GROUNDWATER CHEMICAL QUALITY BULLETIN

HARYANA (PRE MONSOON-2024)

ABSTRACT

Pre-monsoon ground water quality assessment (2024) highlights the findings and groundwater contamination status.

CGWB, NWR, CHANDIGARH

1.0 INTRODUCTION

Ground water is an important resource widely used for drinking, irrigation and industrial purpose. Ground Water plays an important role in the sustainable socio-economic development. In regions with scarcity of fresh surface water sources dependence on ground water increases exponentially. Haryana exemplifies such a region, where groundwater resources, as of 2023, constitute a modest 2% of the total. They fulfill substantial proportions of irrigation and drinking water needs. However, heightened reliance on groundwater across various sectors has resulted in declining water quality and dwindling water levels. The ground water quality is dependent upon chemical characteristic of rocks and minerals composition of aquifer material. Due to redox reaction, ions can be dissolved from minerals by dissolution and crystallization within aquifer and concentrate beyond permissible limits. Poor ground water quality can also be due to excessive use of fertilizers, urbanization and industrial effluent discharge. According to UNESCO more than 80% of health issues are caused due to consumption of poor-quality water. Inorganic contaminants including Salinity, Fluoride, Nitrate, Arsenic, Iron and Uranium are important in determining the suitability of ground water for drinking purposes.

Therefore, periodic ground water quality assessment is important to alert people who utilize it for domestic and irrigation purpose.

Numerous studies have been carried out on the poor quality of groundwater. However, an extensive temporal and spatial study of Haryana State is lacking. Our efforts in the present study are to fulfill the following objectives:

1. To present current GW quality scenario, parameter wise for each district
2. To identify present day hot spots of poor-quality ground water through spatial variation analysis of latest 2024 quality pre monsoon data.

2.0 STUDY AREA

Haryana State, spanning 27°39' to 30°55' N latitude and 74°27' to 77°35' E longitude, covers 44,212 sq. km, comprising 1.4% of India's total area. Predominantly characterized by alluvial deposits, it hosts older and newer types rich in clay, silt, and sand, with piedmont deposits and sand dunes in specific regions. While alluvial plains dominate, hard rock formations from the Delhi Pre-Cambrian system exist in the south, and the Shiwalik Tertiary system lies in the north. As per 2023 Groundwater resource assessment, Total Annual Ground Water Recharge of the State has been

assessed as 9.55 bcm and Annual Extractable Ground Water Resource is 8.69bcm. The Total Current Annual Ground Water extraction is 11.80bcm and Stage of Ground Water extraction is 135.74 %.

Geomorphologically, the state is divided into three parts: Yamuna Flood Plain, Ghaggar Flood Plain, and inland basin (Figure 1).Based on Exploratory drilling by CGWB down to approximately 300m, a fence diagram depicting Haryana State illustrates the boundary between fresh and saline groundwater (Figure 2). The northern region predominantly contains fresh groundwater, whereas the southern and central parts exhibit thin fresh water layer underlain by saline water. While the western section initially harbors fresh water, deeper depths reveal saline water dominance.

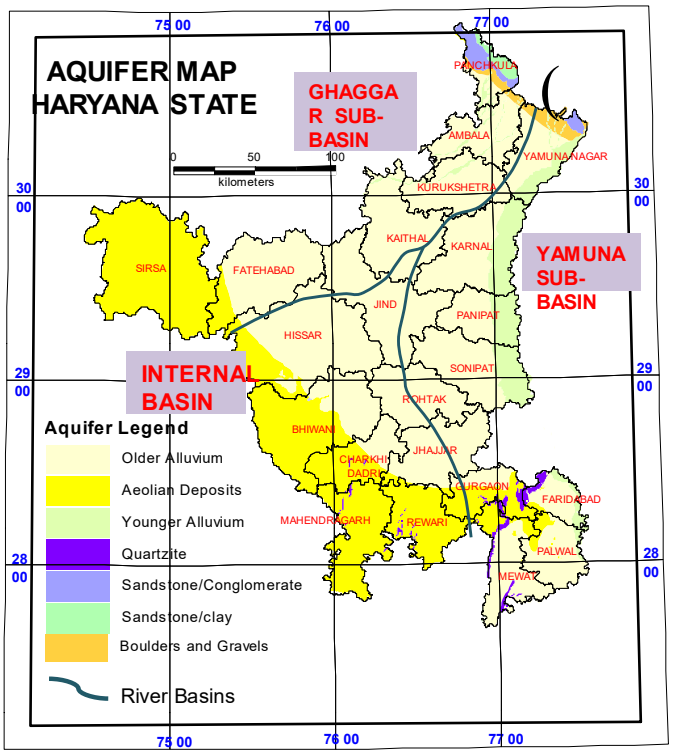


Figure-I: Map showing major aquifers and geomorphic divisions of Haryana State

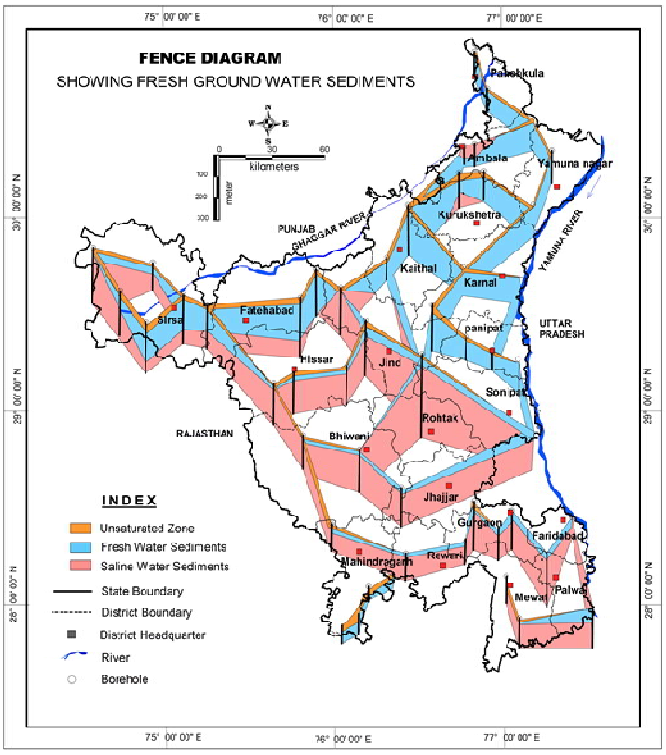


Figure-2: Map showing Fresh Saline Interface of Haryana

3.0 GROUNDWATER QUALITY MONITORING

Monitoring of ground water quality is an effort to obtain information on chemical quality through representative sampling in different hydro geological units. Ground Water is commonly tapped from phreatic aquifers. The main objective of ground water quality monitoring programme is to get information on the distribution of water quality on a regional scale as well as create a background data bank of different chemical constituents in groundwater.The probable causes of deterioration in ground water quality are depicted in Figure 3.

