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Hydrogeo chemistry and fluoride delineation of Southern periphery of Morel Basin in part of Jaipur Distt., Rajasthan,Indi

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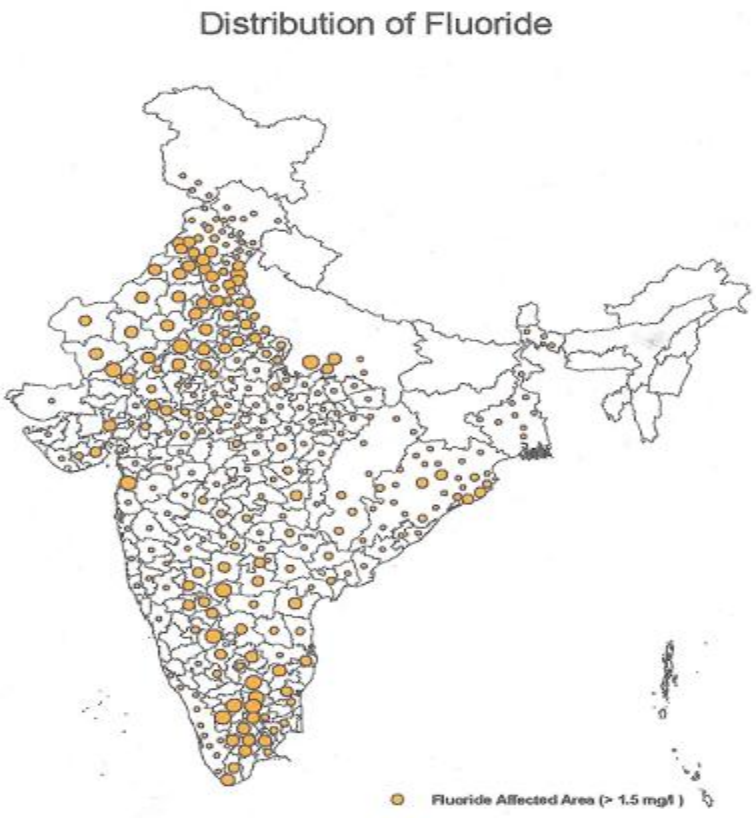
Abstract: - The southern periphery of Morel basin covers entire Chaksu block which falls in south of Jaipur city of Rajasthan State. Groundwater is only source to meet out domestic demand of water in this block. Groundwater occurs in unconfined condition in most of the part in the area of Chaksu block. Occurrence of high fluoride exceeding 1.5ppm in the groundwater of Chaksu block has been found in large number of villages of Chaksu block and delineation of fluoride occurring in groundwater of this block has also been undertaken. De-fluoridation technique can be adopted in areas of high fluoride groundwater so that health hazards can be checked apart from adopting rainwater harvesting through various methods viz. roof top rainwater recharge method.

Key words: - *Groundwater,Chaksu &Fluoride*

I. INTRODUCTION

Fluoride Problem in groundwater has drawn attention of all sections of society in recent years. India is among 23 Nations around the globe facing fluoride problem. An estimated 62 million people in India spread over in 17 states are affected with dental, skeletal and non-skeletal fluorosis and high fluoride locations are shown on map 1 which was prepared by C.G.W.B. Chaksu block falls in Morel Basin, which covers part of Jaipur district. Groundwater is only source to meet out domestic demand of water in entire Chaksu Block due to lack of perennial surface water reservoirs. Groundwater occurs in unconfined condition in most of the part in the area. Earlier no high fluoride was reported in the groundwater of this block but recently it has been published in local newspapers many times about occurrence of high fluoride exceeding 3ppm in the groundwater of many villages lying in the Chaksu block.



Map 1.(Source C.G.W.B.)

II. PHYSIOGRAPHY OF CHAKSU BLOCK

The southern periphery of Morel basin covers entire southern part of Jaipur district which is comprised of an area of 11,061.41 sq.km in State of Rajasthan. The district lies between $26^0$25´ to $27^0$51´ N latitude and $74^0$55´ to $76^0$10´ E longitude and is divided into 13 tehsils and 13 blocks and Chaksu is one of such block of this district which costitue soutern periphery of Morel basin. Out of total 279 villages of Chasku tehsil, 258 are habitated. Chasku is a town in Chasku tehsil. Chaksu block lies between latitude $26^0$29´ to $26^0$45´ N and longitude $75^0$46´ to $76^0$13´ E and covering an area of 811.92 sq.kms. as shown in Fig1 embodying 288 villages and 1 town as shown in figure 1.It has semi-arid climate with annual rainfall 572.42mm.An ephemeral Dhund river flows from N to S in the chaksu block. Chaksu block has an undulating physiography and irrigation and drinking water is met from groundwater in the area. From year 1984 to 2005, annually water level has declined by 0.62m in alluvial aquifer and 0.59m annually in hard rock aquifer.

