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Research Article

Assessing Levels Along with Risks Due To Fluoride Toxicity in Tohana Block of Fatehabad District, Haryana, India

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Abstract

The purpose of the present research was to assess the fluoride concentration of the surface and groundwater in the Tohana block of Fatehabad district, Haryana. Groundwater serves as the area's main supply of drinking water. 53 samples were collected each from surface (ponds, rivers) and groundwater (tubewells, handpumps and wells) and were examined for fluoride concentration using ion selective electrode. Fluoride concentration ranged from 0.02 mg/l (Lalodha, Rainwali) to 1.91 mg/l (Nanheri) in Tohana block, Fatehabad District in Haryana. 43 villages (out of 53 villages/Town) of Fatehabad district had fluoride levels that were below the WHO's highest admissible limit of 1.5 mg/l; however, Fluoride levels in 10 (out of 53 villages/towns) exceeded the permissible level; making them inadequate for drinking. The principal origins of fluoride in groundwater are assumed to be the abundance of fluoride-bearing minerals in the host rock, along with chemical characteristics like dissociation, dissolution and decomposition, in addition to their interaction with water.

Keywords: Fluoride; Ground water; Contamination; Contaminants; Health risks.

Introduction

Water is a precious and irreplaceable resource. Furthermore, it is necessary not just for the existence of all living organisms, but additionally for their well-being. Access to safe drinking water can be a health requirement, a fundamental right, and a critical component of good health-care systems. Indeed, improved access to safe water for consumption is critical because it provides substantial health advantages. Human life requires a steady supply of healthy drinking water (Sanou *et al*., 2022). Furthermore, waterborne infections caused by contaminated water kill 2.6 million individuals annually (WHO, 2017).

Water with an acceptable chemical composition is thus required for the health and survival of human existence (Dippong *et al*., 2021). Fluoride is a naturally occurring element that is present in various concentrations in fresh and sea water, soil, rocks and many foods. Food represents the most common source of fluoride intake, except in areas with high consumption from ground water sources, where the fluoride concentration far exceeds that of community or municipal drinking water (Taher *et al*., 2024). Numerous studies on fluoride contamination are being conducted in Haryana, which suggests that the groundwater there contains and confirmed the fluoride toxicity (Ahmad *et al*.,

2020; Kaur *et al*., 2020; Kumar *et al*., 2021a; Kumar *et al*., 2021b; Kumari *et al*., 2020; Malik & Kavita, 2022; Pareek *et al*., 2020; Ravish *et al*., 2020; Sharma *et al*., 2020; Singh & Singh, 2021; Yadav & Pandey, 2021; Kumari *et al*., 2024). Fluoride toxicity affects humans, domestic mammals and plants as well (Kumari *et al*., 2023; Kumari *et al*.,2024a; Kumari *et al*., 2024b). The goal of the present research work was to examine surface and groundwater quality in Tohana Block of Fatehabad district of Haryana, India, with a special emphasis on fluoride concentrations.

Site Specifications

Fatehabad is one of the smallest districts in the Haryana State and covers 5.69 % area of the state. The district is surrounded by Punjab state in the north, Jind district in the east, Sirsa district in the west direction, Hissar district and Rajasthan state in the South. It is bounded by 28048′15″ to 29017′10″ N latitudes and 76028′40″ to 77012′45″ E longitude covering an area of 2490 sq.km. It has an average elevation of 208m. Ghaggar River is passing through Northern western part of the district. The district has adequate drainage facilities which prevent the district from floods. The water of the river and drains is being harvested for crop production. The climate of Fatehabad district is very hot in summer and very cold during winters. Temperature ranges from -1 to 48 degree Celsius. Annual rain fall is around 280 mm. Topography of the district is plain and sand dunes. Soils are sandy, sandy loam and clay. Paddy-wheat and cotton-wheat is the main crop rotation followed in the district. The geographical area of the district is 2520 km^2, which is 5.4% of the state share (Fig. 1).

