SPATIAL DISTRIBUTION OF URANIUM AND ASSOCIATED WATER QUALITY PARAMETERS IN SUNDERGARH DISTRICT OF ODISHA

NSE-20

BARC & IIT-Gandhinagar

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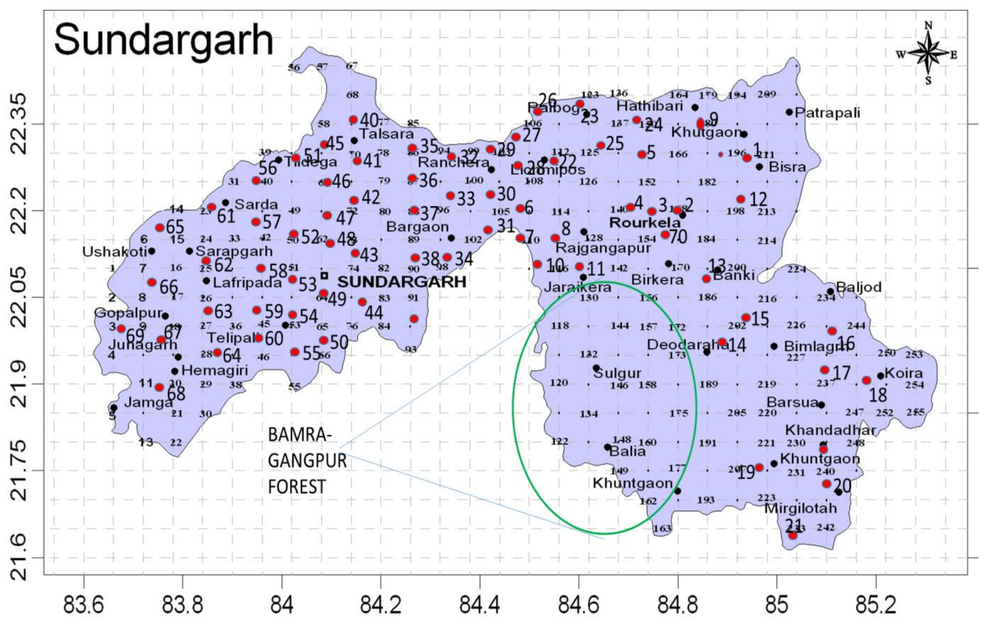
Introduction

The presence of uranium in drinking water and its steady exposure to living creatures may cause various detrimental health effects by chemical action. Few investigations explain the radiological toxicity of uranium in drinking water The land arrangements and dramatic changes in climate conditions are the primary reasons for the leaching of uranium to groundwater. The foremost organs influenced by uranium amount in the body are kidneys, the bones, and the livers. As per the World Health Organization (WHO), the permissible limit for uranium in drinking water is 30µgL^{-1} [1]. The concentration of uranium in drinking water mostly relies on different parameters of water which include its pH, EC, TDS, ORP, etc.

Method

Firstly, the district was divided into an optimized grid size of 6 x 6 km using latitude-longitude as reference coordinates for screening. At least one drinking water sample was collected from each grid in pre- nitric acid cleaned polythene bottle in both pre-monsoon and post-monsoon session. Seven in-situ water quality parameters and eight other ionic species were determined. Uranium in all the collected samples is analyzed by standard addition method using a LED-based fluorimeter to nullify the matrix effect.