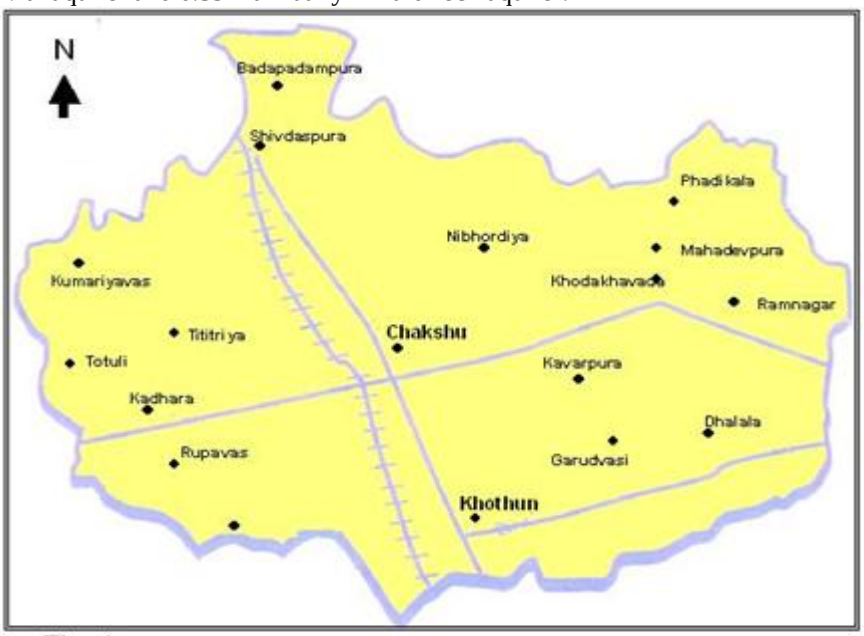


Fig. 1.

III. HYDROGEOLOGICAL SUMMARY OF CHAKSU BLOCK

This block covers an area of 811.92Sq.Km and water bearing formations are Mica Schist and Older Alluvium. Two groundwater potential zones in the block are "Alluvium" & "Hard rock" and are described as under:

The zone of alluvium covers an area of 552.06Sq.Km and the main aquifer is semi consolidated older alluvium. The depth to water varies from 8.80 meters to 31.85metres and the average yield of the wells is 70,000 liters per day and average discharge of the tube wells is 9.00m^3/hr. The chemical quality of ground water is suitable for domestic purpose except high fluoride at certain locations. The present stage of ground water development is 162.49% and long-term trends of water levels have shown the significant decline, therefore, this zone has not been recommended for further ground water exploitation.

The zone of hard rock occupies an area of 177.30Sq.Km. The main aquifer is Schist and groundwater generally occurs in weathered zone and along schistosity, joints and fractured planes. The depth to water varies from 14.08metres to 21.98metres and average yield of the wells is 52,000 liters per day and average discharge of the tube wells is 7.50m^3/hr. The chemical quality of ground water is generally suitable for domestic purpose except high fluoride at certain locations. The present stage of ground water development is 188.90% and long-term trends of water levels have shown significant decline, therefore, this zone has not been recommended for further ground water exploitation. Water level depletion trend is shown in table 1. and water level of selected key wells is shown in table no. 2.

Table 1:- Declining trend of water level of Chaksu Block

S. No	Type of aquifer	Water level in meters				
		1984	1995	1998	2004	2005
1.	Alluvium	10.16	13.98	12.94	21.14	22.47
2.	Schist	7.98	12.77	11.20	19.80	21.03