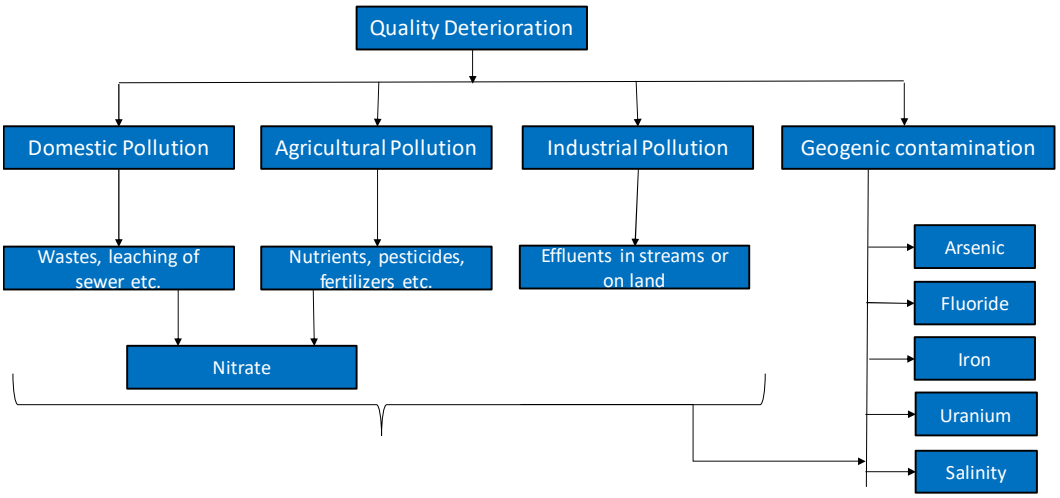


Figure-3: Schematic diagram illustrating the potential factors contributing to the degradation of groundwater quality

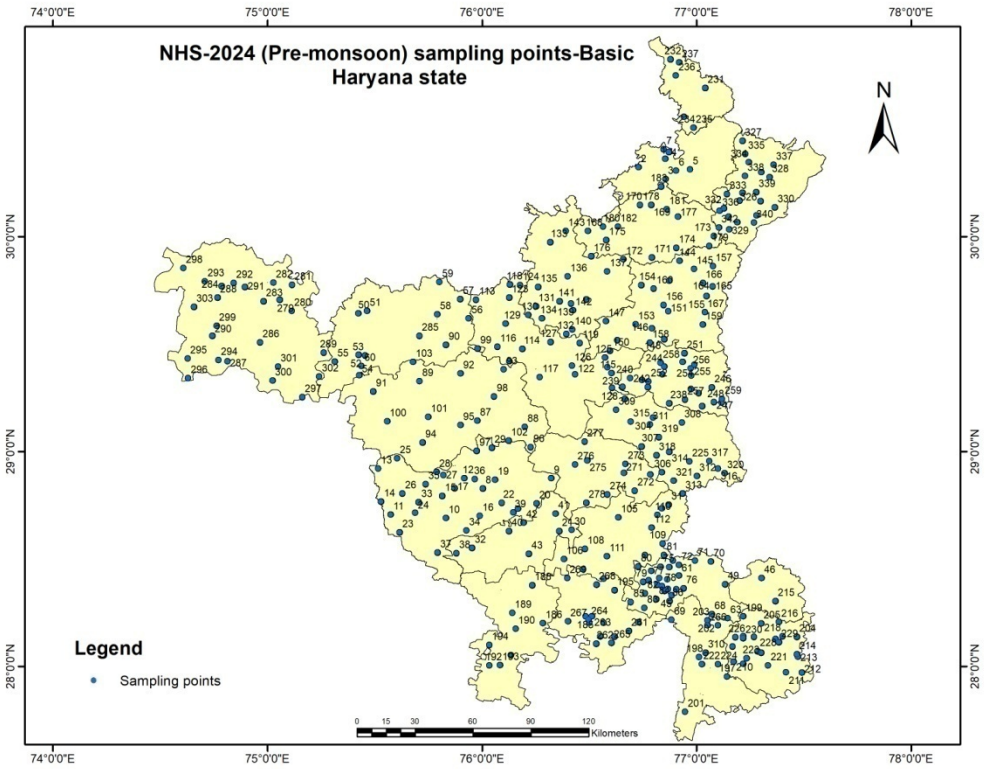


Figure- 4: Map showing Spatial Distribution of Groundwater Quality Monitoring Stations-Basic in Haryana based on 2024 NHS Pre monsoon

The chemical quality of shallow ground water of Haryana state is being monitored by Central Ground Water Board, NWR, Chandigarh twice in a year (Pre-monsoon and Post-monsoon) since 2023. The ground water samples were collected from 342 trend stations during pre monsoon for basic parameters and from 304 trend stations for Heavy Metals in 2024 (Figure 4 & 4A). The district-wise distribution of water Quality Monitoring Stations of CGWB are given in Table 1. The present bulletin is based on the water quality in net work stations of CGWB in year 2024 (Pre monsoon).

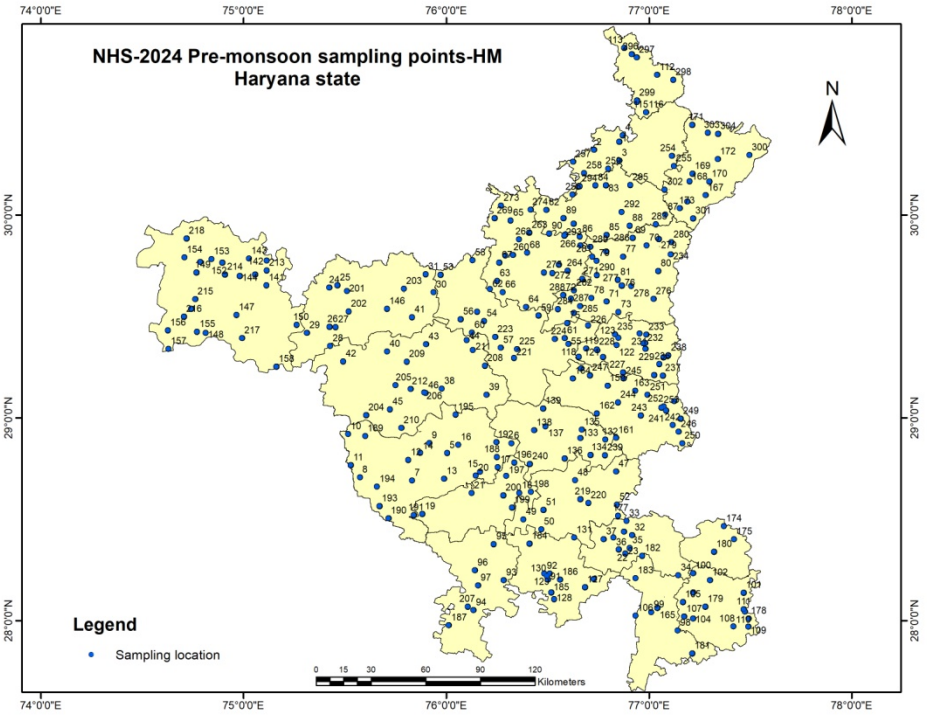


Figure- 4 A: Map showing Spatial Distribution of Groundwater Quality Monitoring Stations-HM in Haryana based on 2024 NHS Pre monsoon

Table 1: District wise distribution of water Quality Monitoring Stations in Haryana- Pre Monsoon-2024

S. No.	District	No. of water quality monitoring stations, Basic analysis	S. No.	District	No. of water quality monitoring stations, Heavy Metals
1	Ambala	7	1	Ambala	10
2	Bhiwani	30	2	Bhiwani	22
3	Charkhi Dadri	6	3	Charkhi Dadri	8

4	Faridabad	6	4	Faridabad	4
5	Fatehabad	11	5	Fatehabad	11
6	Gurugram	26	6	Gurugram	8
7	Hisar	17	7	Hisar	18
8	Jhajjar	9	8	Jhajjar	8
9	Jind	17	9	Jind	15
10	Kaithal	14	10	Kaithal	23
11	Karnal	24	11	Karnal	29
12	Kurukshetra	16	12	Kurukshetra	13
13	Mahendragarh	13	13	Mahendragarh	8
14	Mewat	7	14	Mewat	6
15	Palwal	27	15	Palwal	14
16	Panchkula	7	16	Panchkula	9
17	Panipat	22	17	Panipat	21
18	Rewari	10	18	Rewari	9
19	Rohtak	9	19	Rohtak	10
20	Sirsa	25	20	Sirsa	25
21	Sonipat	18	21	Sonipat	20
22	Yamunanagar	21	22	Yamunanagar	13
		342			304

4.0 GROUNDWATER QUALITY SCENARIO

The main objectives of ground water quality monitoring are to assess the suitability of ground water for drinking purposes as the quality of drinking water is a powerful environmental determinant of the health of a community. Bureau of Indian Standards (BIS) vide its document IS: 10500:2012, Edition 3.2 (2012-15) has recommended the quality standards for drinking water. The ground water

samples collected from phreatic aquifers are analysed for all the major inorganic parameters. Nevertheless, occurrence of high concentrations of some water quality parameters such as Salinity (EC), Fluoride, Nitrate, Iron, Arsenic and Uranium and the changes in water quality based on these parameters have been observed in the various parts of Haryana.

