

ASSESSMENT OF WATER FLUORIDE TOXICITY LEVELS IN NORTHWEST RAJASTHAN, INDIA

Veena Chaudhary,^a Mukesh Sharma,^b BS Yadav^c

Sriganganagar, Rajasthan, India

SUMMARY: Three hundred ground water samples from 57 village sites in the Indira Gandhi, Bhakra, and Gang canal catchment areas of northwest Rajasthan, India, were analysed for fluoride ion (F) and other physicochemical parameters. F concentrations ranged from 0.50 to 8.50 mg/L. From correlation coefficient studies, a highly positive association was found between HCO_3^- and F in irrigated soils. Geological formations of this zone consist of F-containing minerals, which could be a major source of F in these groundwater sources.

Keywords: Bhakra Canal catchment; Gang Canal catchment; Indira Gandhi Canal catchment; Northwest Rajasthan; Water fluoride.

INTRODUCTION

Groundwater is a major and preferred source of drinking water in the rural population of India. Owing to various ecological factors, natural and/or anthropogenic, the groundwater is getting increasingly polluted. In Rajasthan, fluoride (F) is the major inorganic pollutant of natural origin found in high levels in all 32 districts and has become a serious health related issue. Excessive intake of F can result in a progressive crippling condition known as fluorosis. The problem of severe fluorosis has been investigated in southern Rajasthan.¹

The present study area comprises the Sriganganagar and Hanumangarh districts of northwest Rajasthan lying between 28.4° and 30.3°N latitude and 72.3° and 75.3°E longitude (Figure). Groundwater samples from 57 village sites in the Indira Gandhi, Bhakra, and Gang canal catchment areas were analysed from deep aquifer-based tube wells in each area for F and other physicochemical parameters. The depth of the tube wells vary between 30 and 76 meters. Residents of this zone are poor, mostly illiterate farmers, who use the groundwater for irrigation and for domestic consumption without prior treatment.

MATERIALS AND METHODS

The analysis for physicochemical parameters and F in groundwater samples was carried out as per standard methodology. F was determined by SPADNS reagent method using colorimetry.²

RESULTS AND DISCUSSION

F concentrations in 100 water samples from village sites in each of the three canal catchment commands are shown in order of increasing concentration in the tables. In all three catchment areas the highest percentage of samples exceeded 1.5 mg F/L. In the Indira Gandhi catchment (Table 1) only 3% of the samples had <1.0 mg F/L, 12% had 1.0–1.5 mg F/L, and 85% were >1.5 mg F/L.

^aFor correspondence: Dr Veena Chaudhary, C.S.S.S. PG College, Machhra, Meerut, UP, 250110, India; E-Mail: veena_chaudhary@yahoo.co.in. ^bM. D. PG College, Sriganganagar, Rajasthan, India. ^cAgriculture Research Station, Sriganganagar, Rajasthan, India.

