GROUNDWATER CHEMICAL QUALITY BULLETIN

Jammu & Kashmir

ABSTRACT

Periodic ground water quality assessment (2024- Pre Monsson) highlighting the findings, significant trends and groundwater contamination status

CGWB, NWHR, Jammu

1.0 INTRODUCTION

Water is a vital component for living organisms. Without water life cannot exist. About 71 percent of the Earth's surface is water-covered. Oceans store the maximum water approx. 96.5 percent of all Earth's water. The rest can be found in glaciers, rivers, lakes, springs, groundwater etc. Since most of the water is found in oceans, it is not suitable for human beings as it consists of large quantities of chemical components. Thus groundwater becomes the major source of water. The water present in aquifers below the surface is known as groundwater. In India groundwater is lifeline of the people. Majority of the population depends upon the groundwater for their domestic use such as drinking, irrigation and other usages. Ground water is particularly important as it accounts for about 90% safe drinking water in rural areas, where population is widely dispersed and the infrastructure needed for treatment and transportation of surface water does not exist and hence safe resource of water is groundwater. Ground water plays an important role in India with context to increase in pollution of surface water resources.

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.

Numerous studies have been carried out on the poor quality of groundwater. However, an extensive temporal and spatial study of Jammu & Kashmir is lacking. This year the analysis of groundwater samples of J&K is done on the basis of Pre and Post Monsson. Groundwater samples have been collected twice this year for the locations exhibiting higher level of contamination as per SOP. The trend samples are selected on the basis of higher level of EC, Nitrate and Fluoride. The Hotspots are selected on the basis of Iron and Manganese with Arsenic, Uranium as other constituents.

Our efforts in the present study are to fulfill the following objectives:

1. To present GW quality scenario for the locations having higher elevated level of EC, Nitrate and Fluoride.

2. To identify present day hot spots of poor-quality ground water through spatial variation analysis of latest 2024 pre monsoon quality data.

3. To assess temporal variation of ground water quality showing improvement / deterioration during the pre-monsoon period from 2023 to 2024 providing insights for effective water quality management measures.

2.0 STUDY AREA

Jammu and Kashmir is the northern most UT of India after Ladakh. It lies within latitudes of 32°17’ and 36°08’ N and longitudes of 73°23’ and 76°47' E. The UT has a total geographical area of 42,241 Sq. Km. The Union Territory has international border with Pakistan in the west. The UTs of Punjab and Himachal Pradesh form its southern border and UT of Ladakh forms the northern and north eastern border. Major parts of the J&K UT represent high and rugged mountainous terrain. The Jammu & Kashmir is divided into two administrative divisions’ viz. Kashmir Division and Jammu division, further divided in 20 districts (10 each in Jammu Division & Kashmir Division). Beside this, two districts i.e. Mirpur & Muzaffarabad are inaccessible. Groundwater quality monitoring is done in alluvial/valley parts. The administrative map of the UT is shown in figure 1.

Geological formations ranging in age from Pre-Cambrian to Recent are found in the UT. These formations can broadly be classified into three categories. Hard or consolidated- rocks comprising granites, slates, quartzite, Panjal traps, limestone etc. Semi-consolidated rocks comprising of claystone, siltstone, sandstone etc. Unconsolidated formations from Quaternary to Recent age are comprised of Clay, Silt, Sand, Gravel, pebbles, Boulder etc. The principal aquifer map of J&K UT is given in figure 2.

