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## Groundwater quality scenario and its suitability for domestic and irrigation uses: Special study on water pH value of Rohtak District, Haryana

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### Abstract

Groundwater is the major resource for all domestic and agricultural uses of Rohtak district in Haryana but in the present time human activities have a lot of impacts on the water quality. In this research paper focused on the pre and post monsoon hydrochemistry of groundwater in the Rohtak district of Haryana region to examine the quality of groundwater for agricultural and domestic uses. In this study groundwater quality determine during pre and post monsoon 2021. A total of 147 villages groundwater quality data were collected from central and state government ground water cells. There are many water quality index such as pH (Potential of Hydrogen), EC (Electric Conductivity), Ca (Calsium), Mg (Magnesium), HCO<sub>3</sub> (Bicarbonate), CO<sub>3</sub><sup>2</sup> (Carbon Trioxide), Cl (Chlorine), Na (Sodium), TH (Total Hardness), RSC (Residual Sodium carbonate) and SAR (Sodium Absorption Ratio). With the help of quality water standard demarcated the Rohtak district into different water qualities zones for many purposes such as domestic and agricultural uses. Spatial distribution maps were generated for pH value of water using GIS software.

**Keywords:** Water quality, pH value, groundwater, parameter, BIS

### Introduction

Water is a natural resource and it is fundamental component for sustainable development. Water is used for many purposes such as drinking, irrigation and many others human needs. The quality of water is the main issue in the world. All developments of human beings directly or indirectly related to the water and the quality of water is directly related to the human activities. Characteristics of water (Biological, Chemical and Physical) are related to the quality of water. If there is any change in any of these characteristics, then it effects the quality of water enormously. Various types of natural and human factors are affecting these characteristics of water, which is also affecting the quality of water. Irrigation is one such factor. The quality of water in most of the regions in the world is being affected due to the irrigation system. In many countries of the world, irrigation system affected the quality of water. Due to irrigation system the quality of water in India is also affected. The quality of water in Haryana, Punjab, Uttar Pradesh, Bihar, Jharkhand, Madhya Pradesh, Chhattisgarh, Maharashtra, and Odisha are highly affected by irrigation system.

### Research Problem

Understanding of ground water quality is most important because it is an important thing which decides water suitability for domestic, agricultural and industrial purposes. The suitability of groundwater for domestic and irrigation uses has determined on the basis of pH, TH, EC, Na etc. by comparing them with the Bureau of Indian Standards (BIS), United States Salinity Laboratory (USSL), and European Economic Community (EEC) criteria. In Rohtak district, the quality of water is getting affected by some natural and artificial sources. Generally, during pre and post monsoon period, the water quality is degraded approximately 15 percent to 40 percent. However during 2003 to 2023, indiscriminate use of chemical in agriculture and excessive use of canal irrigation has degraded the quality of water about 35 percent to 65 percent. There has been impairment in groundwater quality due to over-exploitation of groundwater, use of chemicals in agriculture and others factors like rapidly increasing population, rising rate of living standard, high growth rate of industrialization and

urbanization have put pressure on water resources and due to this pressure the water quality is getting worse day by day.

### Parameters for groundwater quality

Water quality is getting affected and poor quality of water is directly affecting human and crops health. The quality of water, depends upon various types of impurities present in water.

Therefore, the analysis and diagnosis of chemical composition of water is necessary to determine its suitability. The suitability of water for domestic use is based on the hydrogen ion concentration (pH), total hardness (TH) and total dissolved solids (TDS) and the suitability of water for irrigation purposes is based on Residual Sodium Carbonate (RSC), Sodium Adsorption Ratio (SAR), Electrical Conductivity (EC) and Sodium (Na). Some quality parameters used for classifying and analysing water quality in study area are pH, EC, TDS,  $Ca^{2+} + Mg^{2+}$ ,  $Na^{+}$ ,  $HCO_3^{-}$ ,  $CO_3^{2-}$  and  $Cl^{-}$  etc.

### Objectives

The study has three main objectives

1. To assess the pre-monsoon (June) and post-monsoon (October) groundwater quality.
2. To demarcate the study area into different groundwater quality suitability zones for domestic as well as agricultural.
3. To study the effect of monsoon on groundwater quality.

### Study Area

The study area lies in the central part of Haryana with  $28^{\circ}40'30''N$  to  $29^{\circ}05'35''N$  latitude and  $76^{\circ}13'22''E$  to  $76^{\circ}51'20''E$  longitude geographical coordinates and covers an area of about 1747.31 km<sup>2</sup>. It is drained by diversion drain No. 8. The study area has five blocks namely Rohtak, Maham, Sampla, Kalanaur, and Lakhna Majra. There are about 150 villages in this area (Fig. 1).