Grid map of sundergarh district

Results

In the present study, 70 drinking water samples for pre and post-monsoon sessions were collected, respectively Parameters like Gamma radiation in the Sundergarh district of Odisha was observed in the range of 70 – 240 nSv/h with an average value of 137 nSv/h. Summary of results is presented in Table 1 for pre- and post-monsoon, respectively. pH, EC, TDS and salinity in the water samples were found to vary in the range of 6.0 – 8.0; 54 – 2165 µS/cm; 34 – 1303 ppm and 20 – 1090 ppm, respectively. The average TDS level in the district was founded to be 281.5 and 354.5 ppm in pre- and post-monsoon, respectively. Out of 70 sampling areas, 13 and 9 from pre- and post-monsoon, respectively, the TDS level was found to be higher than the BIS acceptable limit of 500 ppm [2-4]. nitrate and sulphate levels in the water samples in pre- and post-monsoon were found to be less than BIS acceptable limits of 45 and 200 ppm, respectively. In case of Chloride and Flouride out of 70 water samples 5 and 9 water samples are higher than the BIS acceptable limit 250and 1 ppm respectively in pre- and post-monsoon. Uranium levels were found to be < 0.2 – 39.42 ppb in pre-monsoon and < 0.2 – 33.21 ppb in post-monsoon session, with a median value of 0.02 and 0.69 ppb, respectively.

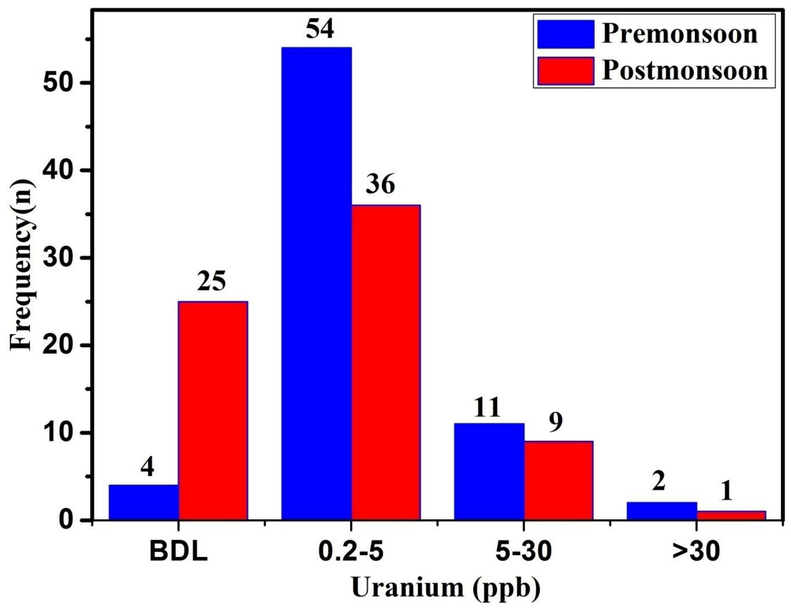


Fig 1. Uranium distribution in pre and post-monsoon session

Table 1: Descriptive statistics for water quality parameters during pre-monsoon and post-monsoon for the district, Sundergarh

Parameter	Sundergarh District, Odisha								
	Pre-monsoon				Post-monsoon				Permissible limit
	Min	Max	Avg	Median	Min	Max	Avg	Median	BIS / WHO limits
pH	6	7.69	6.65	6.64	6.01	8	6.58	6.51	6.5-8.5
TDS (ppm)	34.03	988.1	281.5	225.2	34.03	1303	354.5	295	500
EC(µS/cm)	54	2165	475.2	343	102	2005	535.6	463	-
ORP (±mV)	0.5	81.7	23.5	17.8	-108.2	282.6	17.4	15.7	-
Temp (^{0}C)	26.5	35	29.7	29.5	22.8	30.2	27.5	28	-
Salinity (ppm)	20	1090	174.6	110	30	1010	205.8	150	-
DO (ppm)	2.01	7.9	5.3	6.09	2.01	7.5	3.2	2.8	-
F^- (ppm)	0.18	1.68	0.77	0.77	0.02	2.36	0.47	0.28	0.5-1.5
Cl^- (ppm)	11.07	603.5	97.03	60.90	16.61	560.2	114	83	250
NO3- -N (mg/l)	1.1	18.1	7.01	6.7	1.2	44	15.4	14	45
Alkalinity (mg/l)	24.3	195.1	117.4	112.7	21.2	190.1	89.42	70.15	200
[HCO_3^-] (mg/l)	18.3	191.7	110.7	106.7	21.2	190.1	187.4	67.1	-
TH (mg/l)	32.2	139.8	55.5	50.2	30.2	102.6	50.9	45.8	200
Ca H(mg/l)	21	107	41.03	37	19	69	32	27	-
MgH (mg/l)	8.1	68.8	14.5	13.6	11.2	71.2	18.9	16	-
PO_4^{3-}(mg/l)	0.23	17.25	3.04	1.92	0.21	10.31	2.89	1.97	-
SO_4^{2-} (mg/l)	10.01	137.6	38.9	18.04	10.16	164.8	53.73	43.14	200
Uranium (ppb)	0.2	39.42	3.60	0.02	0.2	33.21	3.03	0.69	60 (AERB)
Gamma Radiation (nSv/h)	80	240	137.3	130	70	210	137.7	140	