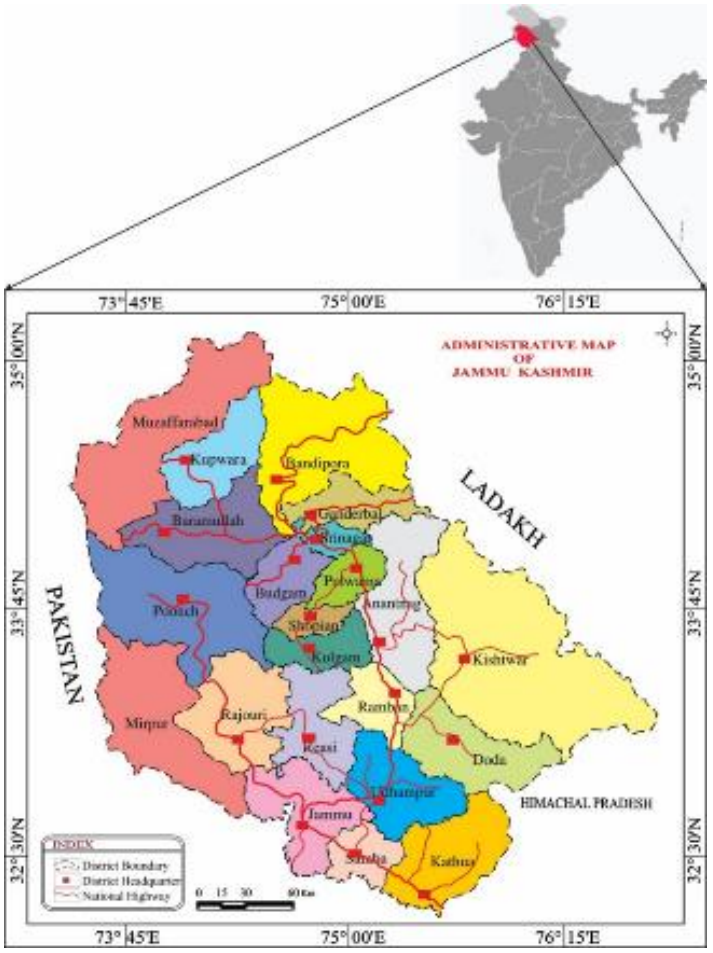


Figure 1: Administrative Map of J&K UT

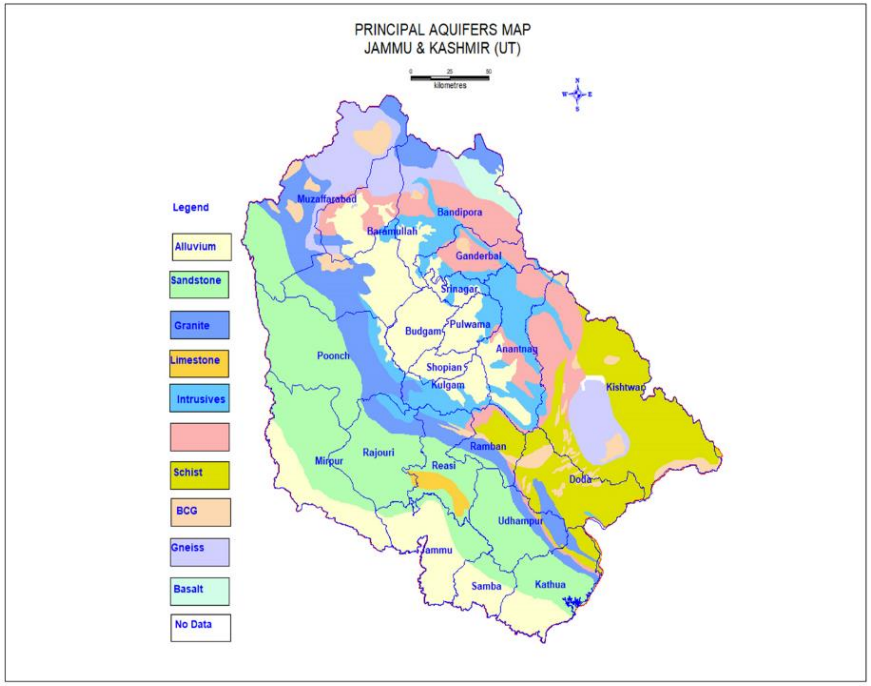
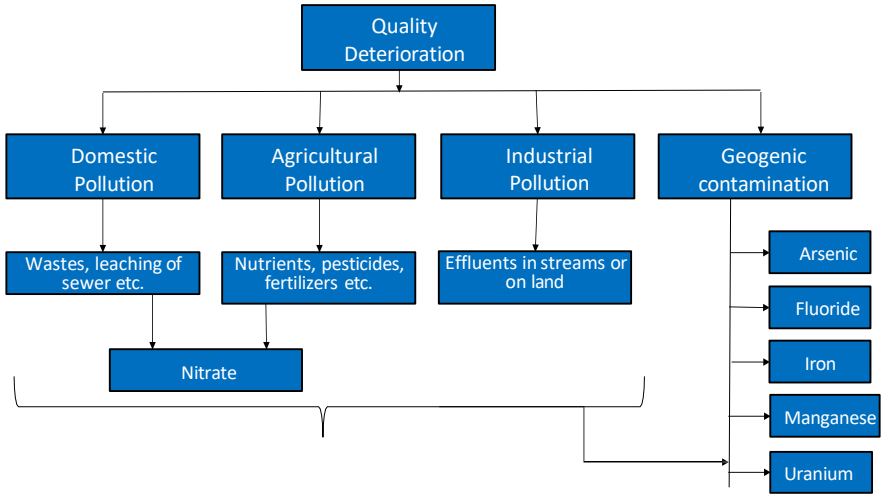


Figure 2: Principal Aquifers Map of J&K UT

3.0 GROUND WATER QUALITY MONITORING

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



Monitoring of ground water quality is an effort to obtain information on chemical quality through representative sampling in different hydrogeological 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 ground water. The probable causes of deterioration in ground water quality is depicted in Figure 3.

The chemical quality of shallow ground water is being monitored by Central Ground Water Board during Pre-monsoon (May-June) through 298 locations located all over the UT (Figure 4). The district-wise distribution of water Quality Monitoring

