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Reappraisal of Hydrogeochemical Characteristics of Phagi Block of Jaipur District, Rajasthan.

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Abstract: *The hydrogeochemical characteristics of groundwater in Phagi block of Jaipur district, Rajasthan were evaluated during pre-monsoon season to assess its quality. Thirty eight groundwater samples from bore wells/dug wells were collected and analyzed for pH, EC, TDS, total hardness, major anions and cations. Fluoride concentration ranges from 0.02 to 10.50 mg/l. The probable source of fluoride in the study area is appears to be geogenic due to high residence time.*

Keywords -*Hydrochemistry, Groundwater, Fluoride, Geogenic, Phagi, Jaipur.*

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I. INTRODUCTION

Water is a vital natural resource for sustaining life and environment that we have always thought to be available in abundance and free gift of nature [6]. Water contains many ions major, minor and trace elements viz. calcium, magnesium, sodium, potassium, fluoride, iron etc. Hydrochemical studies are helpful to understand the subsurface geology as well as the processes involved in the chemical evolution of groundwater [2]. In last few years, the groundwater availability is at a higher risk in Rajasthan state of India due to increasing population, urbanization, and excessive withdrawal of groundwater for crop production. Drought events and overexploitation of groundwater resources have caused severe drop in water table level of Rajasthan [3].

The study area Phagi block of Jaipur district is located in the state of Rajasthan is one of such region that is facing the problem of fluoride contamination in groundwater which is responsible for causing various kinds of fluorosis, neurological diseases, cardiovascular disease, endocrine disruption, arthritis, hypersensitivity etc. It is prudent to develop a methodology to control the fluoride problem and develop safe drinking water source.

II. PHYSIOGRAPHY & MORPHOLOGY

The study area Phagi block lies between latitude 26°25' to 26°45'N and longitude 75°19' to 75°48'E (Survey of India toposheet no. 45N/5, 45N6, 45N/7, 45N/9, 45N/10, 45N/11, 45N/14 & 45N/15). It is situated in southern marginal part of Jaipur district, Rajasthan and its distance from Jaipur is 51 km. It covers an area of about 1114.34 km^2. It has an average elevation of 383 metres (1.257 ft.). For admininstrative convenience, the block is divided into 171 villages. Phagi block covered 32 gram panchayats. According to 2011 census, total population of Phagi tehsil was 161,610. The location map of the study area is presented in **Fig. 1**.

In the north of this block, an ephemeral River-Bandi flows from NW to SE direction and southern part of the block is drained by Mashi River. The temperatures are highest on average in May, at around 34.0°C and January is the coldest month, with temperatures averaging 15.9°C. The region falls in semi-arid climate and the annual average rainfall of the area is 536 mm [5].

Geomorphologically, the area is mostly covered with pediment- pediplain complex and pediplain with thick alluvium of the Quaternary sediments, both of aeolian and fluvial nature. The only high relief is seen in the form of NW-SE trending ridge and few hillocks south- east of Mohabbatpura in the northeast. Hills are predominant in Pahariya and Mohabbatpura villages whereas the topography of rest of the block is undulating [4].