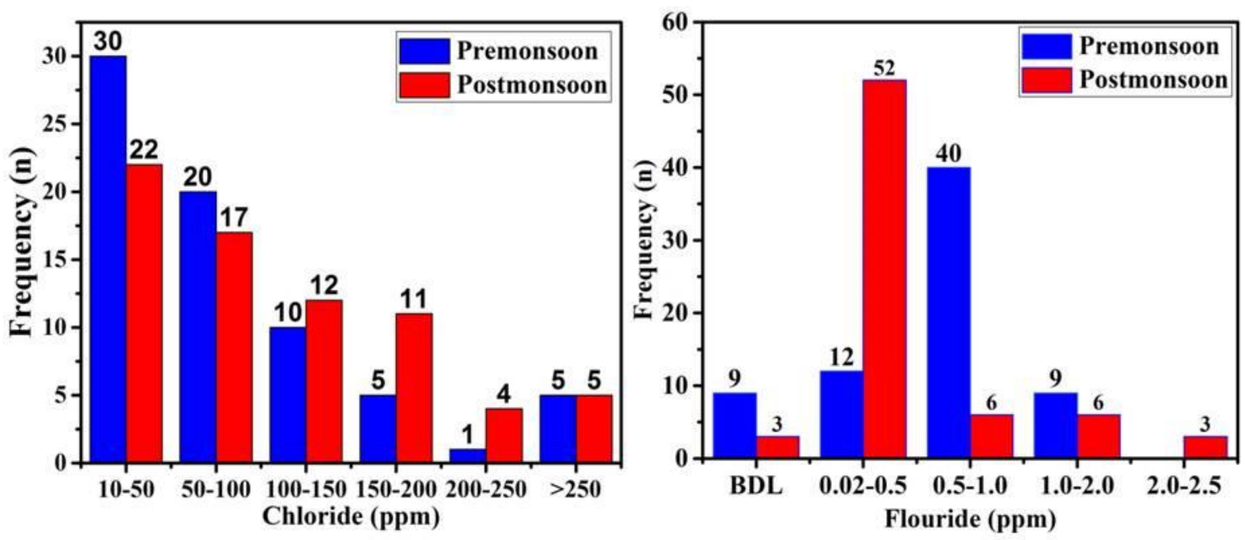


Fig 2. Frequency distribution curve of Chloride and Fluoride in pre and post-monsoon session

Conclusions

The parameters like pH, EC, TDS and salinity in the water samples were found to vary in the range of 6.0 – 8.0; 50 – 2165 µS/cm; 34 – 1303 ppm and 20 – 1090 ppm, respectively. Fluoride and chloride are found to be very high in both the session. Nitrate and sulphate levels in the water samples in pre- and post-monsoon were found to be less than BIS acceptable limits. Uranium levels were found to vary from < 0.2 – 39.4 ppb and < 0.2 – 33.2 ppb in pre- and post-monsoon, with a median value of 0.02 and 0.69 ppb, respectively.

Main references

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Acknowledgments- I would like to thank my supervisor Dr. Harekrushna Sahoo and Co-supervisor Dr. Priyabrat Dash for all of his help and guidance, and BRNS,DAE for funding and National Institute Of Technology Rourkela for instrumental facility.

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