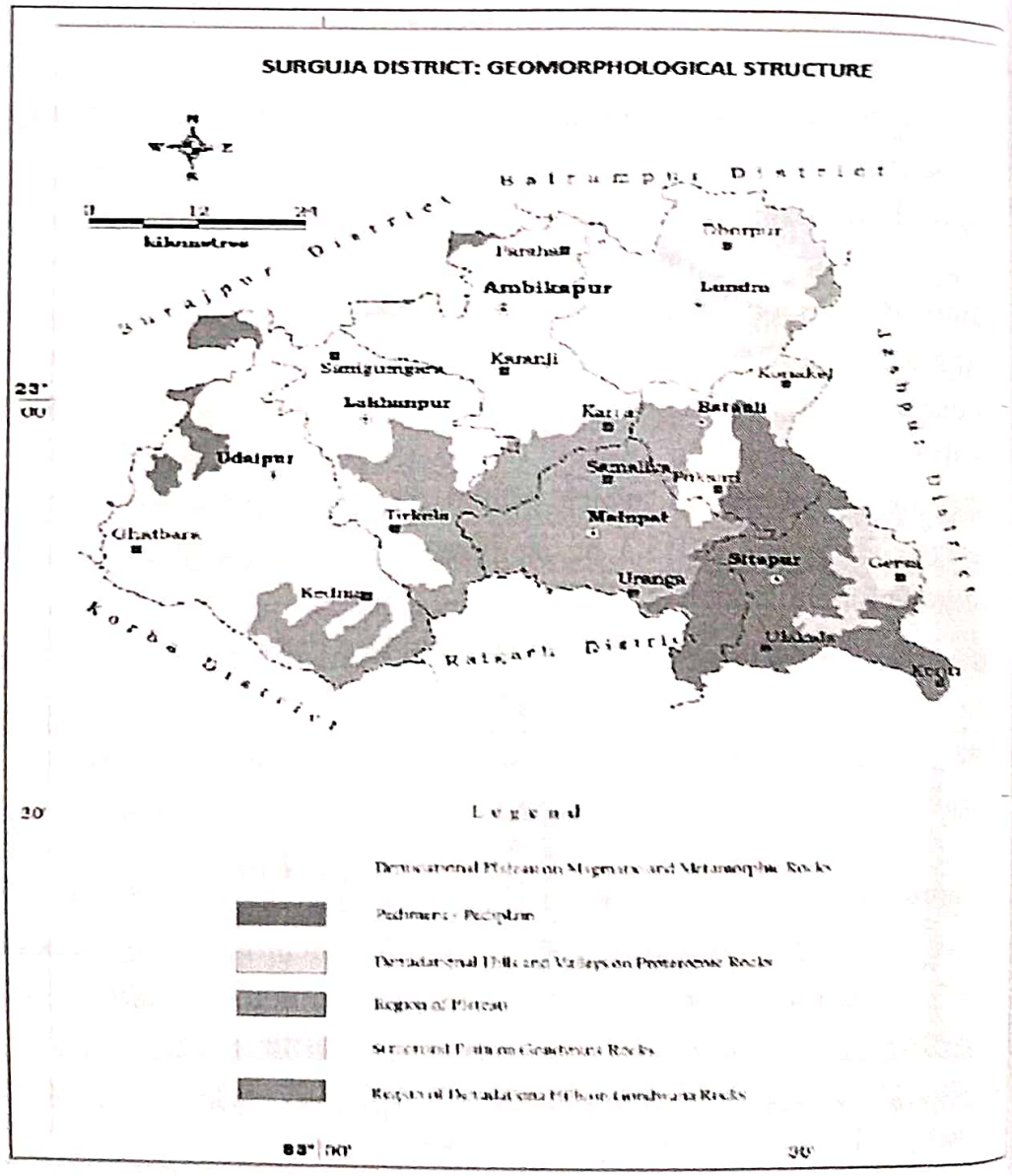
(IV) Soil

The soils in the district are having wide variations. About 33% of the district area, is covered by Alfisols- red sandy soil, covering main Udaipur block, northern part of Ambikapur block and eastern part of Sitapur and Batauli block. About 42% area of the district covering part of Lakhanpur, Sitapur, Batauli and Ambikapur blocks covered by Ultisol red and yellow soils. About 19 % of district area i.e. Mainpat block and adjoining area of Lakhanpur block have the Ultisols in the form of laterites. The remaining part of the district is represented by light grey and shallow black inceptisols.



