

Original Research Article

Water Quality Index for Assessment of Groundwater Quality Parameters in Udham Singh Nagar District of Uttarakhand

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ABSTRACT

The paper aims at determining the suitability of ground water according to water quality index. Due to human and rapid development in the area of Udham Singh Nagar district of Uttarakhand ground water is contaminated. This is the serious problem now a days. Therefore analysis of ground water quality is must to maintain the natural eco system. The assessment of groundwater is carried out in different blocks of Udham singhnagar district of Uttarakhand. The ground water samples of all the selected stations in the district were collected for a physiochemical analysis. For calculating present water quality status by statistical evaluation and water quality index, following 15 parameters have been considered viz. colour, odour, taste, pH, electrical conductivity, total dissolved solids, total hardness, calcium content, magnesium content, sodium content, chloride, alkalinity, nitrate, dissolved oxygen, turbidity. The obtained results are compared with different norms such as World Health Organization, Indian Council of Medical Research and Bureau Indian Standard Drinking Water specification. The study of physico-chemical and biological characteristics of ground water sample in the US Nagar district, suggests that the evaluation of water quality parameters as well as water quality management practices should be carried out periodically and precisely to protect the water resources in the area.

Keywords

Ground water,
Water quality
standards,
Physico-chemical,
Water Quality

Introduction

Groundwater is better known as universal solvent. The degree of contamination of the groundwater, in phreatic aquifer, is largely dependent on the formation and geo-chemistry of the soil through which the water flows before reaching the aquifers (Zuane, 1990). Groundwater, in its natural state, is of good quality, in general, because the rocks and their byproducts, such as soils, act as filters but it can become unpotable if the material above the aquifer is permeable. According to WHO the water

alone is responsible for about 80% of the major diseases in human beings. Once the groundwater gets contaminated, its quality cannot be restored instantaneously by ceasing the pollution source rather it takes a long time to regain its natural state. It, therefore, becomes important to regularly monitor the quality of groundwater and to develop an effective management plan to protect it.

Water quality index (WQI), introduced by Horton (1965), has been a useful tool for

water quality monitoring programs, to study trends in water quality, and to evaluate the impacts of corrective measures on water quality. Water quality indices enable the processing of the composite water quality data for an effective transformation in to environmental information (Swamee and Tygai, 2007). It provides the unique numerical value that expresses overall quality of water, based on the different physico-chemical parameters.

The Udham Singh Nagar district of Uttarakhand, being rich in fertile land and water resources, therefore it is mostly favoured for industrial development. In recent years, the demand for water has increased many times because of rapid urbanization and establishment of Industrial areas at Pantnagar, Kashipur and Sitarganj in Udham Singh Nagar district. Keeping these criteria in view, the assessment of quality of groundwater in phreatic aquifer in Udham Singh Nagar district of Uttarakhand has been proposed.

Materials and Methods

Water samples were collected in pre-cleaned sterilized polypropylene bottles with necessary precaution from different locations of the district for the analysis of water samples.

Determination of Physico-chemical parameter

Various physico-chemical parameters are analysed as given in standard manual of water and effluent water analysis. Basically fifteen parameters were selected for the assessment of the water sample taken from the different location of the Udham Singh Nagar District of Uttarakhand which given in the table 1.

Determination of Water Quality Index(WQI)

The Water Quality Index was calculated using Weighted Arithmetic Index Method. Essentially aWQI is a compilation of number of parameters that can be used to determine the overall quality of a water.

The mathematical relation used to calculate WQI is given as-

$$WQI = \sum Q_i W_i / \sum W_i$$

Where Q_i – Quality rating scale

W_i - Relative weight, $W_i = 1/S_i$

S_i - Std. permissible value

$$Q_i = 100 [(V_n - V_i) / (V_s - V_i)]$$

V_n - actual or test value of the parameter

V_i - ideal value of the parameter

V_s - Recommended standard of the parameter

Results and Discussions

Water quality indexing for drinking purposes

The water quality index (WQI) for the groundwater of Udham Singh Nagar district was estimated by considering 15 quality parameters, and the standard and permissible limits prescribed by BIS, ICMR and WHO for drinking purpose using the weighted arithmetic index method (Brown *et al.*, 1970).

The WQI (BIS standards) varied from 33.32 at Ahuja Colony, Rudrapur (Gadarpur block) to 94.61 at Jhagadpuri (Gadarpur block) whereas on the basis of WHO standards WQI values for these two locations were 23.92 and 99.80, respectively. According to values of water quality index we categorized the sample for portable use.