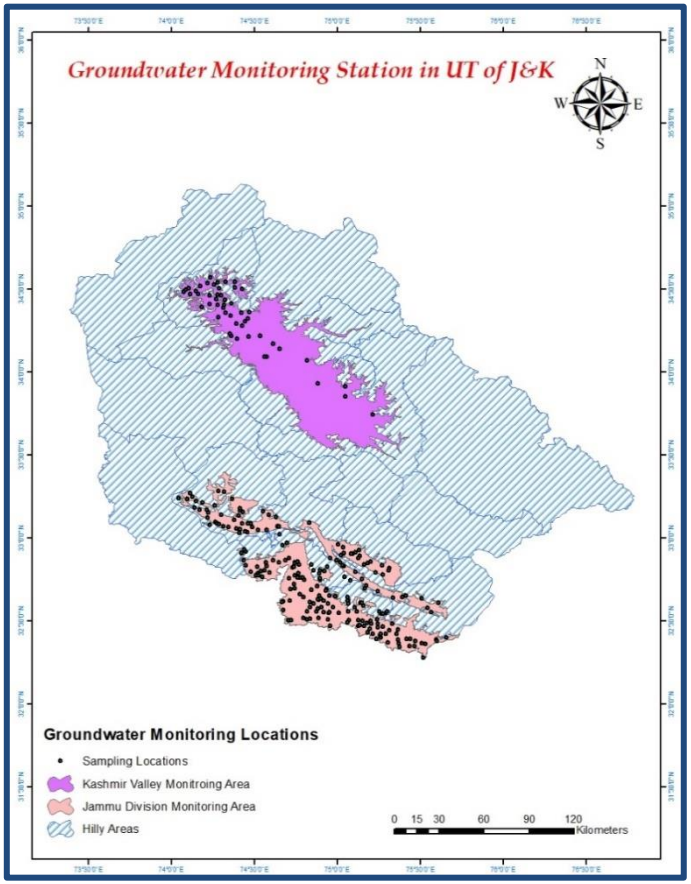


Figure 4: Groundwater monitoring Station of J&K

Stations of CGWB is given in Table 1. The present bulletin is based on the changing scenario in water quality in network observation wells of CGWB in J&K UT.

However, this year as per SOP, groundwater sampling was done on the basis of Pre Monsoon and Post Monsoon. Trend sampling was done i.e. 25 % of total samples showing elevated levels of EC, Nitrate and Fluoride collected during both pre and post Monsoon. NHS Hotspots were selected on the basis of high levels of Iron, Manganese, Arsenic and Uranium.

Table 1: District wise distribution of water Quality Monitoring Station.

Sl. No.	Region	District	Total No of Monitoring wells
1	KASHMIR	Anantnag + Shopian	1
2		Baramulla + Bandipora	21
3		Kupwara	27
4		Pulwama + Kulgam	5
5		Srinagar + Ganderbal	2
6		Budgam	0
	Total		**56**
11	JAMMU	Jammu	91
12		Kathua	40
13		Rajouri	39
14		Reasi	9
15		Samba	39
16		Udhampur	24
	Total		**242**
	TOTAL J&K		**298**

4.0 GROUND WATER 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 analyzed for all the major inorganic parameters. Based on the results, it is found that ground water of the J&K is mostly of calcium bicarbonate (Ca-HCO3) type. Occurrence of high concentrations of some water quality parameters such as Nitrate, Iron, Arsenic and Manganese and the changes in water quality based on these parameters have been observed in the various parts of J&K.

4.1 QUALITY ASSESSMENT OF GROUNDWATER IN UNCONFINED AQUIFERS

Unconfined aquifers are extensively tapped for water supply and across the UT therefore; its quality is of paramount importance. The chemical parameters like EC, Fluoride, Nitrate, Iron, Arsenic and Uranium etc. are main constituents defining the quality of ground water in unconfined aquifers. Therefore, presence of these parameters and the changes in chemical quality with respect to these in ground water in samples collected during NHS 2024 pre Monsoon monitoring are discussed below. The comparison with 2023 pre monsoon data is also done.

1. Electrical Conductivity (> 3000 µS/cm)
2. Nitrate (> 45 mg/litre)
3. Fluoride (> 1.5 mg/litre)
4. Total Hardness (> 600 mg/litre)

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 –15000 µS/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 a limit of 500 mg/I corresponding to EC of about 1000 µS/cm at 25°C) that can be extended to a TDS of 2000 mg/I (corresponding to EC of about 3000 µUS/cm at 25°C) in case of no alternate source. Water having TDS more than 2000 mg/litre are not suitable for drinking purpose.

Distribution of Electrical Conductivity (EC)

Trend samples from the NHS were selected based on EC values analyzed from the 2023 NHS background data. 73 samples were collected during pre-monsoon NHS 2024. The highest EC values obtained is 2024 µS/cm in Allah location. This location has also highest EC value during the year 2023. The average EC value is 965.41 µS/cm. None of the samples in year 2024 shows the EC values greater than 3000 µS/cm, indicating that salinity is not an issue in J&K. 51 locations i.e. 69.86 % of samples have shown EC values between 750 to 3000 µS/cm, rest 22 locations are having EC values less than 750 µS/cm.

District wise percentage of EC distribution in wells is shown as a bar diagram in Fig 5 and the occurrences of Electrical Conductivity in ground water of J&K UT has been shown on the map as Fig 6.