4.1Quality Assessment of Groundwater in Unconfined Aquifers

Unconfined aquifers are extensively tapped for water supply and irrigation across the state therefore; its quality is of paramount importance. The chemical parameters like TDS, Fluoride, Nitrate, Iron, Arsenic and Uranium etc are main constituents defining the quality of groundwater in unconfined aquifers.

1. Electrical Conductivity (> 3000 µS/cm)
2. Fluoride (>1.5mg/litre)
3. Nitrate (>45mg/litre)
4. Iron (>1.0mg/litre)
5. Arsenic (>0.01mg/litre)
6. Uranium (>30 ppb)

4.1.1 The Electrical conductivity

Electrical conductivity or Total dissolved solids or Salinity is the dissolved salt content in a water body. Different substances dissolve in water giving it taste and odor. Electrical conductivity represents total number of cations and anions present in groundwater, indicating ionic mobility of different ions, total dissolved solids and saline nature of water.

In general water having EC < 1500µS/cm, is considered as fresh water, EC 1500 –15000µS/cm, is considered as brackish water and >15000µS/cm is considered as saline water. Salinity always exists in ground water but in variable amounts. It is mostly influenced by aquifer material, solubility of minerals, duration of contact and factors such as the permeability of soil, drainage facilities, quantity of rainfall and above all, the climate of the area.BIS has recommended a drinking water standard for total dissolved solids limit of 500mg/I (corresponding to EC of about 750 µS/cm at 25^0C) that can be extended to a TDS of 2000 mg/L corresponding to EC of about 3000 µS/cm at 25^0C) in case of no alternate source. Water having TDS more than 2000 mg/L are not fit for drinking purpose.

Present Day Scenario in Haryana w.r.t Electrical Conductivity (EC)

Distribution of Electrical Conductivity (EC)

Grouping water samples based on EC values, it is found that nearly 22.22 % of them have EC less than 750 µS/cm, nearly 45.03 % have between 750 and 3000 µS/cm and the remaining 32.75 % of the samples have EC above 3000µS/cm. The map showing aerial distribution of EC (Figure 5) with intervals corresponding to limits as above.

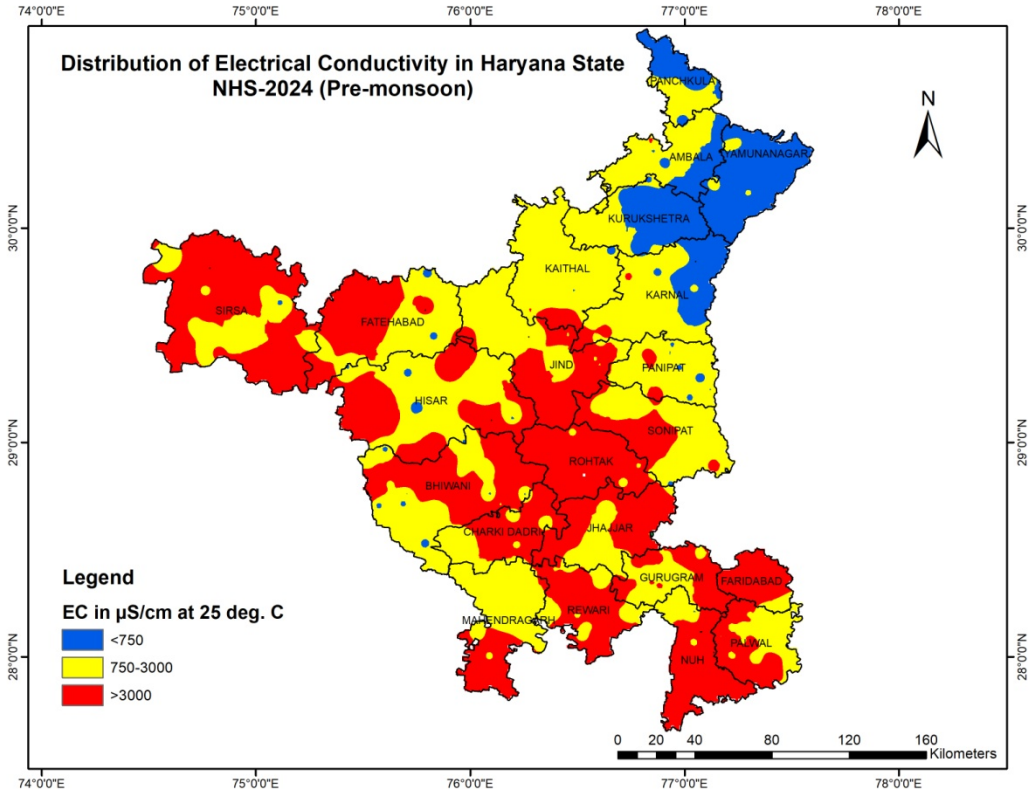


Figure 5: Map showing distribution of Electrical Conductivity in Haryana based on NHS 2024 Data

The ground water occurring in parts of Mahendergarh, Bhiwani, Charkhi Dadri, Nuh, Palwal ,Sirsa, Hisar, Rohtak, Jhajjar, Faridabad, Fatehabad and Sonipat districts is mostly saline and is not suitable for drinking purpose in terms of Electrical Conductance.

Table 2: District wise distribution of EC in shallow GW of Haryana

S. No.	District	No. of samples analysed	Permissible limit µS/cm	Desirable limit (µS/cm)	Q1	Q2	Q3	No. of samples (%)		
								< 750	750-3000	> 3000
1	Ambala	7	3000		568	815	2458	28.57	57.14	14.29
2	Bhiwani	30	3000		760	2985	6754	26.67	26.67	46.67
3	Charkhi Dadri	6	3000		1898	2814	6149	16.67	50.00	33.33
4	Faridabad	6	3000		2542	3905	4446	0.00	16.67	83.33
5	Fatehabad	11	3000		754	2113	3930	18.18	45.45	36.36
6	Gurugram	26	3000		1301	2166	4974	0.00	61.54	38.46
7	Hisar	17	3000		566	1578	4944	35.29	23.53	41.18
8	Jhajjar	9	3000		1068	3555	5141	11.11	33.33	55.56
9	Jind	17	3000		1500	1969	2901	0.00	82.35	17.65
10	Kaithal	14	3000		1183	2063	2900	7.14	71.43	21.43
11	Karnal	24	3000		646	802	1588	41.67	50.00	8.33
12	Kurukshetra	16	3000		486	677	815	68.75	31.25	0.00
13	Mahendragarh	13	3000		873	1930	2753	15.38	61.54	23.08
14	Mewat	7	3000		3704	5874	9649	14.29	0.00	85.71
15	Palwal	27	3000		1769	2340	5474	0.00	62.96	37.04
16	Panchkula	7	3000		498	554	1268	71.43	28.57	0.00
17	Panipat	22	3000		699	1537	2133	27.27	54.55	18.18
18	Rewari	10	3000		1850	2986	5362	0.00	50.00	50.00
19	Rohtak	9	3000		2636	4873	6773	0.00	33.33	66.67
20	Sirsa	25	3000		1290	3486	6198	4.00	32.00	64.00
21	Sonipat	18	3000		1474	2263	3317	5.56	61.11	33.33
22	Yamuna Nagar	21	3000		386	464	590	85.71	14.29	0.00

4.1.2 Nitrate

Naturally occurring nitrate forms when nitrogen and oxygen combine in soil, primarily sourced from atmospheric nitrogen. Groundwater nitrate mainly comes from chemical fertilizers, animal manure leaching, and sewage discharge. Identifying natural vs. man-made sources is challenging. Chemical and microbiological processes like nitrification and denitrification also affect groundwater nitrate levels.