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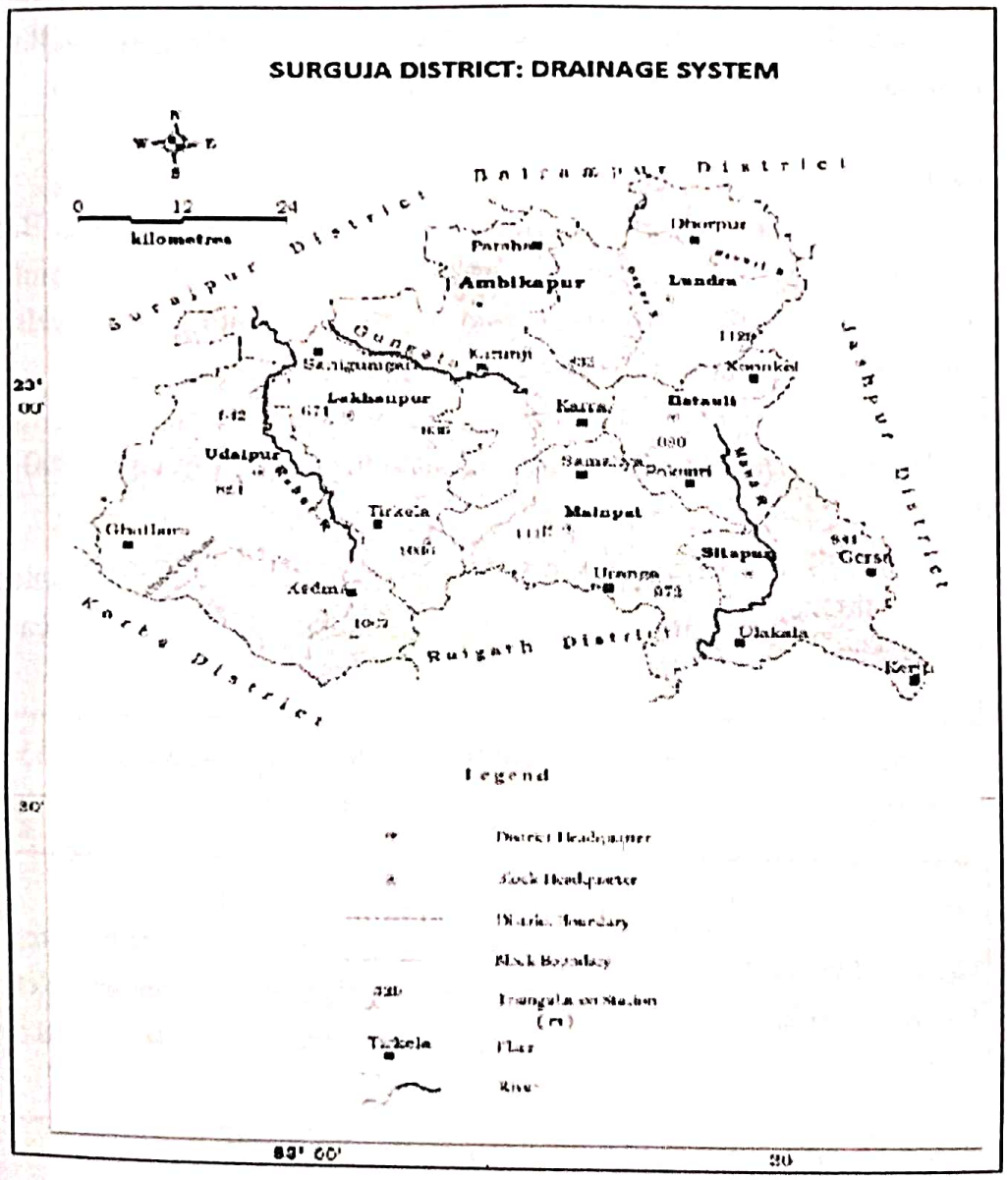
(V) Hydrology and Drainage

Surguja district forms a part of Mahanadi basin with rivers viz. Hasdeo, Gej, Chornai and Mand as well as Ganga basin with rivers viz Mahan, gagar and Bichri. The Ganga basin covers 65 % of the area however the remaining area is drained by the Mahanadi basin. The drainage pattern in the District is dendritic to sub-dendritic and the drainage density is high in central and southern parts.



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(VI) Geology and Hydrogeology

The district is underlain mainly by three distinct geologi formations ranging in age from Achaean to recent. The crystall basement, occupy eastern parts of the district, comprising of granite a granitic gneiss rocks belonging to Chhota Nagpur group, severa intruded by the quartz veins and basic dykes. Western part of the distı mainly Udaipur block and part of Lakhanpur and Ambikapur block the district is occupied by the rocks of Gondwana Super Group a represented by the sandstone, shale and coal seam. In Mainpat area th is exposure of Deccan trap.

(VII) Irrigation

Agriculture is practiced in the area during Kharif and Ra season every year. During the Kharif, cultivation is done through rainf while during the Rabi season, it is done through ground wateras well partly through surface water like canals and other sources.