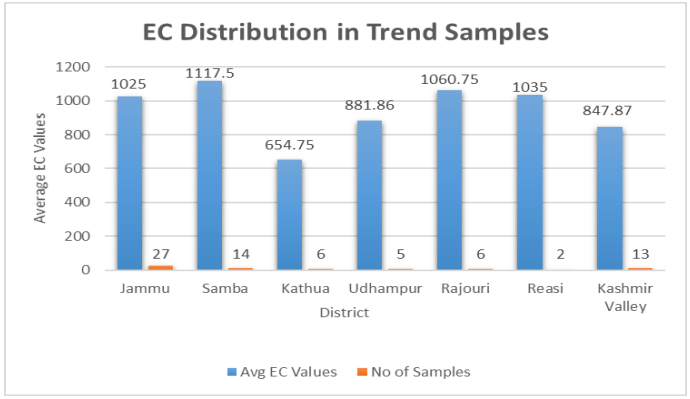


Figure 5: Average EC Distribution in NHS Trend samples of J&K UT

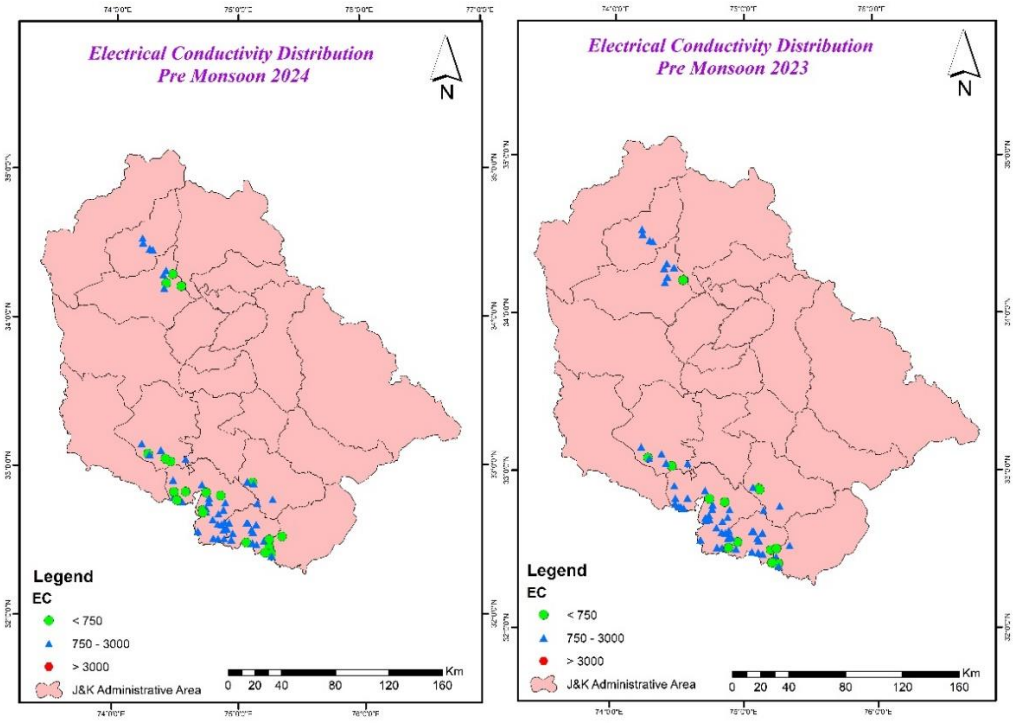


Figure 6: Map showing distribution of Electrical Conductivity in J&K based on NHS Pre Monsoon 2023 and 2024 data

The Table 2 given below provides for the number of trend samples analyzed per district, along with their minimum, maximum, and mean EC values based on NHS 2024 pre monsoon data.

Table 2: District wise Range and distribution of EC in shallow trend GW during Pre Monsoon -2024

District	Number of Samples Analysed	Permissible Limit (µS/cm)	Min	Max	Mean	No. of Samples (%)		
						<750	750-3000	>3000
Jammu	27	3000	305	2051	1025	25.93	74.07	0.00
Samba	14	3000	717	1805	1117.50	7.14	92.86	0.00
Kathua	06	3000	294	1248	654.75	83.34	16.66	0.00
Udhampur	05	3000	597	1152	881.86	20.00	80.00	0.00
Reasi	02	3000	760	1310	1035	0.00	100	0.00
Rajouri	06	3000	536	1764	1060.75	50	50	0.00
Kashmir Valley	13	3000	320	1450	847.87	38.46	61.54	0.00
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TEMPORAL VARIATION OF EC IN GROUND WATER DURING THE PERIOD FROM PRE MONSOON 2023 TO 2024

A comparison of 68 common locations from the pre-monsoon seasons of 2023 and 2024 reveals a decrease in locations with EC values exceeding 750 µS/cm. In 2024, 13 locations recorded EC values above this threshold, compared to 20 locations in 2023.

Table 3: Comparative change in number of locations having EC > 3000 µS/cm for the year 2023 and 2024

EC Limits	Total Number of samples comapred	Year		Change in (%)
		2023	2024	
< 750 µS/cm	68	48	55	10.29% Improvement
750-3000 µS/cm	68	20	13	10.29% Improvement
> 3000 µS/cm	68	Nil	Nil	--

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 methaemoglobonaemia particularly to infants. Adults can tolerate little higher concentration.

PRESENT DAY SCENARIO IN J&K W.R.T NITRATE (NO_3)

Distribution of Nitrate (NO3)

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. In 73 trend samples, nitrate in ground water samples varies from 8.17 to 204.82 mg/L. BIS permits a maximum concentration of 45 mg/L nitrate in drinking water. Considering this limit, 35.62 % sample have more than 45 mg/L Nitrate concentration. Spatial distribution of nitrate (Figure 7).