As per the BIS standard for drinking water the maximum desirable limit of nitrate concentration in groundwater is 45 mg/l. Though nitrate is considered relatively non-toxic, a high nitrate concentration in drinking water is an environmental health concern arising from increased risks of methaemoglobinaemia particularly to infants. Adults can tolerate little higher concentration.

Present Day Scenario in Haryana w.r.t NITRATE (NO_3)

Distribution of Nitrate (NO_3)

The probable sources of nitrate contamination of ground water are through excessive application of fertilizers, bacterial nitrification of organic nitrogen, and seepage from animal and human wastes and atmospheric inputs. BIS permits a maximum concentration of 45 mg/L nitrate in drinking water. Considering this limit, it is found that nearly 75.1 % of the samples, spread over the entire State, have nitrate below 45 and nearly 24.9 % have more than 45 mg/L. Spatial distribution of nitrate is shown in Figure 6.

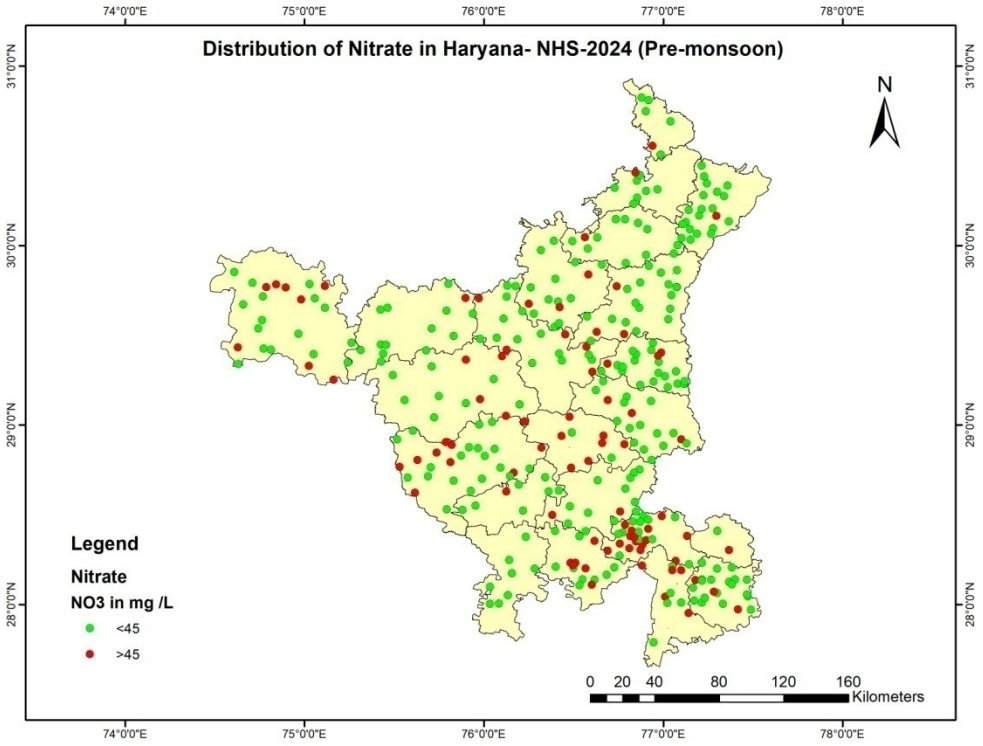


Figure 6: Map showing distribution of Nitrate in Haryana based on NHS 2024 Data

Table-3: District wise distribution of Nitrate in shallow GW of Haryana

S. No.	District	No. of samples analysed	Permissible limit mg/L	Desirable limit mg/L	Q1	Q2	Q3	No. of samples (%)	
								< 45 mg/L	> 45 mg/L
1	Ambala	7	45		0.40	2.40	23.00	85.71	14.29
2	Bhiwani	30	45		1.75	11.47	88.75	70.00	30.00
3	Charkhi Dadri	6	45		9.65	14.50	33.25	83.33	16.67
4	Faridabad	6	45		10.75	56.50	196.25	33.33	66.67
5	Fatehabad	11	45		3.99	22.00	28.00	90.91	9.09
6	Gurugram	26	45		28.75	44.50	105.50	50.00	50.00
7	Hisar	17	45		1.93	6.40	119.00	70.59	29.41
8	Jhajjar	9	45		6.45	13.00	39.50	88.89	11.11
9	Jind	17	45		18.00	39.00	50.50	70.59	29.41

10	Kaithal	14	45		8.00	18.00	40.00	78.57	21.43
11	Karnal	24	45		0.00	3.15	16.00	87.50	12.50
12	Kurukshetra	16	45		0.25	5.20	18.00	93.75	6.25
13	Mahendragarh	13	45		8.95	22.00	38.50	84.62	15.38
14	Mewat	7	45		6.00	55.00	57.00	42.86	57.14
15	Palwal	27	45		10.00	18.00	30.00	81.48	18.52
16	Panchkula	7	45		9.60	11.00	42.00	85.71	14.29
17	Panipat	22	45		1.05	9.85	1.20	86.36	13.64
18	Rewari	10	45		5.04	33.50	128.25	60.00	40.00
19	Rohtak	9	45		11.84	51.00	100.75	22.22	77.78
20	Sirsa	25	45		17.50	26.00	68.00	68.00	32.00
21	Sonipat	18	45		4.49	14.50	24.00	83.33	16.67
22	Yamunanagar	21	45		0.00	0.00	0.49	95.24	4.76

4.1.3 Fluoride

Fluorine does not occur in the elemental state in nature because of its high reactivity. It exists in the form of fluorides in a number of minerals of which Fluorspar, Cryolite, Fluorite & Fluorapatite are the most common.

Most of the fluoride found in groundwater is naturally occurring from the breakdown of rocks and soils or weathering and deposition of atmospheric particles. Most of the fluorides are sparingly soluble and are present in groundwater in small amount. The type of rocks, climatic conditions, nature of hydro geological strata and time of contact between rock and the circulating groundwater affect the occurrence of fluoride in natural water.

BIS has recommended a desirable limit of 1.0 mg/l of fluoride concentration in drinking water and maximum permissible limit of 1.5 mg/l in case no alternative source of drinking water is available. It is well known that small amount of fluoride (upto1.0 mg/l) have proven to be beneficial in reducing tooth decay. However, high concentrations (>1.5mg/l) have resulted in staining of tooth enamel while at still higher levels of fluoride (> 5.0 mg/l) further critical problems such as stiffness of bones occur. Water having fluoride concentration more than 1.5mg/l is not suitable for drinking

purposes. High Fluoride >1.5mg/l is mainly attributed due to geogenic conditions. The fluoride content in ground water from observation wells in a major part of the State is found to be less than 1.0 mg/l.

Present Day Scenario in Haryana w.r.t FLUORIDE (F)

Distribution of Fluoride (F)

Fluoride in small amounts in drinking water is beneficial for the dental health while in large amounts it is injurious. BIS recommends that fluoride concentration up to 1.0 mg/L in drinking water is desirable, up to 1.50 mg/L its is permitted and above 1.50 mg/L is injurious. Classification of samples based on this recommendation, it is found that nearly 59.7 % samples have fluoride value less than 1.0 mg/L, 16.7% have 1.0-1.5 mg/L and 23.6% samples have above 1.50 mg/L Fluoride concentration. Map showing spatial distribution (Figure 7) of fluoride contents in shallow ground water of Haryana.

