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Scanning of Naturally Occurring, Anthropogenic Radionuclide Concentration in Different Matrices of the Ganges River

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Abstract-- River Ganges is considered to be the most pious river of India. That is why its increasing level of pollution becomes a major environmental concern. Due to industrial affluent, municipal sewage, household drainage etc. the increasing concentration of heavy metals and radionuclieds as major pollutant is alarming. The present paper reported the concentration of heavy metals viz. cadmium, copper, lead and zinc ions in the different matrices of the river Ganges from Rishikesh to Allahabad. The concentration of these metals were determined through differential Pulse Anodic Striping Voltametry (DPASV) from the water and sediments of Ganges at different places from the above said locations. The results showed that the water at Narora barrage was maximum contaminated with Cd and Cu, while at Narora barrage and Jajmau, Kanpur, Pb and Zn were found at its maximum level than others. The Narora ghat river bank and Jajmau, Kanpur river bed sediments gave maximum amount of Cd, Cu and Pb while the maximum amount of Zn was found both in Narora bank as well as bed sediment and highest in the Jajmau river bank sediment. Natural and Anthropogenic radionuclides are measured in environmental matrices for wide range of purposes including migration studies, environmental monitoring, dose assessment, counter terrorism and age dating. There are approximately five thousand natural and artificial radionuclides that have been identified, each with different half life-radioactive waste has been created by humans as a byproduct of various endeavors since the discovery of radioactivity in 1896 by Antoine Henri Becquerel. The collected sediment samples were dried at 110^0C for 24 hrs, sieved through a 2 mm mesh sieve. About 250 g of meshed samples were transferred to a pre-weighed cylindrical acrylic container with dimension of 75 mm diameter 75 mm, sealed and kept for 30 days to allow for growth of radon gas in order to achieve secular equilibrium. The activity levels of 226 Ra, 228 Ra, 40 K and Cs-137 were wine measured using Gamma- Ray spectrometry system based on a co-axial high purity Ge detector of 50% relative efficiency and Uranium is detected by LED Flourimetery.

Keywords: *Radio Nuclieds, LED Flourimetry, Spectroscopy, DPSAV*

I. INTRODUCTION

Radioactive concentration in water is useful to generate the baseline data on naturally occurring and anthropogenic radionuclides concentration in different matrices (water and sediments) of the Ganges river. The results provide spatial and temporal variation in the activity levels of radionuclides and physio-chemical analyses in sediment and water samples of the Ganges river.Data provide the inter elemental relationship with and to identify the sources (anthropogenic /natural).for comparative purposes, the results can also be used to estimate human-health risk from irradiation due to direct ingestion. The routine monitoring of water can assure the public that the quality of water is adequate. The selected area for this study is taken and its comparison with various standards: (USEPA, 2000), (AERB), and (WHO, 2011) and to estimate dose due to radionuclids to general public by the ingestion of drinking water.(1,2-8) The study establish the baseline data on naturally occurring and anthropogenic radionuclides ssconcentrations, gross alpha, gross beta and associated water quality parameters of water sampling is the study region. Laser / LED fluorimeter will be used for uranium analysis. Radiation survey meter will be used for environmental gamma radiation measurement. GPS unit is needed for identifying location of sampling sites. Water quality sensors are required for measurement in-situ parameters such as pH, EC, TDS. Temp. Salinity, DO , etc. The radionuclids concentrations in various environmental matrices including soils, rocks, plants, water etc. have been reported in yesteryears.Other sources of radionuclids in any area include coal burning, application of phosphate fertilizers, mining, and nuclear power generation, etc. Anthropogenic activities can also elevate its levels in the environment but they are quite unlikely to cause any significant change in its concentration It is normally present in the water through weathering of underground parent rocks (8-9)

The measurements of radionuclids concentration in drinking water are useful in assessing its dose incorporated to an average person through its pathway. The risk of the radionuclids consumption to general public depends on various factors including radionuclids concentration present in the drinking water, water ingestion rate, duration of ingestion along with general health of the person. According to Cothern and Lappenbusch (9) drinking water contributes about 85% of total ingested uranium.