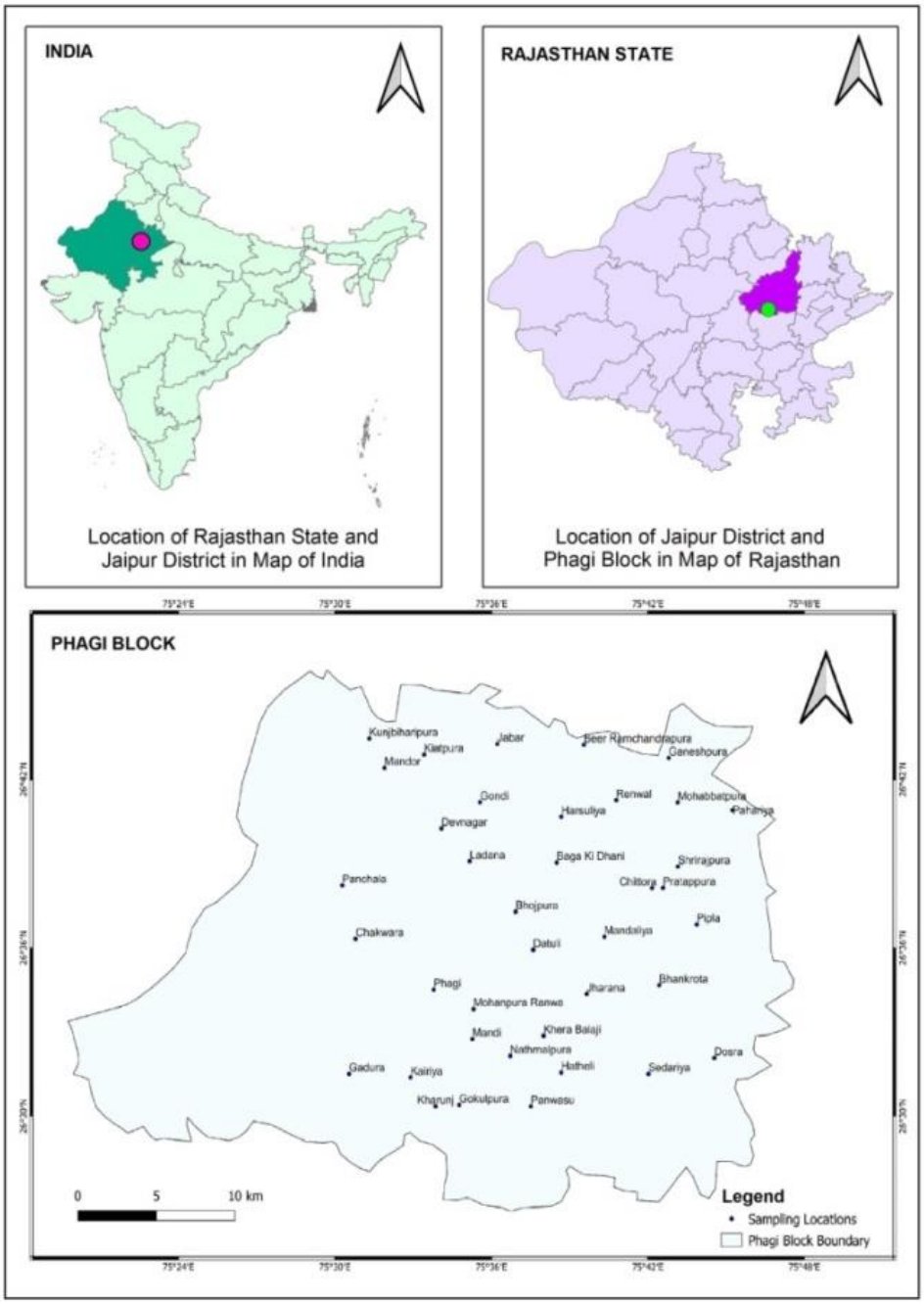

Fig.1. Location map of the Study Area.

III. GEOLOGY & HYDROGEOLOGY

The area is occupied by meta- pellites, meta sedimentary rocks, migmatites, gneisses of Sandmata complex of the Bhilwara Supergroup (Archean) concealed under Quaternary sediments. The quartzite ridge is exposed to south east of Mohabbatpura. The abandoned commercial mining activity especially for mica is observed near to Bhojpura and Datuli villages in the study area. Mostly, area is covered with gniesses, granite gniesses, mica schist, pegmatites and some intrusion of basic rocks in the eastern part of block but the rocks are at shallow depth and exposed only a few places of depression or nala cuttings [4].