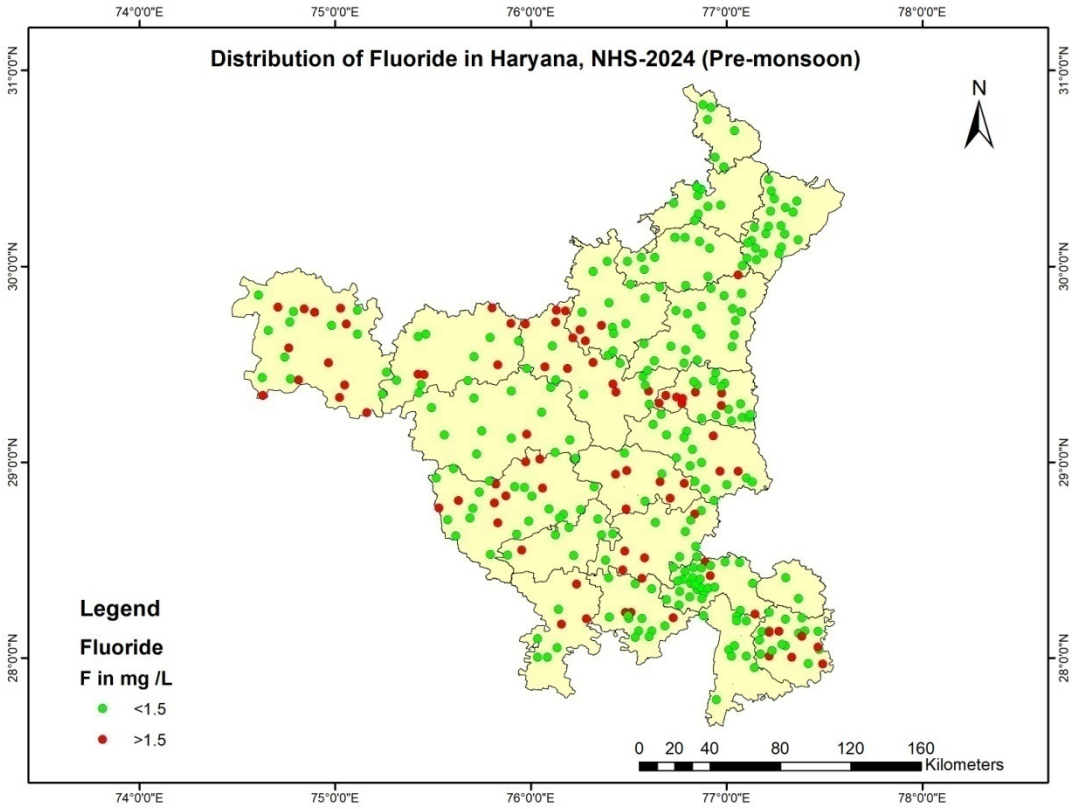


Figure 7: Map showing distribution of Fluoride in Haryana based on NHS 2024 Data

Table 4: District wise distribution of Fluoride in shallow GW of Haryana

S. No.	District	No. of samples analysed	Permissible limit mg/L	Desirable limit mg/L	Q1	Q2	Q3	No. of samples (%)	
								< 1.50 mg/L	> 1.50 mg/L
1	Ambala	7	1.50	1.00	0.41	0.57	0.78	100.00	0.00
2	Bhiwani	30	1.50	1.00	0.53	0.94	1.93	70.00	30.00
3	Charkhi Dadri	6	1.50	1.00	0.55	0.71	1.05	100.00	0.00
4	Faridabad	6	1.50	1.00	0.30	0.51	0.69	100.00	0.00
5	Fatehabad	11	1.50	1.00	0.69	1.08	1.95	63.64	36.36
6	Gurugram	26	1.50	1.00	0.34	0.44	0.74	88.46	11.54
7	Hisar	17	1.50	1.00	0.38	0.68	1.00	82.35	17.65

8	Jhajjar	9	1.50	1.00	0.64	1.20	2.15	55.56	44.44
9	Jind	17	1.50	1.00	0.75	1.60	2.20	41.18	58.82
10	Kaithal	14	1.50	1.00	0.62	0.84	2.10	71.43	28.57
11	Karnal	24	1.50	1.00	0.60	0.63	0.92	100.00	0.00
12	Kurukshetra	16	1.50	1.00	0.71	0.94	1.18	93.75	6.25
13	Mahendragarh	13	1.50	1.00	0.69	1.00	2.44	61.54	38.46
14	Mewat	7	1.50	1.00	0.28	0.64	0.87	100.00	0.00
15	Palwal	27	1.50	1.00	0.47	1.00	1.91	70.37	29.63
16	Panchkula	7	1.50	1.00	0.35	0.56	0.73	100.00	0.00
17	Panipat	22	1.50	1.00	0.89	1.40	2.14	63.64	36.36
18	Rewari	10	1.50	1.00	0.23	0.58	1.48	80.00	20.00
19	Rohtak	9	1.50	1.00	0.90	1.60	5.35	33.33	66.67
20	Sirsa	25	1.50	1.00	0.82	1.30	2.45	52.00	48.00
21	Sonipat	18	1.50	1.00	0.59	1.05	1.35	88.89	11.11
22	Yamunanagar	21	1.50	1.00	0.38	0.53	0.55	100.00	0.00

5. HEAVY METAL

5.1. Arsenic

Arsenic, a naturally occurring element, is widely distributed throughout the Earth's crust and can be found in various environmental mediums such as water, air, food, and soil. It exists in two primary forms: organic and inorganic. While natural processes like biological activities, weathering reactions, and volcanic emissions contribute to arsenic release, human activities also play a significant role. Anthropogenic sources include mining activities, fossil fuel combustion, the use of arsenical pesticides, herbicides, and crop desiccants, as well as arsenic additives in livestock feed, especially poultry feed. Although the use of arsenical products like pesticides and herbicides has declined over recent decades, their use in wood preservation remains common.

The maximum permissible limit for arsenic according to the Bureau of Indian Standards (BIS) is 10 parts per billion (ppb).

Present Day Scenario in Haryana w.r.t ARSENIC

Distribution of Arsenic (As)

BIS recommends that arsenic concentration up to 0.01 mg/L in drinking water is acceptable. Classification of samples based on this recommendation, it is found that only one samples in Ambala district and two samples in Sonipat district have arsenic above 0.01 mg/L. Map showing spatial distribution (Figure 8) of arsenic content in ground water (2024).