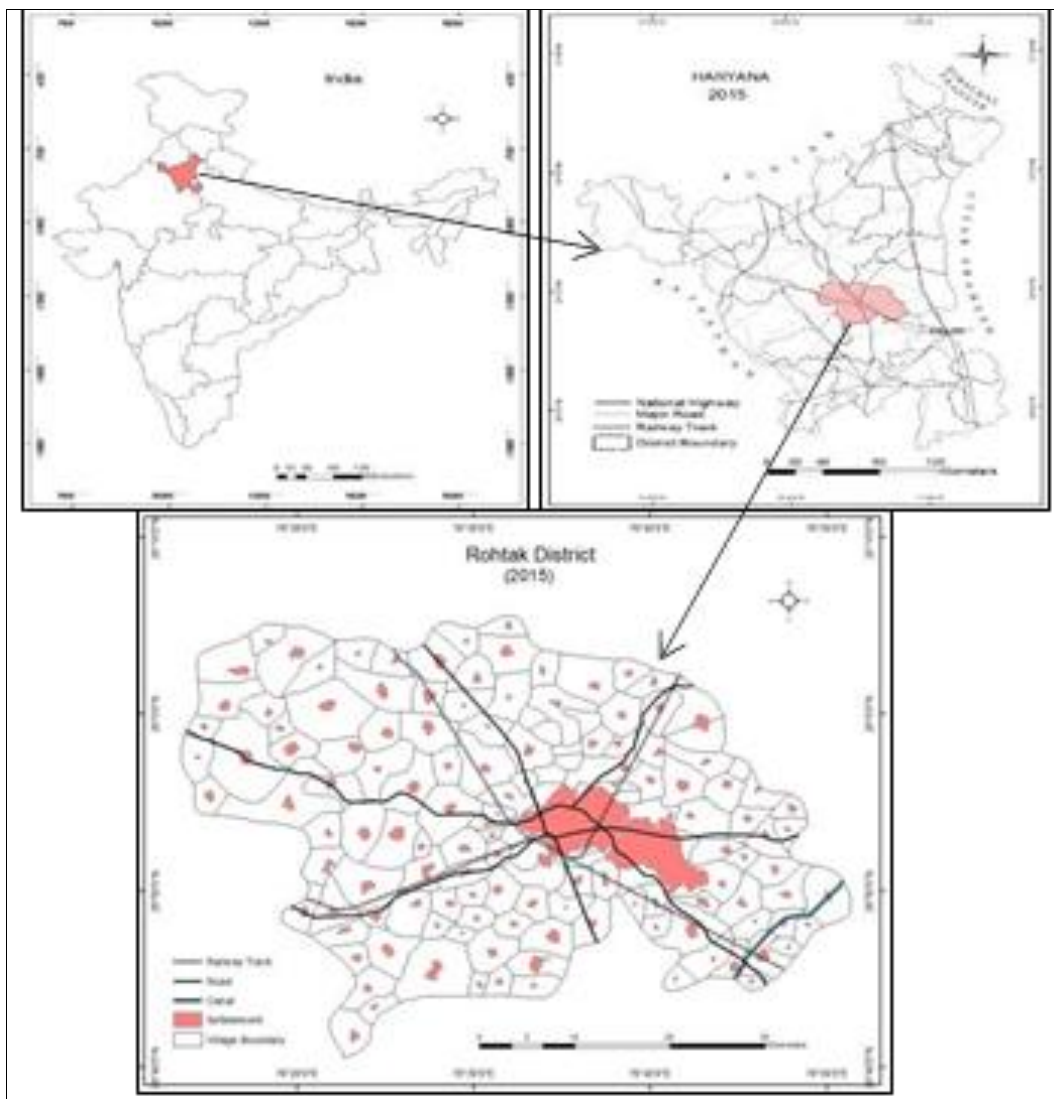


Fig 1: Location Map

### Data and Methodology

More than 20 years underground water quality decadal data is collected from ground water cell of Haryana government and central agencies of India. The current year data collected by instrument (potentiometer) and with the help of

water quality checking laboratories. The suitability of groundwater for domestic and irrigation uses are determined on the basis of pH by comparing them with the Bureau of Indian Standards (BIS) criteria.

## Results and Discussion

Groundwater is a valuable and important natural resource for all types of regions; it found in all geological formations under the earth surface. Thousands of local aquifer systems generates the groundwater for agricultural as well as domestic purposes. In the study area groundwater is a main source for drinking water, other domestic uses and irrigation. But last few decades it was pollutants due to many sources such as agriculture, industrial and domestic. In the many parts of study area groundwater pollution crossed the sustainable limits. There has been tremendous increase in demand for fresh water due to population growth and intense agriculture activities.