The main sources for irrigation are wells, open wells and tube wells. The main aquifer of the Phagi block are older alluvium which covers approx. 51% area of this block and remaining is comprised of hard rocks such as schist and gneiss. The groundwater is mainly found in gravel, sand, loess and kanker origin. The seasonal crop grown in the area is the millet, wheat.

The groundwater level amount in north part of block is approx. 30 m, and in south 30 m, in east 22 m and in west 15 m and in the middle part of the block is about 19 m. The average yield as per available in literature of sand and gravel aquifer is varies from 6000 to 9000 litre/hour whereas in hard rock aquifer it varies

from 5000 to 7000 litre/hour. The water table drawn in alluvium aquifer is 0.35 m/year whereas in hard rock 0.64 m/year.

IV. METHODOLOGY

Conventional as well as advance methodology was adopted during the course of present study. Total 38 groundwater samples were collected during pre-monsoon (2017). The samples were collected from bore wells/open dug wells for physico-chemical analysis to find the quality of groundwater in the study area. Physico-chemical parameters includes pH, electrical conductivity, total dissolved solids (TDS), calcium (Ca^{2+}), sodium (Na^{+}), potassium (K^{+}), magnesium (Mg^{2+}), total hardness, chloride (Cl^{-}), bicarbonate (HCO_3^{-}), fluoride (F^{-}), nitrate (NO_3), sulphate (SO_4^{2-}) and all these parameters were analysed.

Methods adopted for water quality analysis are followed by using standard procedure (APHA 1985) [1].

- The parameter pH is measured on the spot at the time of sample collection using portable pH Meter and also measured in the laboratory with the help of pH Meter.
- Digital Conductivity Meter was used to quantify conductivity and Digital TDS Meter was used to determine total dissolved solids.
- Fluoride (F^{-}) concentration was determined with the help of Selective Ion Meter.
- Analysis for the major cations – Sodium (Na^{+}) and potassium (K^{+}) was carried out by means of Flame Photometer.
- Standard Titration Methods were used for the estimation of total hardness (TH), calcium (Ca^{2+}), chloride (Cl^{-}) and Bicarbonate (HCO_3^{-}).
- Magnesium (Mg^{2+}) was calculated through subtracting calcium by total hardness (TH-Ca^{2+}).
- Nitrate (NO_3^{-}) was measured by Spectrophotometer.
- Sulphate (SO_4^{2-}) was measured by Turbidity method.

V. HYDROCHEMISTRY

Total thirty eight groundwater samples were collected to examine the groundwater quality of the study area, after analysis the following results were obtained**.** Fluoride concentration exceeded maximum permissible limit i.e., 1.5 mg/l (WHO) for drinking water has been found in groundwater from major part of the study area. The concentration of fluoride is very high (10.50 mg/l) which is found in sample at village Harsuliya.

At some places, the concentration of nitrate is also very high more than permissible limit of 50 mg/l and the highest value of nitrate is 566.53 mg/l in Ladana village sample. With the exception of pH and sulphate, all the parameters crossed their maximum permissible limits. TDS ranges from 380 mg/l to 9800 mg/l, electrical conductivity ranges from 680 to 11260 measured in µS/cm, total hardness with minimum value of 60 mg/l and maximum value of 8000 mg/l, chloride ranges from 19.04 mg/l to 4259.46 mg/l, calcium ranges from 18 mg/l to 1200 mg/l, magnesium with minimum value of 42 mg/l and maximum value of 6800 mg/l, potassium ranges from 0.03 mg/l to 127.50 mg/l, sodium from 36.60 mg/l to 1089.70 mg/l, bicarbonates from 110 mg/l to 2000 mg/l. Comparison of hydrochemical parameters with World Health Organization drinking water standards is shown in Table 1.

It has been observed that the water is not suitable for drinking purpose in most of the part of study area without proper chemical treatment.

Table 1: Comparison of hydrochemical parameters with WHO (1993 & 2011) Standards.