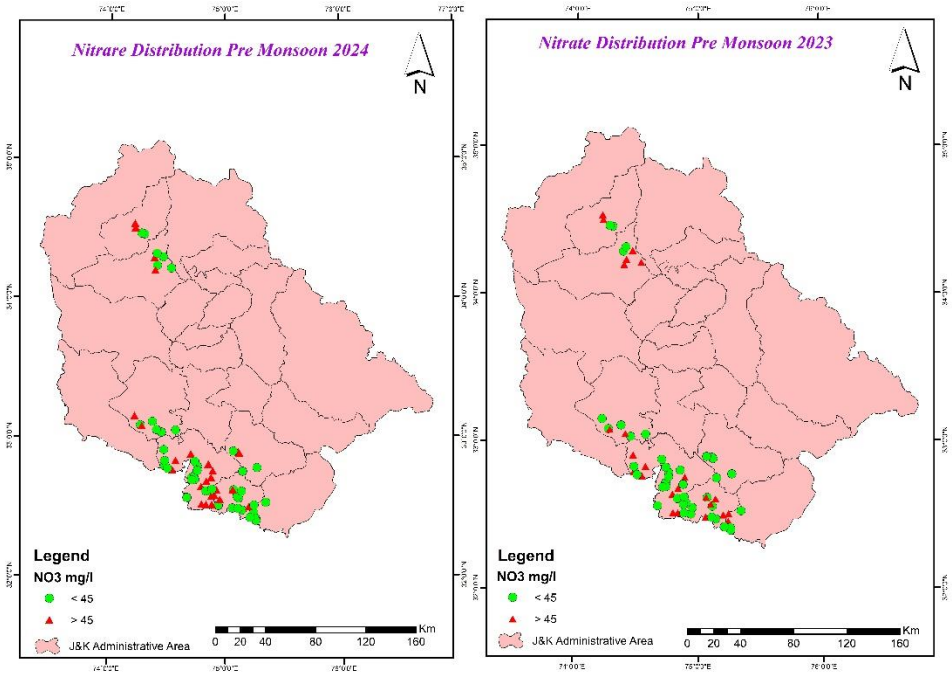

Figure 7: Map showing distribution of Nitrate in J&K based on NHS 2023 & 2024 Pre Monsoon Data

The Table 4 given below provides for the number of samples analyzed per district, along with their minimum, maximum, and mean Nitrate values based on NHS 2023 background data.

Table 4: District wise Range and distribution of Nitrate in shallow GW of J&K

District	Number of Samples Analysed	Permissible Limit (mg/l)	Min	Max	Mean	No. of Samples (%)	
						< 45	> 45
Jammu	27	45	8.17	204.82	55.35	51.85	48.15
Samba	14	45	16.11	184.71	58.44	64.29	35.71
Kathua	06	45	11.33	22.56	16.66	100	0
Udhampur	05	45	16.59	172.22	71.87	60	40
Reasi	02	45	16.59	35.06	25.83	100	0
Rajouri	06	45	10.55	69.90	39.42	66.67	33.33
Kashmir Valley	13	45	12.44	132.9	47.92	69.23	30.77
	73						

Table 5: List of Districts Showing Localized Occurrence of Nitrate (>45 mg/L) in Ground Water in UT of J&K

Sl. No.	UT	Parts of Districts having Nitrate > 45 mg/L
1.	**Jammu & Kashmir**	Baramulla, Jammu, Rajouri, Samba, Kupwara & Udhampur

Table 6: Comparative Change in number of Districts having Nitrate > 45 mg/L in UT of J&K

S. No.	UT	Nos. of districts having NO_3> 45 mg/L.		
		2023	2024	Increase/ Decrease
1.	Jammu & Kashmir	06	06	--

TEMPORAL VARIATION OF NITRATE in GROUND WATER DURING THE PRE MONSOON PERIOD FROM 2023 TO 2024

An analysis of data from 68 common locations during the pre-monsoon periods of 2023 and 2024 revealed a slight difference in nitrate concentrations. In 2024, there was one fewer location with reduced nitrate levels compared to 2023, indicating minimal variation in nitrate trends between the two years and highlighting the overall stability of nitrate levels across these locations. This information is presented in Table 7. Additionally, Table 8 illustrates the common locations where nitrate concentrations exceeded 45 mg/L during the both pre-monsoon periods of 2023 and 2024.

Table 7: Comparative change in number of locations having Nitrate > 45 mg/l for the year 2023 and 2024

Nitrate Concentration	Total Number of samples comapred	Year		Change in (%)
		2023	2024	
< 45 mg/l	68	42	43	1.47 % Improvement
> 45 mg/l	68	26	25	1.47 % Improvement

Table 8: Common locations having nitrate greater than 45 mg/l for the pre monsoon period 2023 & 2024

S. No.	Well No.	UT	District	Location
1	W324535074534101	J&K	Jammu	Sidhra
2	W324600074325801	J&K	Jammu	Hamirpur Kohna
3	W324635074313202	J&K	Jammu	Hamirpur Sidhar
4	W325000074343001	J&K	Jammu	Jourian
5	W323103074501201	J&K	Jammu	Allah
6	W323113074475501	J&K	Jammu	Arnia II
7	W323845074474101	J&K	Jammu	Miran Sahib
8	W324120074504501	J&K	Jammu	Satwari
9	W330450074173001	J&K	Rajouri	Seri
10	W323015075121001	J&K	Samba	Jasath
11	W323726075035401	J&K	Samba	Nagrota Uttarbani
12	W341203074235102	J&K	Baramulla	Uplona
13	W343213074131001	J&K	Kupwara	Gulgam
14	W343019074132601	J&K	Kupwara	Karihama

Table 9: Variation of Nitrate during Pre Monsoon 2023 & 2024.

