

# Assessment of Groundwater Quality in Selected Villages of Shahpur Taluk, Yadgir District, Karnataka

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**Abstract:** Groundwater is a critical resource in semi-arid regions of India, particularly in Karnataka where rural communities rely on borewells. The present study assesses groundwater quality in selected villages of Shahpur Taluk, Yadgir District, Karnataka. Eight source were selected, samples were selected borewells and hand pumps across Gogi-K, Gogi-P, Hoskera, and Hattigudur. Physico-chemical parameters including pH, Temperature, Total Hardness (TH), Calcium, Magnesium, Chloride, Fluoride, Nitrate, and Dissolved Oxygen were analyzed. Results indicated that while pH remained within BIS/WHO limits, hardness, calcium, magnesium, fluoride, and nitrate often exceeded permissible standards. Water Quality Index (WQI) shows that most sources as unfit for consumption to very poor, rendering them unsuitable for domestic use without treatment.

**Keywords:** Groundwater quality, WQI, Physico-chemical characteristics

## I. INTRODUCTION

Groundwater forms the backbone of rural water supply in India, meeting nearly 85% of domestic needs. In Karnataka's semi-arid regions, declining rainfall and over-extraction have exacerbated stress on groundwater resources. Shahpur Taluk, Yadgir District, is particularly vulnerable due to its hard rock geology, low recharge potential, and extensive dependence on borewells. Groundwater contamination from both geogenic (fluoride, uranium) and anthropogenic (nitrate, chloride) sources poses significant public health risks. This study aims to evaluate groundwater quality in selected villages of Shahpur Taluk and classify its suitability for drinking based on Water Quality Index (WQI).

## II. OBJECTIVE

1. To characterize the physicochemical properties of groundwater.
2. To compare the water quality with the IS standards
3. To determine water quality index and suggest suitable measures (if required) for treatment.

## III. STUDY AREA

Shahpur Taluk is located in northeastern Karnataka (16°30'N–17°45'N, 76°15'E–77°30'E), covering ~1,097 km<sup>2</sup>. The region experiences semi-arid climate with annual rainfall of 600–800 mm. Geology is dominated by Deccan Traps and limestone formations, influencing groundwater chemistry. Selected villages include Gogi-K, Gogi-P, Hoskera, and Hattigudur, where communities rely mainly on deep borewells.

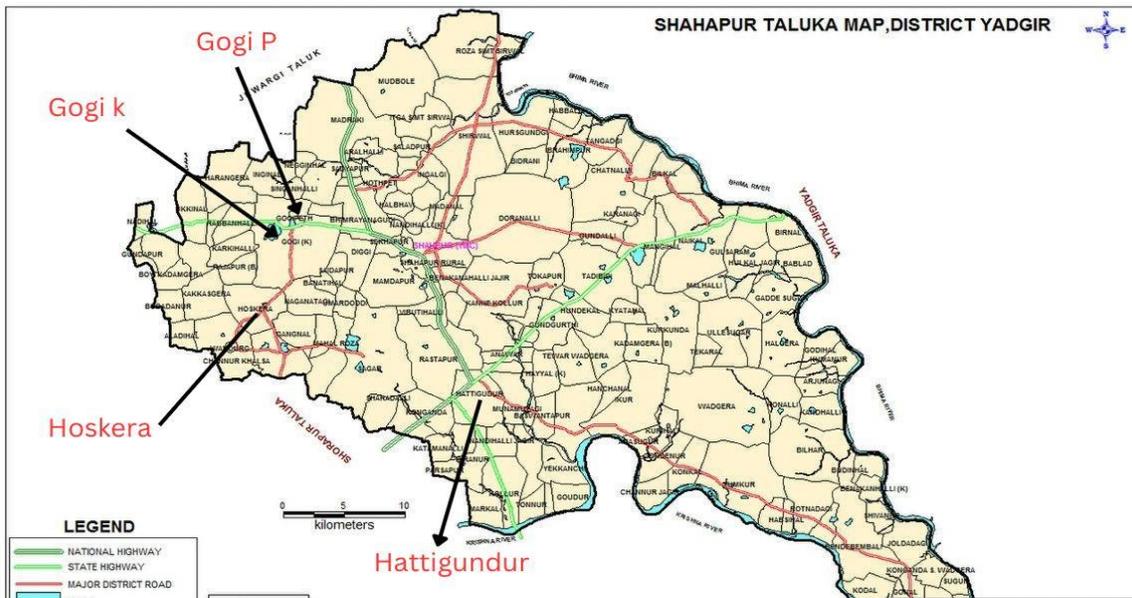


Fig.1. Showing villages selected for the study

IV. MATERIALS AND METHODS

Table 1. Sampling locations of selected villages of Shahpur taluk.

S. No	Location	Source	Source No.
1	Gogi-K: Near Darga	Borewell (Hand pump)	S1
2	Gogi-K: Near Bridge	Borewell (Hand pump)	S2
3	Gogi-P: Police Station	Borewell (Hand pump)	S3
4	Gogi-P: Near Well	Borewell (Hand pump)	S4
5	Hoskera: Hanuman Temple	Borewell (Hand pump)	S5
6	Hoskera: Govt. School	Borewell (Hand pump)	S6
7	Hattigudur: Near Garage	Borewell (Hand pump)	S7
8	Hattigudur: Temple Gate	Borewell (Hand pump)	S8

B. Parameters Analyzed

- pH: Digital pH meter
- Total Hardness, Ca<sup>2+</sup>, Mg<sup>2+</sup>: EDTA titration
- Chloride: Argentometric titration
- Nitrate: PDA method (UV-Vis, 410 nm)
- Fluoride: SPADNS method (UV-Vis, 570 nm)
- Dissolved Oxygen: Winkler’s method

Methodology of WQI Calculation

The Water Quality Index (WQI) was derived using the weighted arithmetic index technique outlined by Brown et al. (1972). The approach involves four main stages: first, identifying the key physico-chemical parameters that influence water quality, such as pH, TDS, hardness, calcium, magnesium, chloride, nitrate, fluoride, and dissolved oxygen; second, assigning unit weights to these parameters in proportion to their health significance and permissible standards; third, determining the quality rating of each parameter by comparing measured concentrations with the guideline values recommended by BIS or WHO; and finally, computing the overall WQI as the weighted average of all parameter ratings. The resulting index values are grouped into different categories, ranging from excellent quality to water unsuitable for drinking, as shown in Table 2.