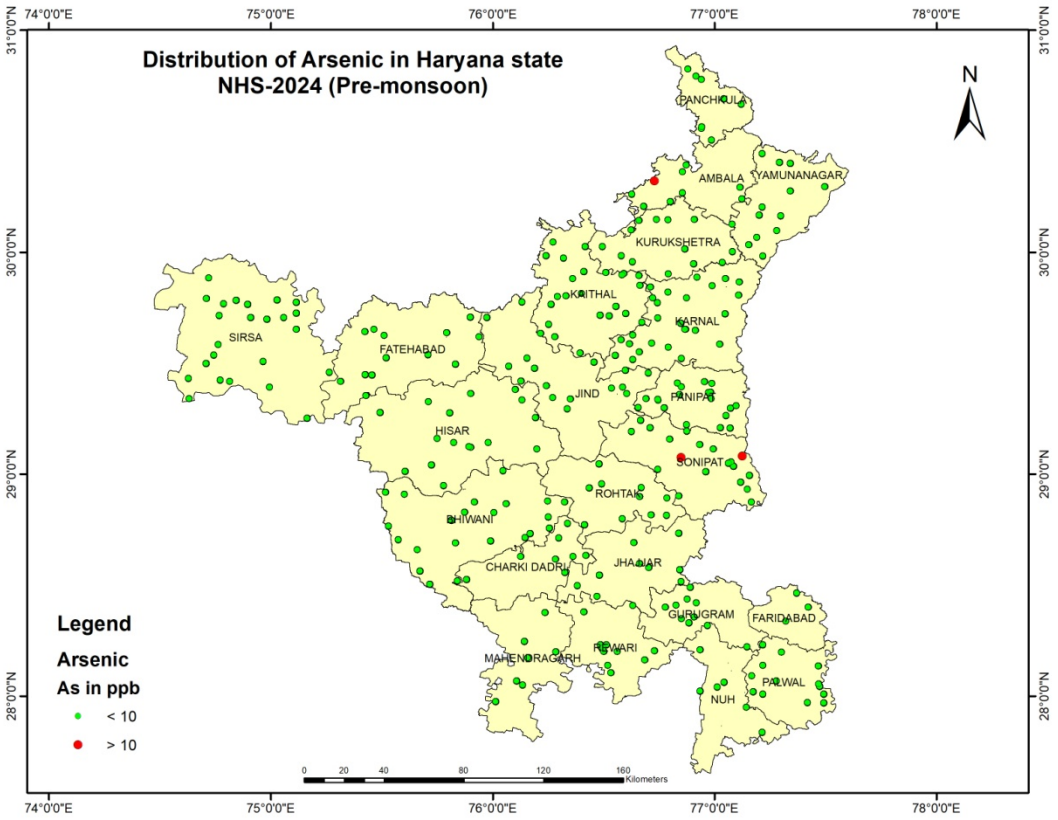


Figure 8: Map showing distribution of Arsenic in Haryana based on NHS 2024 Data

Table 5: District wise distribution of Arsenic in shallow GW of Haryana

S. No.	District	No. of samples analysed	Permissible limit (ppb)	Desirable limit (ppb)	Q1	Q2	Q3	No. of samples (%)	
								<= 10ppb	> 10 ppb
1	Ambala	10	10.0		0.674	1.326	4.120	90	10
2	Bhiwani	22	10.0		0.356	0.843	1.674	100	0
3	Charkhi Dadri	8	10.0		0.220	0.389	1.012	100	0
4	Faridabad	4	10.0		0.201	0.497	0.526	100	0
5	Fatehabad	11	10.0		0.316	0.876	1.248	100	0
6	Gurugram	8	10.0		0.181	0.399	0.467	100	0
7	Hisar	18	10.0		0.186	0.298	0.810	100	0
8	Jhajjar	8	10.0		0.408	0.547	2.428	100	0
9	Jind	15	10.0		0.866	0.954	2.534	100	0
10	Kaithal	23	10.0		0.520	0.905	2.016	100	0
11	Karnal	29	10.0		0.376	0.504	0.686	100	0
12	Kurukshetra	13	10.0		0.494	0.669	1.583	100	0
13	Mahendragarh	8	10.0		0.379	0.391	2.060	100	0
14	Mewat	6	10.0		0.059	0.118	0.744	100	0
15	Palwal	14	10.0		0.229	0.509	0.624	100	0
16	Panchkula	9	10.0		0.135	0.167	0.328	100	0
17	Panipat	21	10.0		0.491	0.636	1.055	100	0
18	Rewari	9	10.0		0.142	0.242	0.491	100	0
19	Rohtak	10	10.0		0.466	0.840	6.460	100	0
20	Sirsa	25	10.0		0.611	0.767	1.401	100	0
21	Sonipat	20	10.0		0.362	0.581	2.402	90	10
22	Yamunanagar	13	10.0		0.205	0.355	1.202	100	0

5.2 Iron

Iron is a common constituent in soil and ground water. It is present in water either as soluble ferrous iron or the insoluble ferric iron. Water containing ferrous iron is clear and colorless because the iron is completely dissolved. When exposed to air, the water turns cloudy due to oxidation of ferrous iron into reddish brown ferric oxide.

The concentration of iron in natural water is controlled by both physico chemical and microbiological factors. It is contributed to ground water mainly from weathering of ferruginous minerals of igneous rocks such as hematite, magnetite and sulphide ores of sedimentary and metamorphic rocks. The permissible Iron concentration in ground water is less than 1.0 mg/litre as per the BIS Standard for drinking water.

Present Day Scenario in Haryana w.r.t IRON

Distribution of Iron (Fe)

BIS recommends that iron concentration up to 1.0 mg/L in drinking water is acceptable. Classification of samples based on this recommendation, it is found that 97.7 % samples have iron less than 1.0 mg/L and 2.3% samples have iron more than 1.0 mg/L. Map showing spatial distribution (Figure 9) of iron content in ground water (2024).

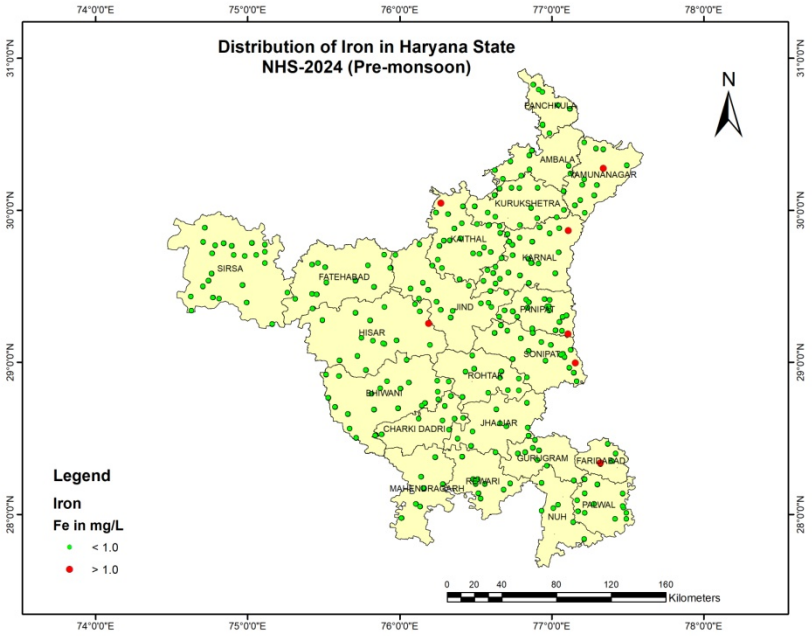


Figure 9: Map showing distribution of Ion in Haryana based on NHS 2024 Data

Table 6: District wise distribution of Iron (Fe) in shallow GW of Haryana

S. No.	District	No. of samples analysed	Pemissible limit (ppm)	Desirable limit (ppm)	Q1	Q2	Q3	No. of samples (%)	
								<= 1.0	> 1.0
1	Ambala	10	1.00		0.01	0.01	0.03	100.00	0.00
2	Bhiwani	22	1.00		0.01	0.01	0.03	100.00	0.00
3	Charkhi Dadri	8	1.00		0.02	0.04	0.24	100.00	0.00
4	Faridabad	4	1.00		0.00	0.00	0.46	100.00	0.00
5	Fatehabad	11	1.00		0.01	0.02	0.04	100.00	9.10
6	Gurugram	8	1.00		0.00	0.00	0.00	100.00	0.00
7	Hisar	18	1.00		0.01	0.02	0.23	94.44	5.56
8	Jhajjar	8	1.00		0.00	0.00	0.02	100.00	0.00
9	Jind	15	1.00		0.00	0.00	0.01	100.00	0.00
10	Kaithal	23	1.00		0.01	0.01	0.02	95.65	4.35
11	Karnal	29	1.00		0.01	0.01	0.02	96.55	3.50
12	Kurukshetra	13	1.00		0.01	0.01	0.02	100.00	0.00
13	Mahendragarh	8	1.00		0.00	0.00	0.01	100.00	0.00
14	Mewat	6	1.00		0.00	0.01	0.09	100.00	0.00
15	Palwal	14	1.00		0.01	0.01	0.02	92.86	0.00
16	Panchkula	9	1.00		0.00	0.01	0.02	100.00	0.00
17	Panipat	21	1.00		0.00	0.01	0.08	95.24	4.76
18	Rewari	9	1.00		0.00	0.01	0.30	100.00	0.00
19	Rohtak	10	1.00		0.00	0.01	0.10	100.00	0.00
20	Sirsa	25	1.00		0.01	0.01	0.02	100.00	0.00
21	Sonipat	20	1.00		0.00	0.00	0.08	95.00	5.00
22	Yamunanagar	13	1.00		0.01	0.03	0.19	92.31	7.69

5.3 Uranium

Uranium occurs naturally in groundwater and surface water. Being naturally occurring uranium in groundwater and surface water poses health risks due to its radioactive properties. Sources include natural deposits, nuclear industry emissions, coal combustion, and phosphate fertilizers. Human exposure occurs mainly through drinking water, food, air, and occupational hazards. Concentrations exceeding 30 ppb, according to BIS standards, can cause damage to internal organs with prolonged intake, necessitating caution in consumption.