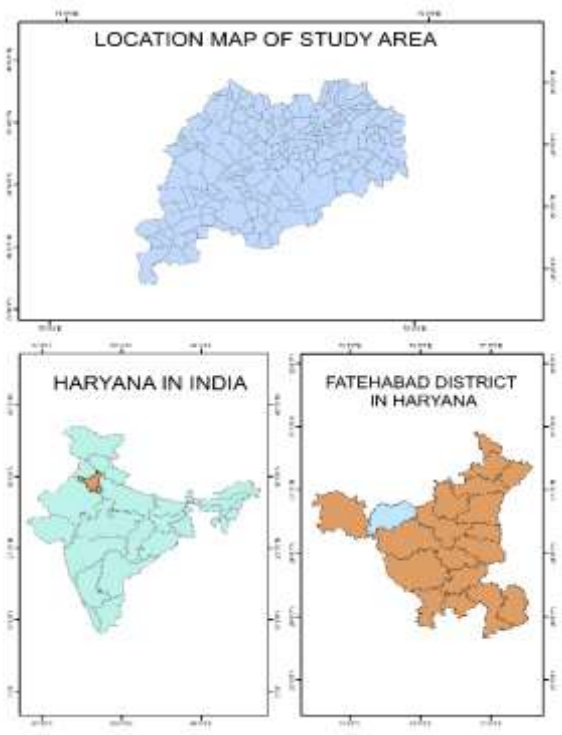

Fig. 1: Location map of study area

Water Sampling and Methodology

From 53 villages and towns in Tohana Block area of Fatehabad district, Haryana samples were taken in pre-cleaned plastic bottles while taking the necessary safety steps (Fig. 2). Using a fluoride ion selective electrode, the fluoride content in the water was measured potentiometrically. The electrode was linked to an ion-meter for analysis. In this procedure, one milliliter of TISAB II was mixed with ten milliliters of material. The work was carried out at Baba Mastnath University, Asthal Bohar, Rohtak, Haryana.

Fig. 2: Field photographs showing sampling sites.

Result and Discussion

In surface and groundwater (Fig. 3 and 4), fluoride concentrations were measured in 53 towns/ villages in Haryana's Tohana Block (Table 1 & 2). Fluoride concentrations were found to range from 0.02 mg/l (Lalodha, Rainwali) to 1.91 mg/l (Nanheri) (Table 3). The current investigation found that 43 out of 53 villages or towns had fluoride concentration in groundwater within 1.5mg/l.; the maximum permissible limit recommended by the World Health Organization. Fluoride concentrations in 10 out of 53 villages/towns exceeded the permissible level, making them unfit for drinking. Groundwater at 10 test locations (19 percent) was found to be inappropriate for drinking purposes according to the intended and highest allowed level for fluoride in water (Fig. 3, 4 and 5). All surface water samples lied in range of WHO and BIS permissible limit.

Table 1: Fluoride level in collected water samples from Tohana Block.