Table 3 : Surguja District- Area irrigated by various sources (in ha)

No. of canal s (privateand Govt.)	Irrigated area	No.of bore wells/ Tube wells	Irrigated area	No. Of dug wells	Irrigate area
52	7006	3409	922	11256	4885

No. of Talabs	Irrigated area	Irrigated area by other sources	Net Irrigated area	Gross irrigated area	% of irrigated area wrt. Net sownarea
779	417	9009	17203	19521	9.84

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Table 4 : Surguja District -Statistics showing Agricultural and Irrigated

Net Irrigated Area	Net Irrigated Area by ground water	Percentage of Area Irrigated by ground water wrt. net irrigated area
17203	5807	33.75

Water Level Behavior

(i) **Pre monsoon Water Levels:-** Water Levels in Phreatic aquifer in Granite and Granite gneiss is varies from 3.30 to 16.60 m below ground level with average of 7.06 m bgl whereas in deeper fracture aquifer it varies from 6.60 to 22.25 mbgl with average 14.16 mbgl. In Sandstone (Gondwana) formation, Water Levels in Phreatic aquifer varies from 3.50 to 13.91 mbgl with average of 7.34 mbgl whereas in deeper fracture aquifer it varies from 8.40 to 28.50 mbgl with average 15.64 m.

(ii) **Post Monsoon Water Levels:-** Water Levels in Phreatic aquifer in Granite and Granite gneiss is varies from 1.0 to 10.40 m below ground level with average of 3.84 Metre below Ground Level (mbgl) whereas in deeper fracture aquifer it varies from 0.65 to 16.15 mbgl with average of 7.85 m bgl. In Sandstone (Gondwana) formation, Water Levels in Phreatic aquifer varies from 1.06 to 7.00 (mbgl) with average 3.80 mbgl where as in deeper fracture aquifer it varies from 3.83 to 20.50 mbgl with average 9.22 m.

(iii) **Seasonal water level fluctuation:-** The water level fluctuation data indicates that in study area, water level fluctuation in phreatic aquifer in Granite and Granite gneiss varies from 0.50 to 13.95 m with an average fluctuation of 3.22 m whereas in sandstone varies from 0.70 to 9.73 m with an average fluctuation of 3.54 m. Water level fluctuation in semiconfined Aquifer in Granite and Granite gneiss varies from 0.91 to 10.80 m with an average fluctuation of 6.31 m whereas in Sandstone varies from 1.75 to 9.30 m with an average fluctuation of 6.43 m.The long term water level trend indicates that there is decline in pre-monsoon water level in Ambikapur block, in

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urban area there is significant decline in water level. In other parts the Surguja district there is no significant decline in water level.

GROUND WATER RESOURCES

Table 5 : Surguja District :Ground Water Resources (in Hec. meter

Block District	Dynamic resource Unconfined Aquifer (Hectare meter)	Dynamic Ground Water Resource Confined Aquifer (Hectare meter)	Total Static Resources Unconfined Aquifer(Hectare meter)	Total Resource(Hectare meter)	Stage of Ground Water Extraction(%)	Categorization
Ambikapur	8366.71	106.48	12459.84	20933.03	54.14	Safe
Batauli	4225.96	79.40	7479.41	11784.77	37.38	Safe
Lakhanpur	5740.90	99.21	14394.82	20234.93	39.96	Safe
Lundra	6431.33	118.48	13739.93	20289.74	32.58	Safe
Mainpot	2695.48	112.64	12326.67	15134.79	27.01	Safe
Sitapur	4103.25	70.60	9301.38	13475.23	31.22	Safe
Udaipur	9973.73	187.14	25739.59	35900.46	17.16	Safe
Total (District)	41537.36	773.94	95441.64	137752.94	34.23	Safe

Existing and Future Water Demand (Year-2035)

The existing demand for irrigation in the area is 12120 Hect meter while for domestic demand is 2093.60 Hectare meter. To meet future demand for ground water, a total quantity of 27047.90 Hect meter of ground water is available for future use.

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Table 6 : Surguja district: Ground Water Existing and Future Water Demand (2035)

Block/District	Annual Extractable Ground Water Recharge (Ham)	Current Annual Ground Water Extraction (Ham)				AnnualGround Water Allocationfor Domestic Use as on 2035	Net Ground Water Availability for future use
		IrrigationUse	IndustrialUse	DomesticUse	Total Extraction		
Ambikapur	8366.71	3793.42	2.95	733.05	4529.42	834.77	3735.57
Batauli	4225.96	1410.50	0.00	168.97	1579.47	189.14	2626.32
Lakhanpur	5740.90	1999.66	1.82	292.44	2293.92	331.89	3407.53
Lundra	6431.33	1804.00	0.00	291.11	2095.11	329.42	4297.91
Mainpot	2695.48	543.67	0.00	184.27	727.94	206.38	1945.43
Sitapur	4103.25	1049.90	0.00	231.08	1280.98	253.93	2799.42
Udaipur	9973.73	1518.90	0.00	192.68	1711.58	219.11	8235.72
Total (Dist)	41537.36	12120.05	4.78	2093.60	14218.42	2364.64	27047.90

Groundwater related Issues

During summer, dug wells in some villages becomes dry at many locations. several hand pumps also stop yielding water. The aquifer itself is a low yielding one. In Granite aquifer system potential zone for ground water is related with occurrence of fracture, so drilling a high

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yield well is always a challenge. Proper scientific study coupled w geophysical investigation may minimize the failure of well.