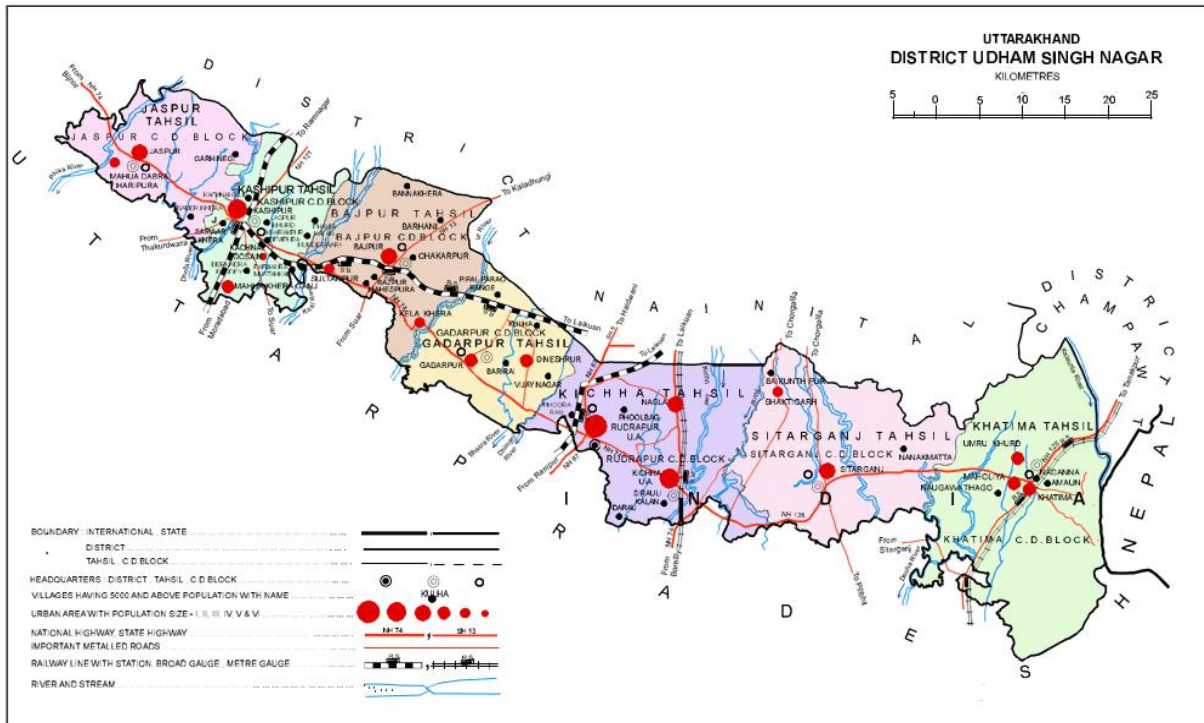
Table.1 Methods used in physico-chemical analysis of water samples

S. No.	Parameter	Method	Equipment
1.	Colour	Visual Interpretation	-
2.	Odour	Smelling	-
3.	Taste	Drinking (with safety precautions)	-
4.	pH	Electrometric	Hach Pocket pH Tester
5.	Electrical Conductivity	Electrometric	Hach Pocket EC Tester
6.	Total Dissolved Solids	Electrical Conductance Method	Hach Pocket TDS Tester
7.	Total Hardness	Titration by EDTA Method	-
8.	Calcium Content	Titration by EDTA Method	-
9.	Magnesium Content	Titration by EDTA Method	-
10.	Sodium Content	Flame Photometry	Flame photometer
11.	Chloride	Titration by AgNO ₃ method (Mohr Method)	-
12.	Alkalinity	Titration by H ₂ SO ₄ method	-
13.	Nitrate	Ion-Sensor	“TROLL9500” by <i>In-situ Inc.</i> , USA
14.	Dissolved Oxygen	Clark Cell	-do-
15.	Turbidity	Turbidity Sensor	-do-

Table.2 Water quality rating based on WQI

WQI Value	Rating of Water Quality	No. of Samples		% Samples	
		BIS	WHO	BIS	WHO
≤ 25	Excellent	0	1	0.00	1.22
>25 – 50	Good	41	62	50.00	76.54
>50 – 75	Poor	40	18	48.78	21.95
>75 – 100	VeryPoor	1	1	1.22	1.22
>100	Unsuitable	0	0	-	-

Fig.1 Administrative map of district Udham Singh Nagar, Uttarakhand



The WQI scores indicated that the quality of groundwater, of the shallow aquifer of Udham Singh Nagar district varied from excellent ($WQI \leq 25$) to very poor ($76 \leq WQI \leq 100$). The rating of water quality for drinking purpose (Brown *et al.*, 1970) is

given in Table 2. Table 2, shows that groundwater samples of only 50% locations have been rated as ‘good’ following the BIS standards of drinking water quality. The groundwater of the remaining 50% locations was mostly rated as ‘poor’.

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