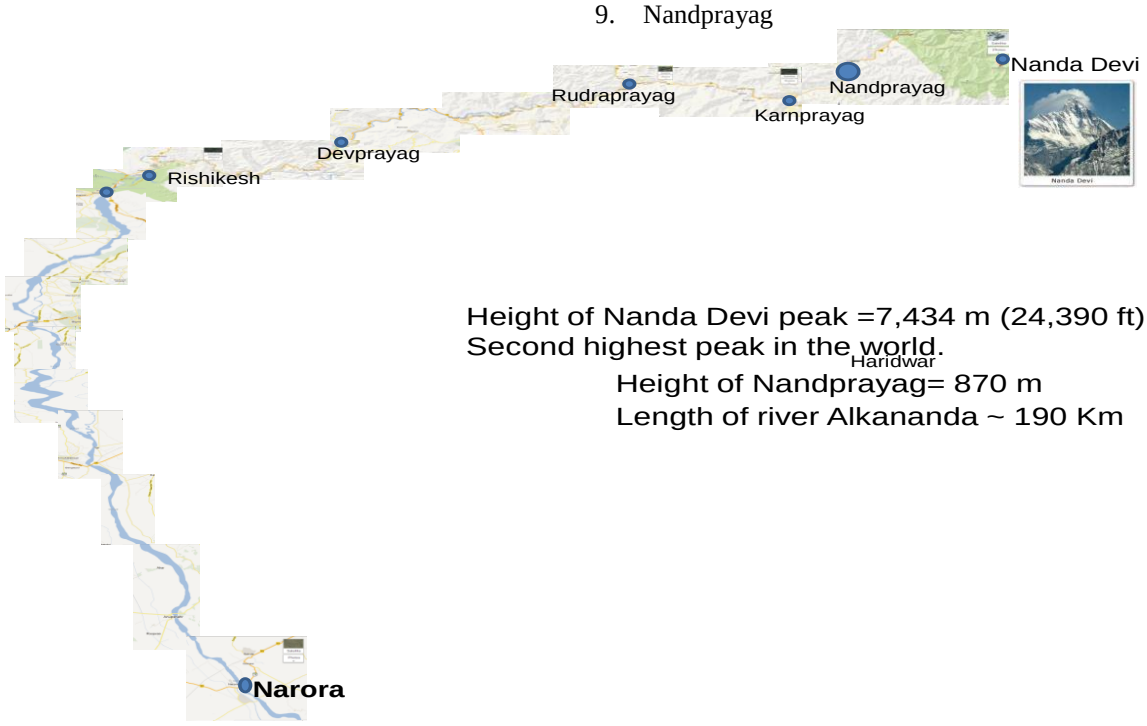
Material and Methods: Sampling carried out based on certain specific criteria so that representative sample can be collected. Samples are collected in two season i.e pre-monsoon and post monsoon as Standard protocol.. The collected samples will be processed and logged in the record book according to their date and locations. Water samples were collected from the middle stream of the rivers and approx. 0.5 meter below the water surface. The collected sediment samples were dried at 110C for 24 hrs, sieved through a 2 mm mesh sieve. About 250 g of meshed samples were transferred to a pre-weighed cylindrical acrylic container with dimension of 75 mm diameter multiplied 75 mm, sealed and kept for 30 days to allow for growth of radon gas in order to achieve secular equilibrium between 226Ra,214Pb and 214Bi in the 238U decay chain and between212Pb,208Tl and 228Ac in the 232Th decay chain.After attaining the secular equilibrium,the activity levels of 226 Ra, 228 Ra, 40 K and Cs-137 in bottom sediments were measured using Gamma-Ray spectrometry system based on a co-axial high purity Ge detector of 50% relative efficiency and Uranium is detected by LED Flourimetery. For the measurement of parameters,

water samples were collected in polyethylene bottles rinsed with 15 % HNO3 (v/v). Collected samples were stored in refrigerator.,A total of 15 water quality parameters were analyzed. Temperature, pH, DO,TDS, and EC were analyzed in situ with the help of portable water analysis kit (GPS Aqua Meter- AP-1000, Aqua Read Ltd, U.K.) and calibration was done at each site before measurement with the help of Rapid Calibration Solution for subsequent analysis. Measurement of major cations and anions were carried out through differential Pulse Anodic Striping Voltametry (DPASV) from the water and sediments of Ganges at different places from the below said locations.