S. N.	Name of Village	Latitude	Longitude	Population	F^- Conc. (mg/l)	
					Surface water	Groundwater
1	Akanwali	29.686700	75.778744	4924	0.21	0.23
2	Amani	29.670383	75.849521	2982	0.15	1.01
3	Balianwala	29.718127	75.940831	2637	0.12	0.73
4	Bhimawala	29.586182	75.950300	1709	0.14	0.84
5	Bhodi	29.663211	75.790566	1509	0.18	0.96
6	Bhodia Khera	29.648867	75.898425	527	0.19	0.77
7	Bidhai Khera	29.648865	75.898423	454	0.31	0.21
8	Budhanpur	29.711593	75.822896	218	0.56	0.61
9	Chandu Kalan	29.642233	75.625011	3037	0.69	0.53
10	Chander Khurd	29.653927	75.615036	960	0.21	0.78
11	Chelewal	29.738936	75.803494	759	0.09	0.44
12	Chitain	29.549786	75.940522	432	0.92	0.70
13	Damkora	29.723650	75.878143	2066	0.21	0.84
14	Dangra	29.665953	75.889672	3461	0.83	1.52
15	Dharshul Kalan	29.680280	75.727054	4105	0.72	1.02
16	Dharsul Khurd	29.683681	75.721173	1961	0.57	0.53
17	Fatehpuri	29.640341	75.845696	2424	0.11	0.67
18	Gajuwala	29.568883	75.887013	3718	0.21	0.45
19	Girnu	29.743568	75.812091	283	0.62	0.53
20	Haiderwala,	29.710600	75.801433	1440	0.19	1.43
21	Hansawala	29.547946	75.883894	2160	0.17	1.47
22	Himatpura	29.750948	75.860988	1326	0.19	1.62
23	Hindalwala	29.720275	75.794670	1397	0.82	1.71
24	Indachhoi	29.641598	75.794672	5826	0.17	0.78
25	Jamalpur	29.701710	75.836017	9944	0.79	1.82
26	Japtewala	29.660374	75.699708	836	0.15	0.87
27	Kamalwala	29.692433	75.933685	1314	0.16	0.92
28	Kanheri	29.678889	75.930488	6207	0.31	0.68
29	Khanora	29.690685	75.833200	1656	0.77	0.97
30	Kullan	29.667387	75.730255	4365	0.15	0.78
31	Laloda	29.636981	75.887698	3759	0.02	0.85
32	Laluwal	29.711973	75.781376	1458	0.16	0.55

Table 1: Fluoride level in collected water samples from Tohana Block.

S. N.	Name of Village	Latitude	Longitude	Population	F^- Conc. (mg/l)	
					Surface water	Groundwater
33	Loha khera	29.677247	75.906235	1896	0.19	1.42
34	Maduwala	29.682253	75.868455	1125	0.82	0.89
35	Malaheri	29.643787	75.943423	23	0.31	0.81
36	Mamupur	29.747152	75.829466	956	0.09	0.76
37	Manghera	29.638696	75.702657	1230	0.22	1.62
38	Mayemadh	29.662087	75.745872	32	0.12	0.91
39	Nangla	29.614832	75.892603	2433	0.06	0.71
40	Nangli	29.591443	75.931812	1139	0.52	0.82
41	Nanheri	29.669134	75.686772	2203	0.68	1.91
42	Parta	29.577187	75.847184	4119	0.12	1.38
43	Pokhri	29.640021	75.751682	225	0.21	0.72
44	Pirthala	29.597320	75.857823	4589	0.31	1.53
45	Rainwali	29.728711	75.827197	1074	0.02	0.92
46	Rasulpur	29.651778	75.689171	705	0.08	0.78
47	Ratta khera	29.660544	75.875187	1960	0.16	0.91
48	Samain	29.627202	75.931600	10892	0.31	0.73
49	Saniyana	29.530209	75.818456	6900	0.72	1.68
50	Simbalwala	29.511975	75.498696	1537	0.82	0.86
51	Tharvi	29.599421	75.834523	1271	0.76	1.23
52	Tharwa	29.609480	75.835624	1167	0.75	1.12
53	Tohana	29.723298	75.869293	2046	0.87	1.78