Problems in Tube well / Bore well construction in Sandsto Aquifer System

In case of filter point wells drilled with hand bores, the depth penetration is variable and whenever the Shale or any other comp layers are encountered, further drilling becomes difficult. When portal rotary rigs are deployed for drilling, the drilling operations become ve slow and the pore spaces in fine grained layers are invaded by drilli fluid as a result the discharges tend to be poor. Proper well developme is seldom carried out by private drillers and as a result fine sands g deposited in the bore. Sometimescaving of wells are commonly repor particularly when the top loss sand is cased and the bottom shale's a drilled with down the hole hammer rig.

Problems in ring well construction Sandstone Aquifer System

The common problem is sand filling inside the rings during ar after the lowering of rings, thereby practically eliminating the change deepening of wells to tap more saturated column in summer months. Th weep holes provided in the rings allow water with fine sands and ge filled up as and when sand removal is in progress thereby making difficult for lowering of rings is highly saturated sands. High value Fluoride and Iron has been reported from several locations.

Management Strategy

(i) It has been observed during fieldwork, there is colossal wastage of groundwater through private well and public water supply system. So, Information, Education and Communication (IEC) activities need to beorganized to sensitize people on the issues of depleting groundwater resource. Massive awareness campaigns are essential to aware people about the importance of community participation in saving water.

(ii) Desiltation of existing Tanks and Talabs to be carried out fo efficient storage of rainwater. Also Rain water harvesting structure may be constructed in villages to reduce stress on groundwater.

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(iii) It has been observed that the demand of ground water is increasing for irrigation, industrial and domestic uses. At locations where water level is declining, 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 Probable sites are also identified for the construction of Artificial Recharge structure such as percolation tank, Nala bunding/ cement plug/ check dam, Gully Plugs/ gabion structures in district as shown in

Table-7

Block/District	Area Feasiblefor recharge (sq.km)	Volume of Sub Surface Potentialfor Artificial recharge (Million Cubic Meter)	Types of Structures Feasible and their Numbers			
			Percolation tank	Nalas bunding/cement plug/ check dam	Gravity head /Dug well/ tube well/Rechargeshaft	Gully plugs/ Gabion structures
Recharge Capacity – (Million Cubic Meter) structure			0.2192	0.0326	0.00816	0.0073
Ambikapur	109.30	6.518	19	28	121	62
Batouli	34.11	1.924	4	14	33	44
Lakhanpur	204.02	7.200	20	30	159	74
Lundra	215.17	7.325	21	26	176	60
Mainpat	113.32	5.897	16	26	130	66
Sitapur	57.54	2.195	5	14	43	40
Udaipur	352.35	8.087	21	43	171	94
Surguja District (Total)	1085.81	39.145	106	181	833	440

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Ground water Conservation

1- **National Water Policy (2012)** has been formulated which advocates rainwater harvesting and conservation of water and highlights the need for augmenting the availability of water through direct use of rainfall. It also advocates conservation of river, river bodies and infrastructure should be undertaken in a scientifically planned manner through community participation.

2- **Water Conservation:** In the urban areas (where groundwater is five-six meters below the surface), it is possible to reduce groundwater depletion by creating green corridors, mapping channels for potential recharge zones to store floodwater, and creating artificial groundwater recharge structures. The use of dysfunctional bore wells for recharging groundwater with clean rainwater will also be a good option.

3- **Regulation of Ground Water Extraction:** Implementing regulations to control the extraction of groundwater can help to ensure that it is not being over-exploited. The requirement for a Water Impact Assessment should be made mandatory for all industries, in addition to introducing a "Blue Certification" program which rates industries according to the amount of water they recharge and reuse.

4- **Promoting the Use of Alternative Sources of Water:** Encouraging the use of alternative sources of water, such as treated wastewater, can help to reduce the demand for groundwater. Developing a dual sewage system for grey water and black water, as well as promoting the reuse of recycled water in agriculture and horticulture, should be promoted.

5- **Water Education and Awareness:** Raising awareness about the importance of conserving water and the need to prevent groundwater depletion can help to encourage individuals and communities to adopt sustainable water use practices.

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