With rapid increase in population and growth of industrialization, groundwater quality is being increasingly threatened by disposal of urban and industrial solid waste. Open dumping is the most common way to dispose municipal and industrial wastes. Subsequent leaching of toxic contaminants through the dumping site also leads to extensive contamination of ground water at many places. It has been estimated that once pollution enters the subsurface environment, it may remain concealed for many years; rendering groundwater is unsuitable for consumption and other uses.

Rate of deterioration of groundwater quality is of immediate concern in the study area. Variation of groundwater quality in an area is a function of physicochemical parameters that are greatly influenced by geological formations and anthropogenic activities. Under groundwater is a main resource for drinking and irrigation purposes in the Rohtak district. This water resource is facing many types of problems including quality hazard in many villages where the increasing in this type of pollution from extent uses of chemical composed substances in agriculture and waste materials of urban areas/industries.

Land use pattern of Rohtak district has changed in last few decades and it continues at alarming rate. Extent uses of canal water in many villages disturbed the under groundwater quality and extent uses of under groundwater also affected the quality and quantity of water. The main purpose of the study is to investigate the groundwater

quality and to classify the groundwater for domestic and irrigation uses in the Rohtak district.

Water quality decide its suitability for many purposes like domestic purpose, agricultural purposes and industrial purposes. Range of water quality parameters of study area compared to BIS water quality standard. On the bases of this quality standard classify the water for domestic, agricultural and industrial uses in the study area.

### Range of pH Value

PH value is the concentration of hydrogen ion in water. It used as an indicator for determining the alkalinity and acidity in water. In this study the results of the water chemical analysis are compared with BIS's water standards to arrive at a conclusion. According to BIS, the pH value of water is found between 0 to 14. The BIS standards prescribe that the pH value of water for domestic use should be between 6.5 to 8.5, however for drinking purpose, it should be between

6.6 to 7.3. If the value of water is less than 6.5, then the water is acidic and if the value of water is more than 7.8, the amount of moss/alkalinity in the water increases. In the study area the range of pH value found between 7.47 to 8.18 in pre monsoon period and it increased in post monsoon period with range between 7.78 to 8.27, these ranges of pH value is suitable for domestic purposes as well as agricultural and industrial purposes.

On the bases of BIS standard water has been divided into five categories i.e. acidic water, pure water, ordinary alkaline water, alkaline water and highly alkaline water to understand the pH value of water. The results reveals that in most part of the study area, the water quality (pH) either falls under the category of alkaline water (Table 1 and 2). Range of acidic water is decreased during pre-monsoon to post-monsoon period, range of pure water is decreased during pre-monsoon to post-monsoon period, range of ordinary alkaline water is stable during pre-monsoon to post-monsoon period, range of alkaline water is increased during pre-monsoon to post-monsoon period, range of highly alkaline water is also increased during pre-monsoon to post-monsoon period.

**Table 1:** Area under pH ground water quality class in pre-monsoon 2003-2023 (area in percent).

Class (mol/l)	2003	2008	2013	2018	2023
Acidic Water (Less than 6.5)	3	4.5	4.2	2.3	4.2
Pure Water (6.6-7.3)	4.8	4.2	5.1	4.2	3.6
Ordinary Alkaline Water (7.4-7.8)	24.6	25.8	24.5	22.3	26.8
Alkaline Water (7.9-8.5)	45.6	42.3	40.2	39.5	42.3
Highly Alkaline Water (Above 8.5)	22	23.2	26	31.7	23.1

**Table 2:** Area under pH ground water quality class in post-monsoon 2003-2023 (area in percent).

Class (mol/l)	2003	2008	2013	2018	2023
Acidic Water (Less than 6.5)	2.7	3.8	3.8	1.2	4.1
Pure Water (6.6-7.3)	4.2	3.9	4.6	2.8	3.5
Ordinary Alkaline Water (7.4-7.8)	20.8	22.3	22.2	18.7	29.3
Alkaline Water (7.9-8.5)	47	47.4	42.3	37.5	40.2
Highly Alkaline Water (Above 8.5)	25.3	22.6	27.1	39.8	22.9

## Conclusion Remarks

From the study, it is concluded that the ground water quality in Rohtak district is alkaline, hard and saline in nature. Therefore, in the major part of the district, the ground water has normal suitability for domestic and agricultural purposes on the bases of pH value of water. However, more than 22

percent area of the district was not permissible for any use. Relatively pH value of water is affected by heavy application of fertilizers and their subsequent leaching under poor drainage conditions. Strict regulations and awareness programs are needed to be implemented to reduce the risk of groundwater contamination by fertilizers and pesticides.

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