Present Day Scenario in Haryana w.r.t URANIUM

Distribution of Uranium (U)

BIS recommends that uranium concentration up to 0.03 mg/L in drinking water is acceptable. Classification of samples based on this recommendation, it is found that nearly 19.1 % samples have uranium above 0.03 mg/L. Map showing spatial distribution of uranium content in ground water (2024).

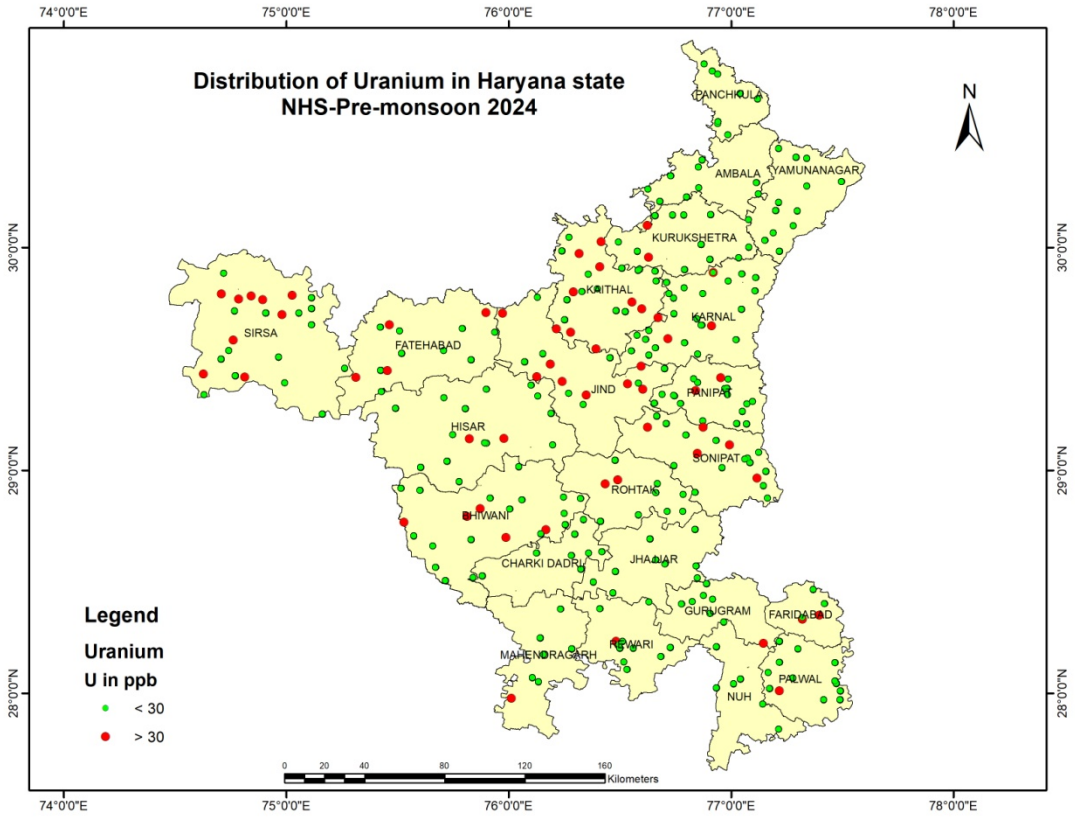


Figure 10: Map showing distribution of Uranium in Haryana based on NHS 2024 Data

Table 7: District wise distribution of Uranium (U) in shallow GW of Haryana

S. No.	District	No. of samples analysed	Pemissible limit (ppb)	Desirable limit (ppb)	Q1	Q2	Q3	No. of samples (%)	
								<= 30 ppb	> 30 ppb
1	Ambala	10	30.00		6.41	8.36	12.04	90.00	10.00
2	Bhiwani	22	30.00		5.27	16.85	33.22	77.27	22.73
3	Charkhi Dadri	8	30.00		7.19	9.77	16.73	100.00	0.00
4	Faridabad	4	30.00		16.28	29.42	43.17	50.00	50.00
5	Fatehabad	11	30.00		17.57	25.29	31.21	63.64	36.36
6	Gurugram	8	30.00		6.95	10.12	19.50	87.50	12.50
7	Hisar	18	30.00		3.81	10.86	16.54	88.89	11.11
8	Jhajjar	8	30.00		4.02	8.53	14.15	100.00	0.00
9	Jind	15	30.00		22.84	28.95	33.45	53.33	46.67
10	Kaithal	23	30.00		16.25	27.76	36.37	56.52	43.48
11	Karnal	29	30.00		11.28	19.12	26.41	86.21	13.79
12	Kurukshetra	13	30.00		9.55	13.02	21.24	92.31	7.69
13	Mahendragarh	8	30.00		5.66	14.22	30.58	75.00	25.00
14	Mewat	6	30.00		0.67	1.63	4.20	100.00	0.00
15	Palwal	14	30.00		6.04	14.55	20.32	92.86	7.14
16	Panchkula	9	30.00		1.03	4.34	5.50	100.00	0.00
17	Panipat	21	30.00		15.21	20.19	23.53	90.48	9.52
18	Rewari	9	30.00		1.99	4.19	7.51	100.00	0.00
19	Rohtak	10	30.00		13.23	21.99	31.53	80.00	20.00
20	Sirsa	25	30.00		13.68	22.81	39.13	64.00	36.00
21	Sonipat	20	30.00		7.42	23.58	30.16	75.00	25.00
22	Yamunanagar	13	30.00		4.37	5.21	11.78	100.00	0.00

6. SUMMARY

District wise Contaminant wise Status Summary based on NHS 2023 Post- Monsoon Data

The Table 8 provides a detailed summary of groundwater quality across various districts in Haryana, focusing on basic parameters (Electrical conductivity, Nitrate, Fluoride) and heavy metals (Iron, Arsenic, Uranium).

Table 8: Summary of Groundwater Quality in Various Districts of Haryana, Highlighting Basic Parameters (Electrical Conductivity, Nitrate, Fluoride) and Heavy Metals (Iron, Arsenic, Uranium)-2024