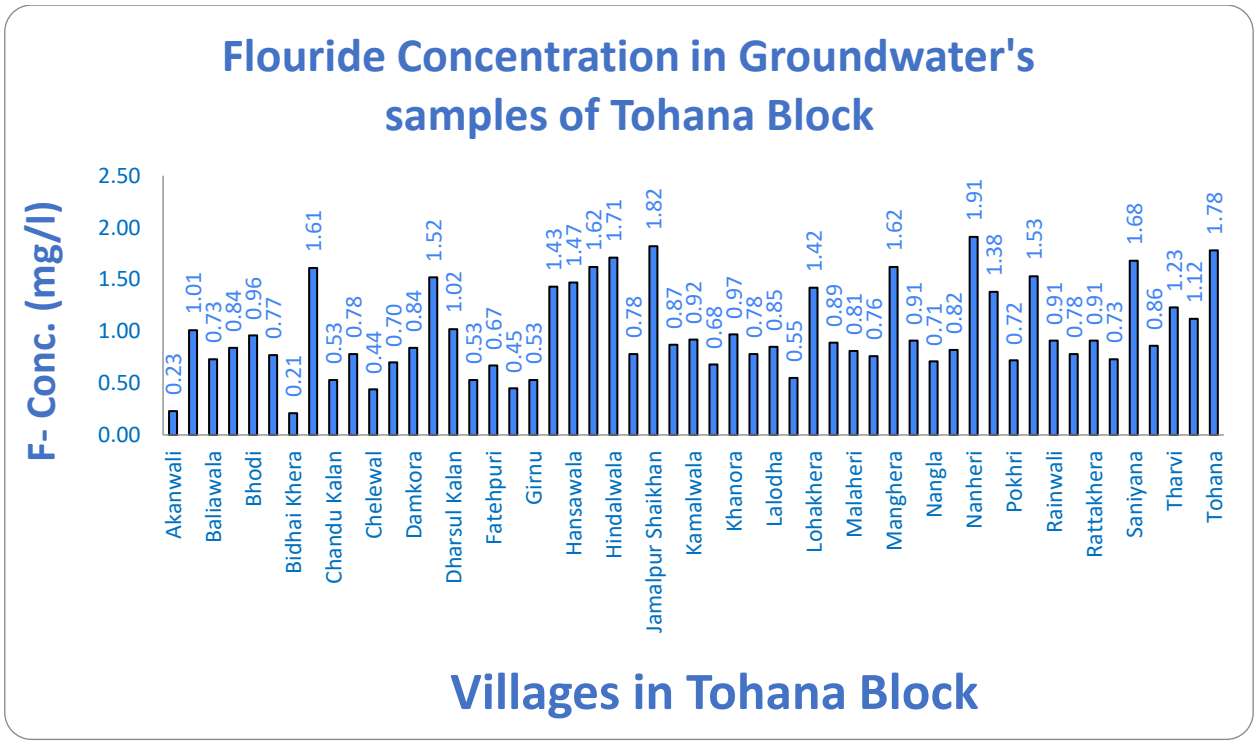

Fig. 3: Groundwater graphical representation depicting Fluoride concentration in collected water samples.