Table 2: Water quality classification

WQI developed by Brown et al (1972)	
Water quality index	Water quality status
0-25	excellent
26-50	good
51-75	poor
76-100	very poor
>100	unfit for consumption

V. RESULTS AND DISCUSSION

The Physico-chemical were analyzed for groundwater from 8 different source, the results were summarized Table no 3. The WQI were summarized in Table no 4.

Table 3 Average Values of Parameters at each source

Source →	S1	S2	S3	S4	S5	S6	S7	S8	BIS Standards
Parameter ↓									
Temperature (°C)	27.28	26.28	25.44	22.20	27.12	24.36	26.12	26.44	
pH	6.66	7.04	7.36	7.94	6.86	6.56	7.36	7.94	6.5–8.5
Total Hardness (mg/L)	423.4	457.8	694.2	337.6	443.2	357.8	362.8	437.8	200
Calcium Hardness(mg/L)	248.8	236.9	279.6	199.0	161.6	141.6	298.4	199.0	75
Magnesium Hardness(mg/L)	174.4	221.2	414.6	138.0	281.6	216.2	64.4	238.8	30
Chloride (mg/L)	607.3	812.0	1277.6	349.0	321.0	289.6	928.8	1623.8	250
Nitrate (mg/L)	58.8	54.8	48.4	43.8	30.2	26.6	39.2	34.8	45
Fluoride (mg/L)	3.34	3.02	2.78	2.52	1.28	1.08	0.86	0.70	1.0
Dissolved Oxygen (mg/L)	14.48	11.92	15.56	13.90	8.52	8.10	17.08	10.12	5

**pH**

The pH of the groundwater samples ranged between 6.56 and 7.94. The BIS guideline specifies a permissible range of 6.5-8.5, and all samples fall within this interval.

**Total Hardness**

Total hardness was found between 337.6 mg/L and 694.2 mg/L. The BIS desirable limit is 200 mg/L, indicating that all samples surpassed the safe level.

**Calcium Hardness (Ca)**

Calcium concentration varied from 141.6 mg/L to 298.4 mg/L, compared with BIS standard of 75 mg/L. every sample exceeded the limit, reflecting excessive calcium content, which contributes to hardness and may create health and domestic concerns if consumed over a long period.

**Magnesium Hardness (Mg)**

Magnesium levels were recorded between 64.4 mg/L and 414.6 mg/L. the BIS acceptable limit is only 30 mg/L, and all samples were well above it. High magnesium not only increases overall hardness but may also impart a bitter taste and can act as a mild laxative when present in excess

**Chloride (Cl)**

Chloride values ranged from 289.6 mg/L to as high as 1623.8 mg/L. The BIS limit for chloride is 250 mg/L. All samples crossed this threshold, with extremely elevated levels observed at S3 and S8.

**Nitrate (NOs)**

Nitrate concentrations ranged between 26.6 mg/L and 58.8 mg/L. The permissible limit as per BIS is 45 mg/L. Samples S1, S2, and S3 were higher than the standards.

**Fluoride (F)**

Fluoride content ranged from 0.70 mg/L to 3.34 mg/L. The BIS permissible level is 1.0 mg/L. Groundwater from S1 to S4 exceeded the standard, which is a concern as long-term use may lead to dental and skeletal fluorosis. The remaining sources, particularly S7 and S8, were within safe limits

**Dissolved Oxygen (DO)**

Dissolved oxygen values varied from 8.10 mg/L (S6) to 17.08 mg/L (S7). The BIS requirement is a minimum of 5 mg/L, and all samples were above this value.

**B. Standards Comparison**

pH values were within BIS/WHO limits. Hardness, Calcium, and Magnesium exceeded desirable limits. Chloride levels were high at S3 and S8. Fluoride was above permissible levels at S1–S4, and Nitrate exceeded the safe limit in S1–S3.

**C. Water Quality Index (WQI)**

WQI was calculated using the weighted arithmetic index method. Most samples were classified as unfit for consumption. With values exceeding 100 in all locations, rendering the water unsuitable for drinking without treatment.

Table 4: Index Value

Sample	Index value	Index value
S1	262.5	unfit for consumption
S2	243	unfit for consumption
S3	242.5	unfit for consumption
S4	199.2	unfit for consumption
S5	9678.5	unfit for consumption
S6	100.7	unfit for consumption
S7	76	Very poor
S8	77.8	Very poor

**VI. CONCLUSION**

Groundwater in Shahpur Taluk exhibits significant variability in physicochemical parameters. While pH and dissolved oxygen were within permissible limits, total hardness, calcium, magnesium, chloride, nitrate, and fluoride frequently exceeded BIS standards, indicating both geogenic and anthropogenic contamination. The Water Quality Index (WQI) classified most sources as unfit for consumption, highlighting very poor water quality. Recommended treatment includes defluorination, nitrate removal, water softening, organic farming, rainwater harvesting, and regular monitoring to ensure safe drinking water in the region.

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