District	Total No. of Basic samples	Samples exceeding permissible limit: In Number (%age of samples)			Total No. of HM Samples	Samples exceeding permissible limit: In Number (%age of samples)		
		EC	NO3	F		Fe	As	U
		µS/cm at 25^0C	mg/L	mg/L		(ppm)	(ppb)	(ppb)
Ambala	7	1 (14 %)	1 (14 %)	0 (0 %)	10	0 (0 %)	1 (10 %)	1 (10 %)
Bhiwani	30	14 (47 %)	9 (30 %)	9 (30 %)	22	0 (0 %)	0 (0 %)	5 (23 %)
Charkhi Dadri	6	2 (33 %)	1 (17 %)	0 (0 %)	8	0 (0 %)	0 (0 %)	0 (0 %)
Faridabad	6	5 (83 %)	4 (67 %)	0 (0 %)	4	0 (0 %)	0 (0 %)	2 (50 %)
Fatehabad	11	4 (36 %)	1 (9 %)	4 (36 %)	11	0 (0 %)	0 (0 %)	4 (36 %)
Gurugram	26	10 (38 %)	13 (50 %)	3 (12 %)	8	0 (0 %)	0 (0 %)	1 (13 %)
Hisar	17	7 (41 %)	5 (29 %)	3 (18 %)	18	1 (6 %)	0 (0 %)	2 (11 %)
Jhajjar	9	5 (56 %)	1 (11 %)	4 (44 %)	8	0 (0 %)	0 (0 %)	0 (0 %)
Jind	17	3 (18 %)	5 (29 %)	10 (59 %)	15	0 (0 %)	0 (0 %)	7 (47 %)
Kaithal	14	3 (21 %)	3 (21 %)	4 (29 %)	23	1 (4 %)	0 (0 %)	10 (43 %)
Karnal	24	2 (8 %)	3 (13 %)	0 (0 %)	29	0 (0 %)	0 (0 %)	4 (14 %)
Kurukshetra	16	0 (0 %)	1 (6 %)	1 (6 %)	13	0 (0 %)	0 (0 %)	1 (8 %)
Mahendragarh	13	3 (23 %)	2 (15 %)	5 (38 %)	8	0 (0 %)	0 (0 %)	2 (25 %)
Mewat	7	6 (86 %)	4 (57 %)	0 (0 %)	6	0 (0 %)	0 (0 %)	0 (0 %)
Palwal	27	10 (37 %)	5 (19 %)	8 (30 %)	14	1 (7 %)	0 (0 %)	1 (7 %)

Panchkula	7	0 (0 %)	1 (14 %)	0 (0 %)	9	0 (0 %)	0 (0 %)	0 (0 %)
Panipat	22	4 (18 %)	3 (14 %)	8 (36 %)	21	1 (5 %)	0 (0 %)	2 (10 %)
Rewari	10	5 (50 %)	4 (40 %)	2 (20 %)	9	1 (11 %)	0 (0 %)	0 (0 %)
Rohtak	9	6 (67 %)	7 (78 %)	6 (67 %)	10	0 (0 %)	0 (0 %)	2 (20 %)
Sirsa	25	16 (64 %)	8 (32 %)	12 (48 %)	25	0 (0 %)	0 (0 %)	9 (36 %)
Sonipat	18	6 (33 %)	3 (17 %)	2 (11 %)	20	1 (5 %)	2 (10 %)	5 (25 %)
Yamunanagar	21	0 (0 %)	1 (5 %)	0 (0 %)	13	1 (8 %)	0 (0 %)	0 (0 %)

Basic Parameters:

- EC (Electrical Conductivity): Nearly 33% of samples exceed permissible limits, with higher occurrences in parts of Mahendergarh, Bhiwani, Charkhi Dadri, Nuh, Palwal ,Sirsa, Hisar, Rohtak, Jhajjar, Faridabad, Fatehabad and Sonipat districts etc.
- NO_3 (Nitrate): Nearly 24.9 % of samples exceed limits, with notable levels in parts of Faridabad, Mewat, Gurugram, Rohtak and Rewari districts etc..
- F (Fluoride): Overall, 23.6 % of samples surpass permissible levels, with notable levels in parts of Rohtak, Jind, Sirsa, Jhajjar, Fatehabd and Panipat districts etc.

Heavy Metals:

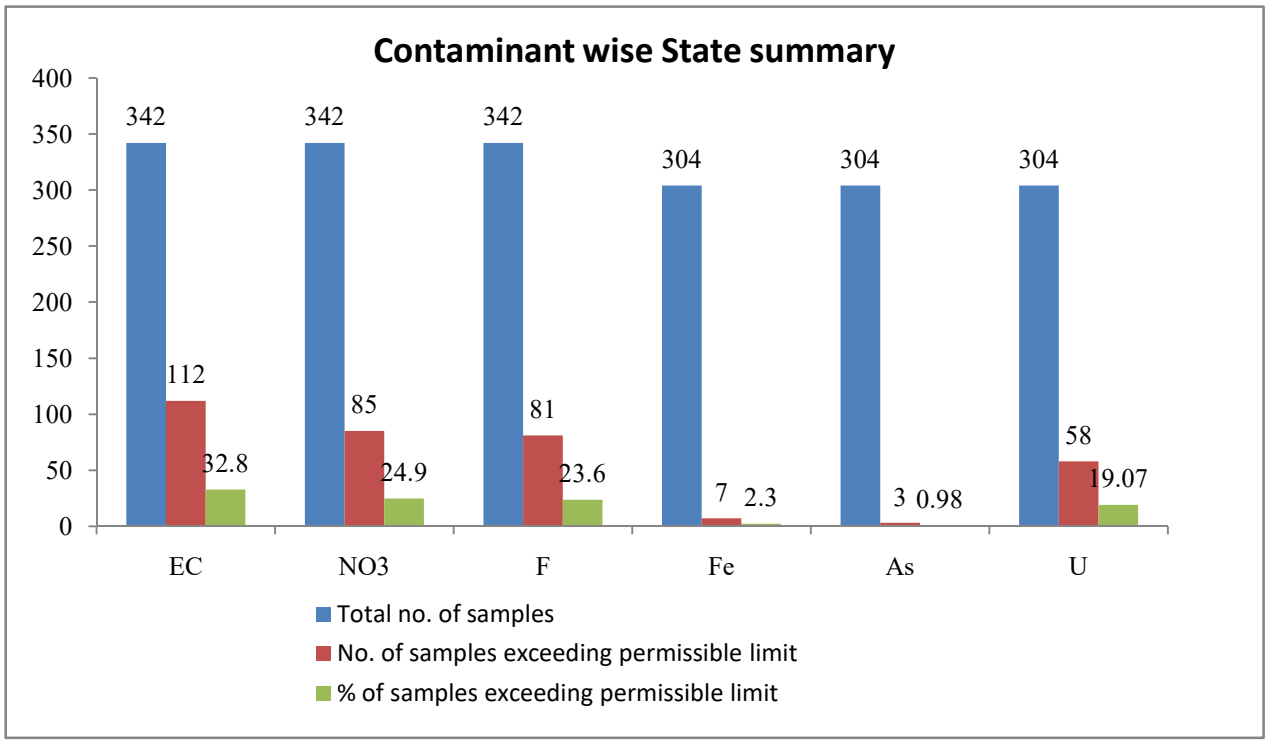
- Fe (Iron): Only in 2.3 % samples, detected in 2 samples of Bhiwani and one sample each in Palwal, Yamunanagar, Hisar, Kaithal, Faridabad and Sonipat district with minimal occurrences across districts
- As (Arsenic): Only in 1.85 % samples, detected in only one sample in Ambala district and two samples in Sonipat districts with minimal occurrences across districts.
- U (Uranium): Detected in 19.1 % of samples, with significant levels in certain districts like Fatehabad, Kaithal, Karnal and Jind districts etc.

The Table 9 provides a summary of groundwater quality in the state of Haryana, broken down by the number of samples collected and the percentage of those samples that are contaminated with various parameters.

Table 9: Summary of Groundwater Quality in Haryana: Samples Collected and Contamination Percentage

		Number of samples contaminated (%age of samples contaminated)		
Haryana State Summary	**Total no. of Basic samples**	**EC**	**NO3**	**F**
	342	112(32.8%)	85(24.9%)	81(23.6%)
	Total no. of HM samples	**Fe**	**As**	**U**
	304	7(2.3%)	3(0.98%)	58(19.07%)

Graphical representation of the same is depicted hereunder



The groundwater quality assessment in Haryana revealed notable levels of contamination across various parameters. Nitrate emerged as the predominant contaminant, with 24.9 % of samples surpassing permissible limits, followed by Fluoride (F) at 23.6 % and Uranium in 19.07 % samples while Arsenic (As) and Iron (Fe) exhibited lower levels of contamination, with 0.98% of samples and 2.3 % samples exceeding permissible limits respectively.