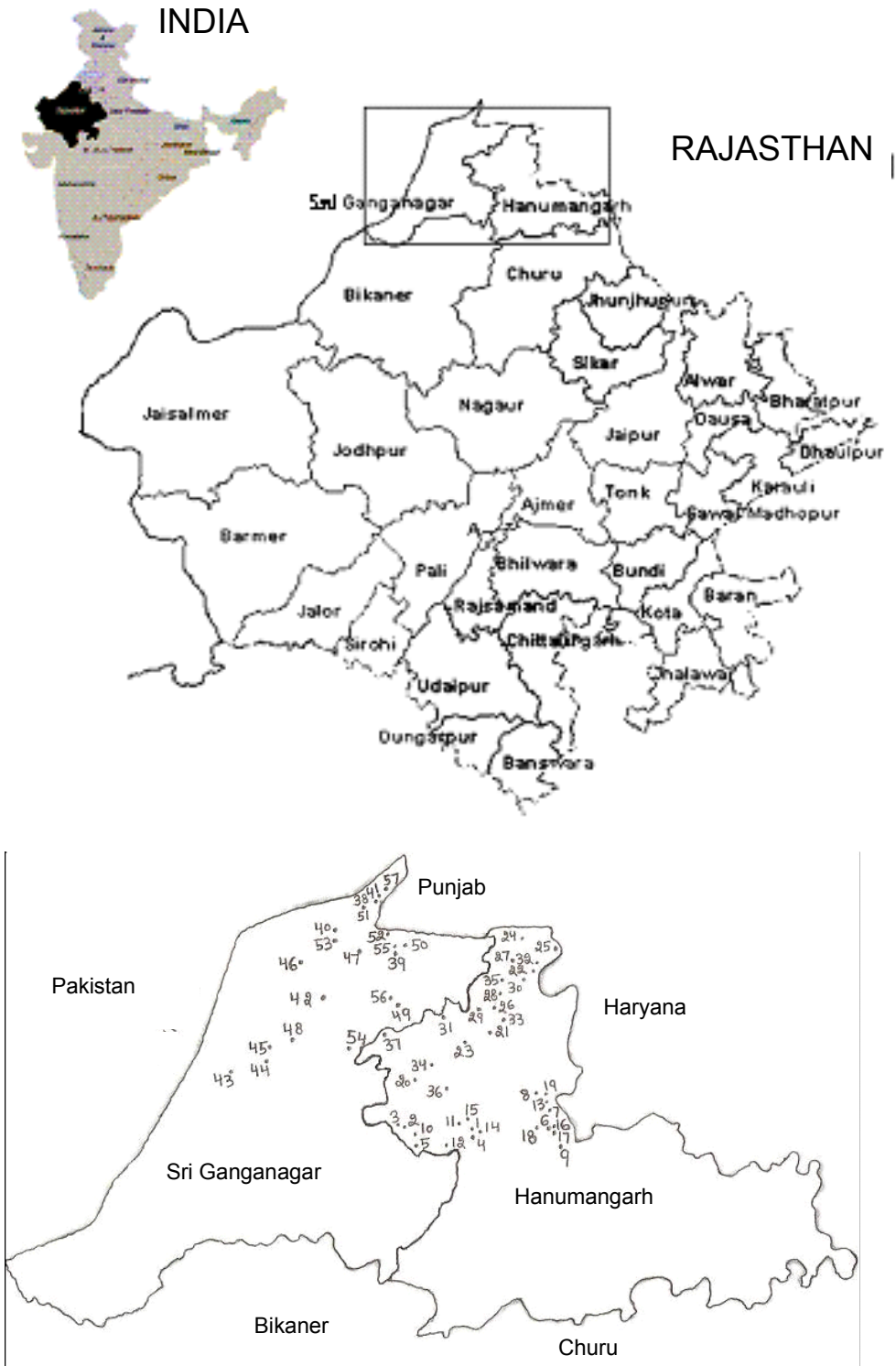


Figure. Location of the study area in the Sri Ganganagar and Hanumangarh districts of northwest Rajasthan, India, showing water sampling sites as numbered in Tables 1, 2, and 3.

Table 1. Fluoride concentration in water samples from villages in the Indira Gandhi canal catchment area of northwest Rajasthan

Site No.	Village name	No. of samples	F Range (mg/L)	Mean F (mg/L)
1	HLM	2	2.50–2.50	2.50
2	Paliwala-Suratgarh	3	1.50–4.0	2.50
3	Paliwala-Sangar	9	1.0–5.0	2.56
4	Ranjeetpura-RP	5	1.0–4.0	2.60
5	Badopal	2	2.50–3.0	2.75
6	Masitawali-RD	4	2.0–4.0	2.75
7	Masitawali-1MST	7	2.0–5.0	2.79
8	Miya ki Dhani	5	1.0–5.50	2.80
9	15-16 KWD	6	0.50–6.0	3.08
10	Thakruwala-NM	3	2.0–4.50	3.17
11	Naurangdeshar-NDR	6	2.0–4.50	3.17
12	Jakharawali-SPD	5	1.0–5.50	3.20
13	Lunawali Dhani	3	2.0–4.50	3.50
14	Rawatsar-KWD	18	0.50–8.0	3.69
15	Chohilawali-2C	5	3.0–5.50	3.90
16	Dabli Khurd	5	3.0–7.50	4.40
17	Brahampura Mani	6	4.0–5.50	4.58
18	Brahampura-AG	4	4.0–5.50	5.0
19	Mehrawala-4NDR	2	5.0–5.50	5.25