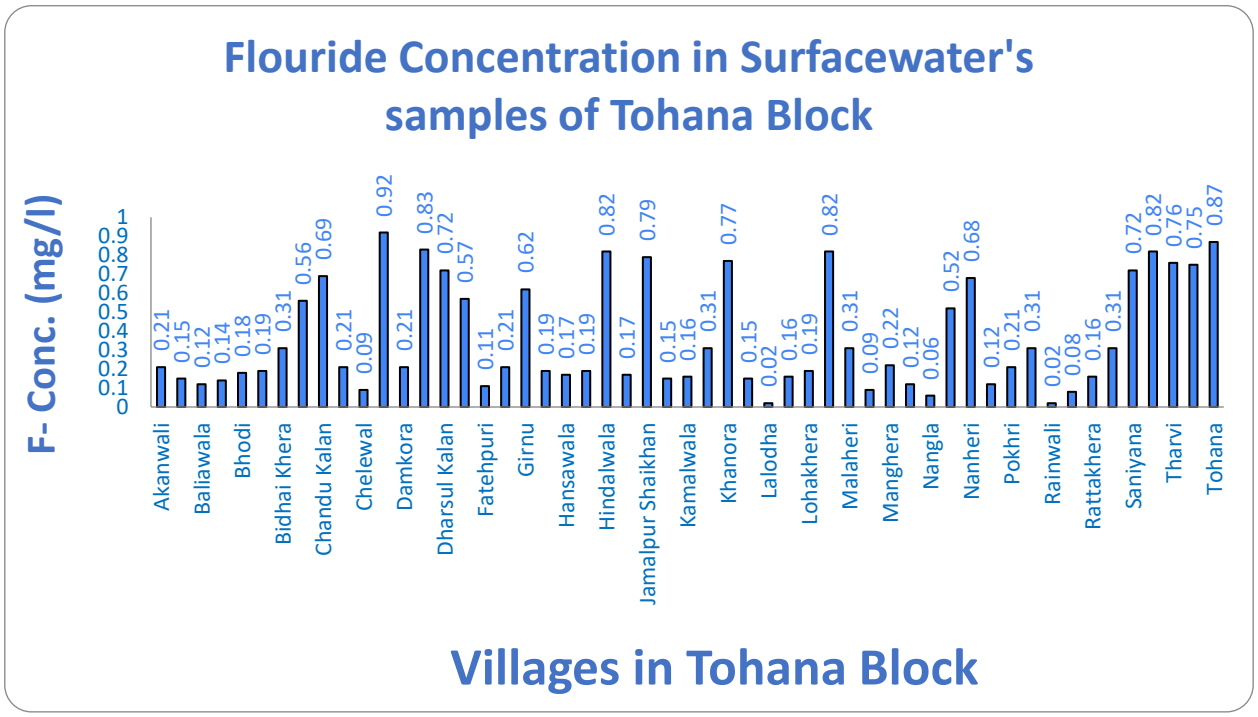

Fig. 4: Surface water graphical representation depicting Fluoride concentration in collected water samples.

Table 2: Fluoride distribution in Tohana Block.

Fluoride Distribution in Tohana Block		
Reading (mg/l)	**No. of Villages**	**Name of Villages**
0.01 to 1.50	43 (Groundwater)	Akanwali, Amani, Balianwala, Bhimawala, Bhodi, Bhodia khera, Bidhai khera, Chandukalan, Chanderkhurd, Chelewal, Chitain, Damkora, Dharsul kalan, Dharsul khurd, Fatehpuri, Gajuwala, Girnu, Haiderwala, Hansawala, Indachhoi, Japtewala, Kamalwala, Kanheri, Khanora, Kullan, Lalodha, Laluwal, Lohakhera, Maduwala, Malaheri, Mamupur, Mayemadh, Nangla, Nangli, Parta, Pokhri, Rainwali, Rasalpur, Rattakhera, Samain, Simbalwala, Tharvi, Tharwa
	53 (Surface water)	All samples lied in this range.
1.51 to 3.00	10 (Groundwater)	Budhanpur, Dangra, Himatpura, Hindalwala, Jamalpur, Manghera, Nanheri, Pirthala, Saniyana, Tohana
	53 (Surface water)	NA
3.01 to 4.50	NA	NA
4.51 to 6.00	NA	NA
6.01 and above	NA	NA

Table 3: Minimum and Maximum range of Fluoride in collected samples of water.

Fluoride Range in water samples of Tohana Block		
Type of Reading	**Reading (mg/l)**	**Name of Villages**
Minimum (Groundwater)	0.21	Bidhai Khera
Minimum (Surface Water)	0.02	Lalodha, Rainwali
Maximum (Groundwater)	1.91	Nanheri
Maximum (Surface Water)	0.92	Chitain