S. No.	Well No.	District	Station Name/ Location	Nitrate (mg/L)		
				PRE 2023	Pre 2024	Increase/Decrease
1	W324535074534101	Jammu	Sidhra	79.07	84.71	Increase
2	W325455075063201	Udhampur	Rakh Badali	44.12	63.92	Increase
3	W325247075073201	Udhampur	Battal Ballian	41.87	172.22	Increase
4	W324743074285601	Jammu	Gigrial	54.21	16.93	Decrease
5	W325300074422001	Jammu	Gura (Akhnoor)	5.26	47.63	Increase
6	W324600074325801	Jammu	Hamirpur Kohna	54.81	49.27	Decrease
7	W324635074313202	Jammu	Hamirpur Sidhar	181.46	204.82	Increase
8	W325000074343001	Jammu	Jourian	62.04	46.73	Decrease
9	W325440074282901	Jammu	Kalah	54.07	35.59	Decrease
10	W324827074512701	Jammu	Khairi (Raipur)	24.59	51.70	Increase
11	W324235074425101	Jammu	Sandhwan	47.73	18.19	Decrease
12	W323103074501201	Jammu	Allah	93.81	108.65	Increase
13	W323113074475501	Jammu	Arnia II	54.53	81.83	Increase
14	W323845074474101	Jammu	Miran Sahib	47.19	171.27	Increase
15	W324120074504501	Jammu	Satwari	45.18	52.56	Increase
16	W330450074173001	Rajouri	Seri	52.63	69.69	Increase
17	W330315074243901	Rajouri	Baja Bain	51.74	10.55	Decrease
18	W330614074114001	Rajouri	Bareri	43.8	69.94	Increase
19	W322940075034501	Samba	Bengular	71.69	22.10	Decrease
20	W322738075143401	Kathua	Jandi (New)	87.4	12.31	Decrease
21	W323015075121001	Samba	Jasath	61.06	60.40	Constant
22	W323041075143001	Kathua	Kootah	76.63	22.56	Decrease
23	W323509075061801	Samba	Daboh	94.48	39.90	Decrease
24	W323647075082501	Samba	Dhora	56.19	31.88	Decrease
25	W323726075035401	Samba	Nagrota Uttarbani	73.62	68.58	Decrease
26	W323300074573001	Samba	Gho Brahmna	18.37	68.38	Increase
27	W323105074531901	Samba	Nandpur	0.1	184.71	Increase
28	W323527074542301	Jammu	Khairi (Bishnah)	6.69	86.80	Increase
29	W323438074525401	Jammu	Kothey Saini	43.4	60.74	Increase
30	W324209074531901	Jammu	Trikuta Nagar	42.81	48.63	Increase
31	W341409074245301	Baramulla	Delina	53.5	20.96	Decrease
32	W341203074235102	Baramulla	Uplona	138.95	103.53	Decrease
33	W341729074232701	Baramulla	Hadipora	36.7	66.19	Increase
34	W343029074225901	Kupwara	Lassipora	53.31	40.61	Increase
35	W341750074280101	Baramulla	Ibrahim Colony	81.04	27.02	Decrease
36	W343213074131001	Kupwara	Gulgam	53.96	54.57	Constant
37	W343019074132601	Kupwara	Karihama	130.36	132.99	Increase

4.1.3 FLUORIDE

Fluorine does not occur in the elemental UT 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 (**upto**1.0 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 UT is found to be less than 1.0 mg/l.

PRESENT DAY SCENARIO IN J&K 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. The fluoride content in ground water ranges from 0.09 to 1.07 mg/L. BIS recommends that fluoride concentration up to 1.0 mg/L in drinking water is desirable, up to 1.50 mg/L it is permitted and above 1.50 mg/L is injurious.

Classification of samples based on this recommendation, it is found that 98.63 % samples have fluoride in desirable range, 1.37 % in the permissible and the no samples have fluoride above 1.50 mg/L.

In 2024, no location reported Fluoride values exceeding the permissible limit, maintaining the trend observed in 2023 when no exceedances were recorded. However, in 2022, two locations showed elevated Fluoride levels above the permissible threshold. Table 10 provides a detailed summary of the number of samples analyzed per district for 2024, along with their minimum, maximum, and mean Fluoride values, based on pre-monsoon NHS trend data. This data offers valuable insights into spatial variations and helps in assessing the overall status of Fluoride concentrations across districts. Table 11 highlights the changes in districts with recorded variations in Fluoride concentrations.

Table 10: District wise Range and distribution of Fluoride in shallow GW of J&K

District	Number of Samples Analysed	Permissible Limit (mg/l)	Desirable Limit (mg/l)	Min	Max	Mean	No. of Samples (%)	
							< 1.50	> 1.50
Jammu	27	1.50	1.00	0.11	1.07	0.38	100	0.00
Samba	14	1.50	1.00	0.11	0.86	0.38	100	0.00
Kathua	06	1.50	1.00	0.11	0.58	0.29	100	0.00
Udhampur	05	1.50	1.00	0.18	0.37	0.27	100	0.00
Reasi	02	1.50	1.00	0.23	0.23	0.23	100	0.00
Rajouri	06	1.50	1.00	0.23	0.51	0.34	100	0.00
Kashmir Valley	13	1.50	1.00	0.09	0.33	0.17	100	0.00
	73							

Table 11: Comparative Change in number of Districts having Fluoride > 1.50 mg/L in UT of J&K

S. No.	UT	Nos. of districts having F> 1.5 mg/L.		
		2023	2024	Increase/Decrease
1.	Jammu & Kashmir	00	00	--

TEMPORAL VARIATION OF FLUORIDE in GROUND WATER DURING THE PRE MONSOON PERIOD FROM 2023 TO 2024

The presence of fluoride in groundwater primarily results from the weathering and leaching of fluoride-bearing minerals in rocks and sediments. An analysis of pre-monsoon data from 2023 and 2024 indicates that fluoride levels in the Jammu & Kashmir Union Territory remain well within the limits prescribed by BIS standards.