In the Bhakra catchment (Table 2) the percentages of water F with <1.0 mg/L, 1.0–1.5 mg/L, and >1.5 mg/L were 3, 13, and 78%, respectively. In the Gang catchment (Table 3) they were 5, 13, and 82%. The highest F concentration of 8.50 mg/L was found in Morjand Sikhan 11MJD village (sample site 35 near the Bhakra canal).

Table 2. Fluoride concentrations in water samples from villages in the Bhakra canal catchment area of northwest Rajasthan

Site No.	Village name	No. of samples	F Range (mg/L)	Mean F (mg/L)
20	Pilibanga	6	0.50–2.50	1.0
21	Lilawali	3	0.50–2.0	1.50
22	Ratanpura	8	0.50–3.50	1.69
23	Khunja-Suratgarh	5	0.50–3.0	1.90
24	Partap pura	2	2.50–3.0	2.75
25	Bhagatpura	2	2.50–3.0	2.75
26	Dholipal	2	1.50–4.0	2.75
27	Bolawali-amarapura	6	0.50–5.0	3.0
28	Morjand Sikhan-MJD	7	2.50–4.0	3.0
29	Mummadkhera-MMK	15	1.50–8.0	3.13
30	Sangaria-Bolanwali	5	3.0–3.50	3.20
31	Mummadkhera	16	1.50–5.50	3.34
32	Nathwana	4	3.0–4.0	3.38
33	Lilanwali	4	0.50–5.50	3.63
34	Gurusar Mordia	3	2.50–4.50	3.67
35	Morjand Sikhan	7	2.0–8.50	4.36
36	Longowal	3	4.0–5.0	4.50
37	Lalgarh Jatan	2	3.50–8.0	5.75

Table 3. Fluoride concentrations in water samples from villages in the Gang canal catchment area of northwest Rajasthan

Site No.	Village name	No. of samples	F Range (mg/L)	Mean (mg/L)
38	Khat labna	6	0.50–2.50	1.50
39	Khyaliwala	4	1.0–2.50	1.63
40	Mirjewala	9	0.50–3.0	1.72
41	Fatuhi-Shivpur	11	2.50–3.0	1.77
42	Bhagwansar	4	1.0–2.50	1.88
43	Bhompura-Nanuwala	2	2.0–2.0	2.0
44	Panwarsar	2	2.0–2.0	2.0
45	Kinkrawali	2	3.0–1.50	2.25
46	Kaminpura	3	3.0–1.50	2.33
47	Z-MINOR	1	2.50	2.50
48	Jaloki	2	2.50–2.50	2.50
49	22ML	3	2.0–3.0	2.50
50	Maluwala-ML	6	0.50–4.0	2.58
51	Koni	12	2.0–3.0	2.58
52	Sadhuwali-Z	4	2.50–3.0	2.63
53	Matili Rathan	3	2.50–3.0	2.83
54	LNP-LNP	6	2.0–4.0	2.83
55	LNP	8	2.0–4.0	2.88
56	Mahiyanwali	7	2.0–5.0	3.14
57	Sadhuwali	5	2.50–5.0	3.50

F concentrations showed a highly positive correlation with irrigated soils (+0.908). HCO_3^- likewise showed a positive correlation (+0.363) with F concentrations compared to other physicochemical parameters, and it has been observed that low Ca^{2+} and high HCO_3^- favour high F content in groundwater.^{3,4}

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