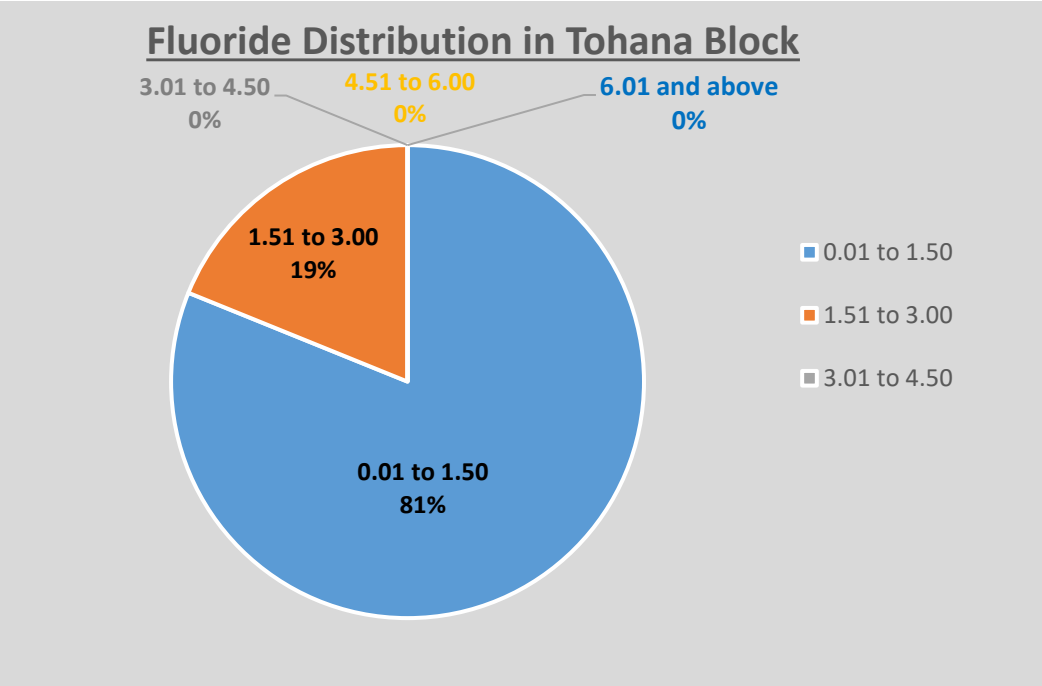

Fig. 5: Pivot representing Fluoride in Groundwater samples in Tohana.

Conclusion

Concentration of Fluoride concentration was found higher in case of groundwater samples as compared to surface water samples. All Surface water samples (100%) were found in the permissible range suggested by WHO and BIS. Groundwater at 10 test locations (19 percent) was found to be inappropriate for drinking purposes according to the intended and highest allowed level for fluoride in water (Fig. 5). It can be concluded that groundwater might be affecting the environment comprising humans and plants as well.

Author's Contribution

All authors contributed equally at all stages of research and preparation of the manuscript. Final form of manuscript was approved by all authors.

Conflict of Interest

Authors declare no conflict of interest with the present research work publication.

References

Ahmad S, Singh, N and Mazhar SN (2020) Hydrochemical characteristics of the groundwater in Trans-Yamuna Alluvial aquifer, Palwal District, Haryana, India. *Applied Water Science* **10**(2). DOI: 10.1007/s13201-020-1150-2.

Dippong T, Mihali C, Roșca OM, Marian M, Payer MM, Țîbîrnac M, Bud S, Coman G, Kovacs E and Hoaghia MA (2021) Physico-chemical characterization of water wells from Remeti, Maramureș. *Studia Universitatis Babeș-Bolyai Chemia* **66**(2): 197–212. DOI: 10.24193/subbchem.2021.02.17

Kaur L, Rishi MS and Siddiqui AU (2020) Deterministic and probabilistic health risk assessment techniques to evaluate non-carcinogenic human health risk (NHHR) due to fluoride and nitrate in groundwater of Panipat, Haryana, India. *Environmental Pollution* **259**: 113711. DOI: 10.1016/j.envpol.2019.113711

Kumar A, Balwinder, Thakur OP and Arya VS (2021a) Assessment of groundwater quality for drinking purpose in Babain block, Kurukshetra District, Haryana. *International Journal of Environment and Health Sciences* **3**(4): 9–13. DOI: 10.47062/1190.0304.02