II. RESULT AND DISCUSSION:

Sampling Time Pre Monsoon July Post Monsoon November –December Sampling Locations:

1. Allahabad
2. Kanpur
3. Narora
4. Haridwar
5. Rishikesh
6. Devprayag
7. Rudraprayag
8. Karnprayag
9. Nandprayag



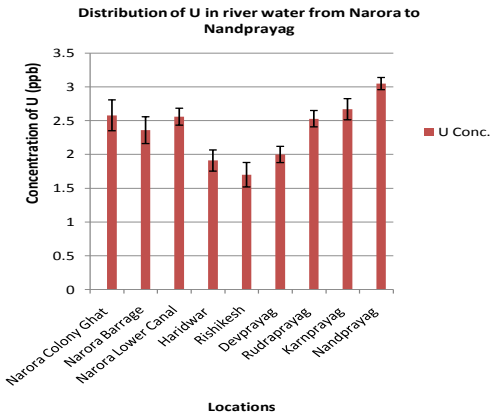
In situ Measurement of Physical Parameters in River Water from Nandprayag to Narora

Locations	Temp (ºC)	pH ±SD	DO±SD (mg/L)	TDS±SD (ppm)	EC±SD (µS/cm)	Salinity±SD (ppt)
Nandprayag Alakananda	11.8	8.89±0.01	10.01±0.05	80±0.76	123.75±1.16	0.06± 0.005
Nandprayag Nandakini	15	8.68±0.01	9.21±0.07	55.5±7.05	83.5±15.88	0.04± 0.004
Karnprayag Pinder	11.2	8.53±0.0	10.28±0.07	75.78±0.44	116.89±0.60	0.5± 0.004
Karnprayag Alakananada	11.1	8.47±0.08	10.29±0.03	76.17±0.98	117.67±1.366	0.5± 0.005
Rudraprayag	13.5	8.88±0.08	10.04±0.16	-	-	0.3± 0.002
Devprayag	17.5	8.73±0.03	9.82±0.12	77.39±2.35	123.22±0.83	0.5± 0.003
Rishikesh	17.2	8.48±0.00	9.59±0.03	76±0.08	117.6±0.55	0.054± 0.005
Haridwar	19.2	8.58±0.02	9.44±0.03	111±1.00	171.6±1.52	0.08±0.002
Narora Colony Ghat	21.24	8.27±0.16	8.63±0.07	125.13±0.83	191.44±5.10	0.089±0.00
Narora Barrage	22.6	8.38±0.02	8.52±0.11	118.85±0.66	183.86±0.66	0.09±0.00

Measurement of Uranium in Water of River Ganges

At different locations from Narora to Nandprayag

Locations	U (ppb)
Narora Colony Ghat	2.58±0.22
Narora Barrage	2.36±0.19
Narora Lower Canal	2.56±0.12
Haridwar	1.91±0.15
Rishikesh	1.7±0.18
Devprayag	2.0±0.12
Rudraprayag	2.53±0.12
Karnprayag	2.67±0.15
Nandprayag	3.05±0.09



Measurement of Gross Alpha & Gross Beta in Water of River Ganges

Locations	Gross Alpha (Bq/L)	Gross Beta (Bq/L)
Narora Colony Ghat	BDL	BDL
Narora Barrage	BDL	BDL
Narora Lower Canal	BDL	BDL
Haridwar	BDL	BDL
Rishikesh	BDL	BDL
Devprayag	BDL	BDL
Rudraprayag	BDL	BDL
Karnprayag	BDL	BDL
Nandprayag	BDL	BDL

MDL for Gross Alpha : 0.0074 Bq/l **MDL for Gross Beta : 0.041 Bq/l**

Measurement of ^{137}Cs & ^{3}H in Water of River Ganges

Locations	^{137}Cs (mBq/L)	^{3}H (Bq/L)
Narora Colony Ghat	BDL	BDL
Narora Barrage	BDL	BDL
Haridwar	BDL	BDL
Rishikesh	BDL	BDL
Devprayag	BDL	BDL
Rudraprayag	1.01 ± 0.07	BDL
Karnprayag	1.11 ± 0.07	BDL
Nandprayag	BDL	BDL

MDL- Cs^{137} = 0.7 mBq/L for 40l sample ^{3}H : 10 Bq/l

5

The observed values of alkaline pH values in Ganges rivers may be partly attributed to the disposal of industrial wastes [14] ,domestic waste water contamination, presence of chemical detergent, release of bicarbonate and carbonate ions and may also be due to lime stone bed rocks.Previous studies have shown comparatively less alkaline water of Ganges at upstream i.e. 7.74±0.32 [12] which indicate increasing trend of pollution in the river. Similar values of pH were reported in the Ganges water of different location (7.0- 8.4) in another report [15].