4.1.4 TOTAL HARDNESS

Total hardness is predominantly caused by cations such as calcium and magnesium and anion such as bicarbonate and sulphate. Total hardness is defined as the sum of calcium and magnesium both expressed as CaCO3 in mg/L. Hardness represents the soap-consuming capacity of water. Species that form insoluble compounds with soap Ca, Mg, Organic compounds etc. Total hardness is sum of Ca and Mg and expresses as CaC03 mg/l. EDTA titration. The two kind of hardness observed in water.

- Temporary hardness is due to Carbonate.
- Permanent hardness is due to Sulphate, Chloride or Nitrate.

The hardness in water is derived largely from contact with the soil and rock formations. Rain water as it falls upon the earth is in capable of dissolving the tremendous amount of solids found in many natural waters. People with kidney and bladder stones should avoid high content of calcium and magnesium in water (K. R. Karanth, 1997). The BIS permissible limit of hardness is 200 – 600 mg/L.

PRESENT DAY SCENARIO IN J&K W.R.T Total Hardness

Distribution of Total Hardness

The total hardness in groundwater across the 73 selected trend locations ranges from 141.40 mg/L to 616.10 mg/L. Table 12 below presents the number of samples analyzed per district, along with the minimum, maximum, and mean total hardness values, based on pre-monsoon NHS 2024 data. Figure 8 illustrates a comparison of total hardness concentrations at common locations between the years 2022 and 2023.

Table 12: District wise Range and distribution of Total Hardness in shallow GW of J&K

District	Number of Samples Analysed	Permissible Limit (ppm)	Desirable Limit (ppm)	Min	Max	Mean	No. of Samples (%)	
							< 600 mg/l	> 600 mg/l
Jammu	27	600	200	171.70	616.10	372.00	96.30	3.70
Samba	14	600	200	241.20	595.90	390.66	100	0.00
Kathua	06	600	200	141.40	434.30	262.11	100	0.00
Udhampur	05	600	200	175.88	311.55	230.43	100	0.00
Reasi	02	600	200	350.15	385.70	367.93	100	0.00
Rajouri	06	600	200	242.40	545.40	396.43	100	0.00
Kashmir Valley	13	600	200	166.60	548.80	326.20	100	0.00
	73							

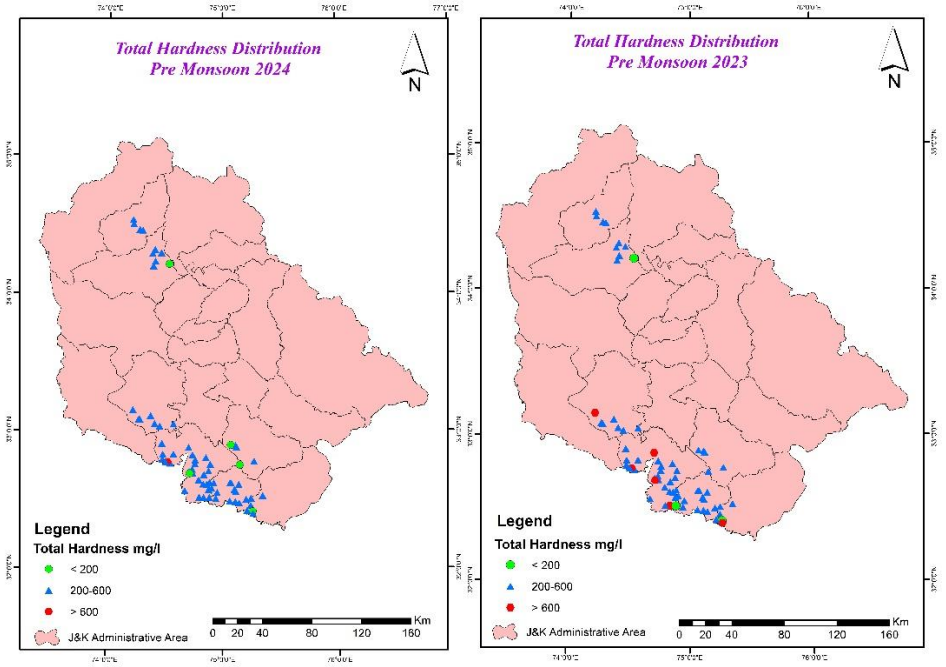

Figure 10: Map showing distribution of Total Hardness in J&K based on pre monsoon NHS 2023 & 2024 Data

TEMPORAL VARIATION OF NITRATE in GROUND WATER DURING THE PRE MONSOON PERIOD FROM 2023 TO 2024

An analysis of data from 68 common locations during the pre-monsoon periods of 2023 and2024 revealed that only one location recorded hardness values exceeding 600 mg/L. The Hamirpur Sidhar location in the Jammu district consistently reported the highest total hardness values in both years. Table 13 below highlights the changes in the number of locations categorized by total hardness concentrations.