Table-2 :- Water Level of Key Wells of Pre-Moonson 2006

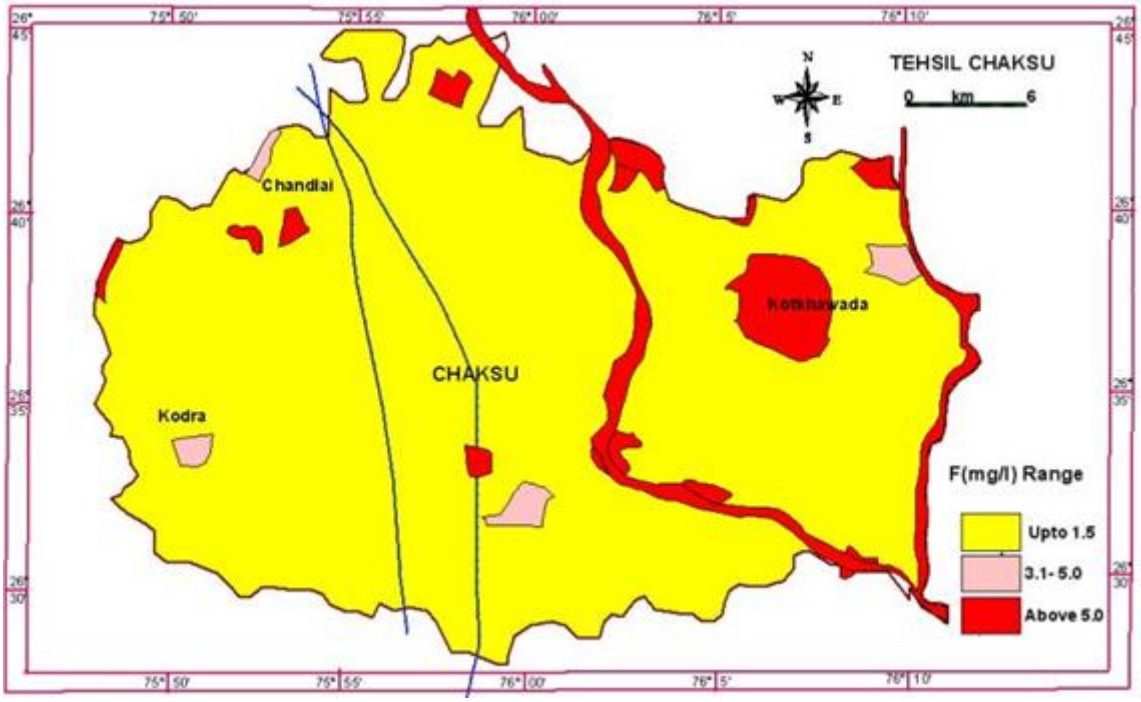
S. No.	Villages	Pre-Moonson
01	Chandlai	16.25
02	Chaksu	Dry
03	Dehlala	34.25
04	Gurwasa	32.45
05	Hingonia	18.20
06	Kadera	26.65
07	Kohlya	Dry
08	Kotkhawda	Dry
09	Rupaheri	Dry
10	Sheodaspura	24.45
11	Titriya	25.55
12	Tuntoli	20.20
13	Garudwasi	Dry
14	Akoriya	24.30
15	Kothun	22.15
16	Sanwasa (Sanwalia)	15.25

IV. GROUNDWATER QUALITY

Groundwater quality is variable in different hydrological conditions and out of a total number of 288 villages of this block, 185 appear to have excess fluoride, 78 villages have excess nitrate, 70 villages have excess TDS and 27 villages have excess chloride. Chemical analysis results of selected key wells are shown in table 3. Fluoride delineation of the Chaksu block falling in southern periphery of Morel basin is shown on map 2