Radionuclids found at different sampling location in BDL so they cause no harm and no risk of the radionuclids consumption to general public depends on various factors including radionuclids concentration present in the drinking water, water ingestion rate, duration of ingestion along with general health of the person.

CONCLUSION

By analyzing the quality of water using WQI (15, 16-18), we have found a significant decline in water quality of Ganges river at each location. Results suggest that purification of water is necessary for consumption. This study recommends the pressing need for continuous monitoring of river water for determining the factors affecting pollution and its impact on water quality are instructive.

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References

[1] WHO, (2011), Guidelines for Drinking Water Quality, 4th Edition, Volume 1.
[2] USEPA, (2000), National Primary Drinking Water Regulation. Radionuclides; Final Rule, United States Environmental Protection Agency.
[3] C.P.C.B. , Central Pollution Control Board, Ministry of Environment and forest Ganga
[4] Water Quality Trend, Monitoring of Indian Aquatic Resources, Series: MINARS/31/2009-2010, (2009)
[5] Status paper on river Ganga, State of Environment and Water Quality. National River Conservation Directorate Ministry of Environment and forests. August (2009)
[6] World Health Organization, Geneva, Health criteria and other supporting information. Total dissolved solids in drinking-water, Guidelines for drinking-water quality, 2nd ed. Vol. 2. (1996)
[7] CPCB, Central Pollution Control Board, Ministry of Environment and forest, Water of Environment & Forest, Assessment & Development of Rivers
8 Kuroda P.K., Essien I.O., Sandoval D.N., (1984), Fallout of uranium isotopes from the 1980 eruption of Mount St. Helens, Journal of Radioanalytical and Nuclear Chemistry, 84, 23-32. iver Basin Series:
[8] Cotheren C.R., Lappenbusch W.L., (1983), Occurance of Uranium in Drinking Water in the US, Health Physics 45(1), 89-99.
[9] Singh S., Rani A., Mahajan R.K., Walia T.P.S., (2003), Analysis of uranium and its correlation with some physico-chemical properties of drinking water samples from Amritsar, Punjab, Journal of Environmental Monitoring, 5, 917–921.
[10] ATSDR (Agency for Toxic Substances and Disease Registry), (1999), Toxicological Profile for Uranium, U.S. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry (ATSDR), Atlanta, GA. 426
[11] D.M. Joshi, A. Kumar, N. Agrawal, Studies on physicochemical parameters to assess the water quality of river Ganga for drinking purpose in Haridwar district. Rasayan J.Chem., 2 :195-203, (2009)
[12] R.M. Tripathi, S.K. Sahoo, S. Mohapatra, P. Lenka , R.N. Nair, V.D., Puranik, Ajay Kumar, P.M. Ravi, S.Rout, R. Karpe, M.K. Mishra, P.K. Sarkar, D.N. Sharma and A.K. Ghosh (2012), A study on uranium in groundwater of Punjab, BARC Report, BARC/2012/R/011.
[13] Mona, M. Shuchi, Analysis of Various Physicochemical Parameters for the Water Quality Assessment of Central Region, Asian J. Engineering and Management 1(1):4-8, (2012)
[14] M. Sinha, D.K. De, B.C. Jha, The Ganga – Environment & fishery, CIFRI, Barrackpore, p.142, (1998) 15. G.C. Cade, Oregon water quality index: a tool for evaluating water quality management effectiveness. Journal of the American Water resources Association, 37 :125-137, (2001)
[15] L. Zhenghui, S. Guoping, H. Shaobin , S. Wei, G. Jun, X Meiying, Water quality index as a simple indicator of drinking water source in the Dongjiang river, China. Internationnal Journal of Environmental Protection, 2:16-21, (2012)
[16] A.K. Singhal, Legal cases on Ganga pollution and judicial activism. Journal of Applied sciences in Environmental Sanitation, 7 :61 - 64, (2012)
[17] A. Hameed , M.J. Alobaidy, H.S. Abid, B.K. Mauloom, Application of Water Quality Index for Assessment of Dokan lake Ecosystem, Kurdistan region, Iraq. Journal of Water Resource and Protection, 2 :792-798, (2010)

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