Table 13: Comparative change in number of locations of Total Hardness concentration for the year 2023 and 2024

Total Hardness Concentration	Total Number of samples comapred	Year		Change in (%)
		2023	2024	
< 200 mg/l	68	03	05	2.94 % improvement
200-600 mg/l	68	59	62	4.41 % improvement
>600 mg/l	68	06	01	7.35 % improvement

5.0 Addition of New Monitoring stations

20 new springs were added to monitoring station this in the year 2024. Pre Monsoon samples were collected from these springs. The overall water quality has been found potable and suitable. The general EC ranges between 182 to 1040 µmhos/cm with average value of 417.50 µmhos/cm. However, 02 samples have shown fluoride concentration greater than the permissible limit. No sample has shown nitrate value greater than 45 mg/l. General water quality is depicted in table 14. The comparison of these samples will be done with post monsoon data 2024.

Table 14: General Spring water quality during Pre Monsoon 2024

Total Number of Spring samples analyzed	Electrical Conductivity		Nitrate		Fluoride	
	Limits (µmhos/cm)	**No. of Samples**	**Limits (mg/l)**	**No. of Samples**	**Limits (mg/l)**	**No. of Samples**
20	< 750	19	< 45	20	<1.50	18
	750-3000	01				
	> 3000	0	> 45	0	> 1.50	02
	Total	**20**	**Total**	**20**	**Total**	**20**

6. SUMMARY

The analytical results indicate a consistent trend: compared pre monsoon data from 2023, the number of groundwater samples in J&K districts exceeding permissible nitrate limits has remained unchanged. Similarly, the number of locations with nitrate contamination mirrors the findings from 2023. This contamination is likely attributable to anthropogenic sources. While most samples from Central Ground Water Board observation wells comply with drinking water standards for basic parameters, some exceed permissible limits, posing potential health risks with prolonged exposure.

7. RECOMMENDATIONS

Protection Against Bacteriological Contamination

- As the water supply in Jammu and Kashmir primarily relies on groundwater, wellhead protection measures should be implemented to prevent bacteriological contamination, including coliform bacteria and E. coli.
- Regular inspection and maintenance of water supply pipelines are essential to ensure they do not intersect or mix with sewer lines.

Mitigation of Nitrate Contamination

- Nitrate contamination in groundwater poses a significant pollution concern, often caused by leachate from septic tanks and sewage discharges.
- Developing a robust sewage management system and ensuring the disposal of sewage far from water sources can help minimize nitrate infiltration into groundwater.

Addressing Sewage and Sanitation Deficiencies

- The lack of adequate sewage and sanitation facilities across the Union Territory has led to contamination of both groundwater and surface water.
- Authorities must prioritize the establishment of proper sewage treatment and disposal systems, particularly in rural areas, to prevent untreated sewage from entering water bodies.
- In areas prone to waterlogging, where polluted surface water contaminates groundwater, comprehensive drainage systems should be designed and implemented.

Treatment of Hard Groundwater

- Groundwater in the region falls within the hard to very hard category, contributing to gastrointestinal health issues.
- Implementing water treatment solutions, such as Reverse Osmosis (RO) or Ion Exchange processes, is critical before distributing water for drinking purposes.
- Regular water quality monitoring should be carried out to ensure compliance with drinking water standards.

DISTRICT WISE CONTAMINANT WISE STATUS SUMMARY BASED ON NHS 2024 PRE- MONSOON NHS TREND DATA

The Table 15 provides a detailed summary of groundwater quality across various districts in J&K, focusing on basic parameters (electrical conductivity, nitrate, fluoride & Total Hardness)

Table 15: Summary of Groundwater Quality in Various Districts of J&K, Highlighting Basic Parameters (Electrical Conductivity, Nitrate, Fluoride)

District	Total no. of Basic Samples	EC(> 3000)	Nitrate (> 45)	Fluoride (>1.50)	Total Hardness (>600)
		µS/cm at 25°C	mg/l	mg/l	mg/l
Jammu	27	0	13 (48.15%)	0	01 (3.70%)
Samba	14	0	05 (35.71%)	0	0
Kathua	06	0	0	0	0
Udhampur	05	0	02 (40 %)	0	0
Reasi	02	0	0	0	0
Rajouri	06	0	02 (33.33%)	0	0
Kashmir Valley	13	0	04 (30.77%)	0	0
Total	**73**	0	26 (35.62%)	0	01 (1.37%)

Interpretation from Basic Parameters:

- EC (Electrical Conductivity): None of samples exceed permissible limits,
- NO3 (Nitrate): 35.62 % of samples exceed limits, with notable levels in Jammu, Samba, Udhampur, Baramulla and Kupwara districts
- F (Fluoride): None of samples surpass permissible levels, with varying percentages across districts.

The Table 16 provides a summary of groundwater quality in the UT of J&K, broken down by the number of samples collected and the percentage of those samples that are contaminated with various parameters.

Table 16: Summary of Groundwater Quality in J&K: Samples Collected and Contamination Percentage (2024)

J&K UT Summary	Number of samples contaminated (%age of samples contaminated)			
	Total no. of Trend samples Analysed	**EC**	**NO3**	**F**
	73	0 (0%)	26 (35.62%)	**0 (0%)**