Table-3 Chemical analysis data of selected key wells

S. No.	Location	TDS Mg/L	pH	Na^{+1}	K^{+1}	Ca^{+2}	Mg^{+2}	Cl^{-1}	SO_4^{-2}	CO_3^{-2}	HCO_3^{-1}	NO_3^{-1}	F^{-1} (mg/L)	TH (mg/L)	Na%	RS meq/L
1	Chandlai	1004	8.2	11.4	0.29	1.10	5.90	9.2	2.10	-	6.20	0.32	Tr	350	61.0	-
2	Chaksu	538	8	5.56	0.05	1.50	2.50	3.0	0.50	0	5.80	0.66	1.20	200	57.8	1.80
3	Dehlala	1664	8	25.3	0.14	1.40	2.10	18.4	2.70	0	7.60	0.16	1.00	175	87.4	4.10
4	Gurwara	1542	8.6	23.5	0.13	1.20	2.40	17.6	2.40	1.20	5.20	0.16	6.40	180	86.3	2.80
5	Hingonia	1713	8.8	25.4	0.27	0.80	2.60	8.2	2.40	2.80	8.20	5.32	2.60	170	87.4	7.60
6	Kadera	1273	8.9	19.8	0.15	0.70	2.40	4.8	2.30	4.00	8.40	1.81	6.80	155	85.9	9.30
7	Kohlya	2272	8.6	34.7	0.37	0.70	3.70	19.8	2.80	3.20	9.60	2.82	1.60	220	87.9	8.40
8	Kotkhaw	1057	8.9	16.5	0.05	0.30	2.20	5.2	1.80	2.80	8.80	0.32	7.40	125	86.6	9.10
9	Rupaheri	1528	8	24.5	0.07	0.70	1.30	10.0	2.40	0.0	14.20	0.48	3.60	100	92.2	12.20
10	Sheodas-pura	1785	8.9	28.1	0.06	1.10	2.70	8.2	2.20	6.0	12.60	1.94	15.00	190	87.9	14.80
11	Titriya	910	8.6	9.6	0.18	1.30	5.90	8.8	1.60	1.20	4.80	0.19	Tr	360	56.5	--
12	Tuntoli	2641	8.7	33.0	0.39	1.10	8.80	23.0	3.30	2.40	6.80	7.82	3.60	495	76.2	--
13	Garudwa-si	1310	8.8	19.8	0.04	0.90	2.20	10.4	2.50	2.40	7.00	0.55	3.60	155	86.3	6.30
14	Akoriya	1389	8.7	21.5	0.06	0.60	3.00	11.6	2.50	1.60	8.20	0.26	2.30	180	85.4	6.20
15	Kothun	1631	8.8	25.4	0.13	0.80	2.30	8.4	2.50	2.00	11.20	2.87	2.20	155	88.7	10.10
16	Sanwasa	1402	7.8	17.8	0.07	1.60	6.20	10.6	2.20	0	12.20	0.48	2.00	390	69.3	4.60



Map No. 2

V. SOURCES OF FLUORIDE IN THE ENVIRONMENT

Abundance of F in Sun, Earth's curst and meteorites is near about same. With Electronic Configuration $1s^2\ 2s^2\ 2p^5$, elemental fluorine is just one electron short of the configuration of inert gases and as such it is most reactive of all the elements. Fluorite is the most widely distributed fluorine bearing mineral in the earth crust. Under supergene environment the element occurs as a highly mobile fluoride ion. Its mobility is severely restricted across a calcium barrier due to CaF_2 precipitation. This leads to its enrichment in calcium rich rocks, like calcareous shale, limestones, dolomite, calcareous sandstones. Fluorine in igneous rocks- in magmatic rocks topaz, apatite and fluorite contain fluorine. The more evolved a rock is the higher is its F content. In apatite, fluorine content increases with increase in silica the rock. The F content of biotite is more in highly evolved granites compared to biotites occurring in lesser evolved Gabbros. Average fluorine content in ultramafic rock is 100ppm, intermediate rocks- 400ppm and granitoids- 800ppm. Average F content of basalts is 450ppm. Fluorine during weathering- Fluorite is dissolved slowly by circulating waters. In soil profile decreasing F content with increasing distance from the parent rock is observed. Under acidic circulating solution F is readily adsorbed in clay structure. Average F content of soils ranges from 90 to 980ppm. In semi-arid climates fluoride migration is inhibited during the summer due to higher calcium and low TDS in waters. During post monsoon, the mobility is enhanced due to low calcium distribution. Fluorine in sediments- Fluorine is the most abundant halogen in sedimentary rocks. The average fluorine content in different sedimentary rocks is shown below in table number 5.

Rocks	*Range in ppm*	Avg. in ppm
Limestone	Upto 1210	220
Dolomite	110-400	260
Sandstone	10-110	200
Shale	10-7600	940
Volcanic ashes	100-2900	750
Oceanic Sediments	100-1600	730

(After Fleischer & Robinson,1963)

VI. CONCLUSION

The chemical quality of ground water is generally suitable for domestic purpose except high fluoride at certain locations. Since fluoride concentration has increased due to high overdraft of ground water in Chaksu block, therefore, it is suggested that artificial recharge of groundwater is essential for dilution of fluoride content in groundwater. The effective groundwater recharge methods are storm water management, recharge through abandoned and dried wells at local level as well as by adopting roof-top rainwater-harvesting which can

popularized by providing financial support to the local residents in form of subsidy so that they can build their own rain water-harvesting structures in individual houses.

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