S.No.	Parameters	Min.	Max.	Mean	WHO (1993&2011)	Polluted sample	Undesirable effects
1.	pH	7.3	8.3	7.85	6.5-8.5	-	Taste, effects mucous membrane
2.	EC (µS/cm)	680	11260	4378. 34	1400	78.94%	Gastrointestinal irritation.
3.	TDS (mg/L)	380	9800	3613.42	1000	76.31%	Gastrointestinal irritation.
4.	TH (mg/L)	60	8000	859.05	500	39.47%	Encrustation in water supply, urolithaisis and adverse effect on domestic use.
5.	Ca^{2+} (mg/L)	18	1200	207.87	200	26.31%	Encrustation in water supply, Scale formation.
6.	Mg^{2+} (mg/L)	42	6800	651.18	50	94.73%	Encrustation in water supply, encephalitis and adverse effect on domestic use.
7.	Na^{+} (mg/L)	36.6	1089.7	442.22	200	76.31%	High blood pressure.
8.	K^{+} (mg/L)	0.03	127.5	14.73	12	28.94%	Bitter taste.
9.	HCO_3^{-} (mg/L)	110	2000	604.84	-	-	-
10.	Cl^{-} (mg/L)	19.04	4259.46	944.20	250	71.05%	Salty taste.

11.	SO_4^{2-} (mg/L)	0.4	315.62	34.60	250	2.63%	Laxative effect.
12.	F^- (mg/L)	0.02	10.50	2.22	1.5	52.63%	Fluorosis.
13.	NO_3^- (mg/L)	0.99	566.53	56.08	50	28.94%	Methaemoglobinaemia.

VI. CONCLUSION

The groundwater of the study area is mainly alkaline in nature. The present study concluded that the water is unsuitable for domestic consumption in most of the part of study area due to higher concentration of fluoride. The groundwater of the study area requires some chemical treatment before use. The probable reason for fluoride contamination seems to be geogenic here due to high residence time.

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REFERENCES

[1]. APHA (1985). Standard Methods for the Analysis of Water and Waste Water (16th edn.), American Public Health Association, Washington D.C.
[2]. Batabyal A.K. (2017). Hydrogeochemical processes and contaminants enrichment with special emphasis on fluoride in groundwater of Birbhum district, West Bengal, India. Environmental Earth Science, 76:285, pp. 1-23.
[3]. Dadhich A.P., Goyal R. and Dadhich P.N. (2021). Assessment and Prediction of Groundwater using Geospatial and ANN modeling. Research Square. (https://doi.org/10.21203/rs.3.rs-246464/v1).
[4]. Rahi R. and Choudhary V. (2015). Geochemical mapping of toposheet 45N/10 covering parts of Jaipur & Tonk Districts, Rajasthan. Geological Survey of India, Govt. of India, pp. 1-142.
[5]. Singh O.P., Singh S.S. and Kumar S. (2012). Rainfall profile of Jaipur, Meteorological Centre, Jaipur. Govt. of India, Ministry of Earth Science, Indian Meteorological Department, New Delhi, pp. 1-98.
[6]. Sunitha V., Reddy B.R. and Reddy M.R. (2012). Groundwater quality evaluation with special reference to fluoride and nitrate pollution in Uravakonda, Anantpur District, A.P, International Journal of Research in Chemistry and Environment, 2 (1), pp. 88-96.
[7]. WHO (1993). Guidelines for Drinking-Water Quality-I, World Health Organization Recommendations, 2nd Edition, Geneva, Switzerland.
[8]. WHO (2011). Guidelines for Drinking-Water Quality 4th Edition, World Health Organization Recommendations, WHO, Geneva 1-4.

Sonam Yadav, et. al. "Reappraisal of Hydrogeochemical Characteristics of Phagi Block of Jaipur District, Rajasthan."*IOSR Journal of Applied Geology and Geophysics (IOSR-JAGG),* 9(5), (2021): pp 20-23.