Kumar, A., Rajesh, Kumar, S., and Datta, G. P. (2021b) Water quality study in Morni town, Panchkula District, Haryana, India. *International Journal of Environment and Health Sciences* **3**(1). DOI: 10.47062/1190.0301.03

Kumari S, Dhankhar H, Abrol V and Yadav AK (2023) A review on negative impact of F^- on cellular functioning of biological system of plants. *Ecology, Environment and Conservation* **29**. DOI: 10.53550/EEC.2023.v29i04.011

Kumari S, Dhankhar H, Abrol V and Yadav AK (2024a) Bioaccumulation of fluoride toxicity in plants and its effects on plants and techniques for its removal. In: Advanced Treatment Technologies for Fluoride Removal in Water: *Water Purification*: 271–290. DOI: 10.1007/978-3-031-38845-3_15

Kumari S, Dhankhar H, Abrol V and Yadav AK (2024b) Effect of Fluoride-Contaminated Water on the Living Being and Their Surroundings. *Advanced Treatment Technologies for Fluoride Removal in Water*: 215–231. DOI: 10.1007/978-3-031-38845-3_12

Kumari S, Kumar N, Kochhar N and Daulta R (2020) Monitoring of fluoride concentration in groundwater of Tosham Block, Bhiwani District, NW India: Correlation with

physico-chemical parameters. *Open Journal of Geology* **10**: 1047–1058. DOI: 10.4236/ojg.2020.1011050

Kumari, S., Dhankhar, H., Saini, A., and Gulia, K. (2024). Status of fluoride in groundwater of Haryana. Ecology, Environment and Conservation, **30** (2): 537–542. DOI: 10.53550/EEC.2024.v30i02.079

Malik A and Kavita (2022) Fluoride contamination in groundwater of intensively cropped Upper Yamuna alluvial basin of India: A hydrogeochemical, human health risk assessment, and multivariate statistical perspective. *Arabian Journal of Geosciences* **15**(17). DOI: 10.1007/s12517-022-10728-9

Pareek R, Singh V and Goyal R (2020) Assessment of Ground Water Quality of Ellenabad Town & Its Near By Villages with Respect to Fluoride. *International Journal of Theoretical and Applied Sciences* **7**(1): 41.

Ravish S, Setia B and Deswal S (2020) Groundwater quality and geochemical signatures in the northeastern Haryana, India. *Arabian Journal of Geosciences* **13**(21). DOI: 10.1007/s12517-020-06094-z

Sanou A, Méité N, Kouyaté A, Irankunda E, Kouamé AN, Koffi AE, Bohoussou KJP and Kouakou LPMS (2022) Assessing Levels and Health Risks of Fluoride and Heavy Metal Contamination in Drinking Water. *Journal of Geoscience and Environment Protection* **10**(11): 15–34. DOI: 10.4236/gep.2022.1011002

Sharma LM, Aparajeeta and Gautam Y (2020) A study on prevalence and impact of fluoride in drinking water in Nuh district of Haryana, India. *IOSR Journal of Environmental Science, Toxicology and Food Technology*14(8).

Singh B and Singh A (2021) Fluoride content in groundwater of Bapoli block of Panipat (NCR) Haryana, India. *Plant Archives* **21**(1). DOI: 10.51470/plantarchives.2021.v21.no1.178

Taher MK, Momoli F, Go J, Hagiwara S, Ramoju S, Hu X, Krewski D (2024) Systematic review of epidemiological and toxicological evidence on health effects of fluoride in drinking water. *Critical Reviews in Toxicology* **54**(1): 2–34. DOI: 10.1080/10408444.2023.2295338

WHO (2017) WHO Guidelines for Drinking Water Quality: First Addendum to the Fourth Edition. *American Water Works Association* **109**(7): 44–51. DOI: 10.5942/jawwa.2017.109.0087

Yadav P and Pandey D (2021) Assessment of Fluoride and Nitrate contamination problem in the groundwater of Mansear, Haryana, India. A case study Sodhsamhita.