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CHARECTERISATION OF WATER QUALITY IN R.R. NAGAR, BENGALURU, KARNATAKA, INDIA – BASED ON WATER QUALITY INDEX

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ABSTRACT

The quality of drinking water is a powerful environmental determinant for human health. Assured drinking water is a foundation for the prevention and control of waterborne diseases. All over the world, human population has inadequate access to potable water and use sources contaminated with disease vectors, pathogens or unacceptable levels of toxins or suspended solids. Drinking or using such water leads to widespread chronic illness and is a major cause for death. Reduction of waterborne diseases is a major public health goal for a civilized society. WQI values are computed for water quality measures in Rajarajeshwari area. In the present investigation 48 groundwater samples have been analysed and interpreted. WQI values in the study area varies between 14.6 to 26.7 with an average of 20.5. According to the WQI classification, most of the groundwater samples represent excellent water quality. In general higher percent of WQI values in poor and very poor water quality classes is mainly due to geogenic and anthropogenic factors. Although the water quality is mainly controlled by rocks and soil chemistry, excessive utilization of agro inputs has also compounded to this problem. The results obtained from the study indicates that groundwater is generally suitable for both drinking and domestic purpose.

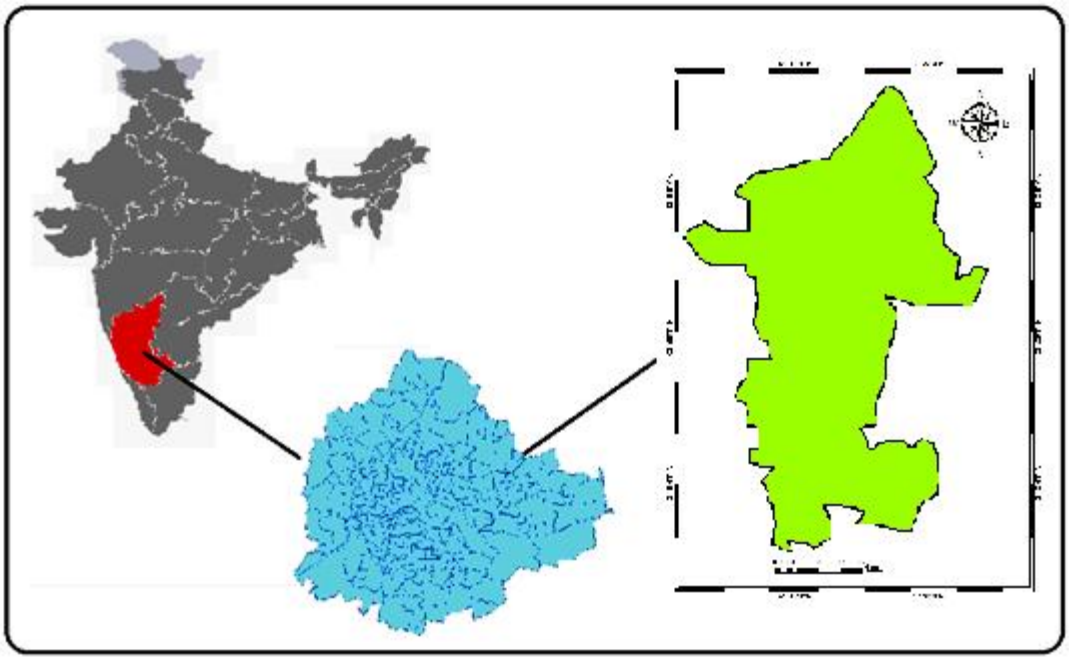
KEYWORDS: Waterborne, population, pathogens, groundwater, WQI.

INTRODUCTION

Water has always been an important and life-sustaining drink to humans and is essential to the survival of all living organisms. The quality of drinking water is a powerful environmental determinant for health. Assured drinking water is a foundation for the prevention and control of waterborne diseases. Over large parts of the world, humans have inadequate access to potable water and use sources contaminated with disease vectors, pathogens or unacceptable levels of toxins or suspended solids. Drinking or using such water leads to widespread chronic illness and is a major cause for death. Reduction of waterborne diseases is a major public health goal. Water quality deterioration in distribution systems is mainly due to inappropriate planning, design, maintenance and water quality control. A fraction of the burden in water-related diseases is attributable to the way water resources are developed and managed. In many parts of the world the adverse health impacts due to water pollution, irrigation development and flood control cause significant preventable disease. Horten was the first to use the concept of Water quality Index (WQI) to represent the gradation in water quality. It reflects the overall water quality for human consumption (Brown,1972). WQI is generating a score by integrating complex data that describes water quality status (Mishra and Naik, 2011). The present study is undertaken to assess the water quality status using water quality index as a tool.

STUDY AREA

The study area lies between latitude $12^{0}55^{'}48^{''}$ E to $12^{0}57^{'}48^{''}$ E and longitude $77^{0}30'10''$N to $77^{0}32'10''$N, (Map -1). The Drainage pattern is Dendritic to semi dendritic and is structurally controlled. The area is made up of plain lands and small dome shaped hillocks. In general the area forms an undulating topography. The main lithology in the study area are Peninsular Gneiss, Chloritic Schist and Granites. The soils seen in the study area are red loamy and red sandy soils.



Map 1 - Study area

METHODOLOGY

In the study area 48 groundwater samples were collected from various locations. The samples so collected were analysed for pH, electrical conductivity (EC), Chloride, Fluoride, DO, Acidity and Alkalinity by adopting standard analytical procedures. The pH was measured with pH meter and EC was measured with Conductivity meter. Chloride, acidity, alkalinity and DO were estimated by titrimetric method. Fluoride concentration was measured with Spectrophotometric technique. The standards for drinking purposes as recommended by BIS has been considered for the calculation of WQI (Davis and Dewiest, 1966 and Holden, 1970).

WQI CALCULATION

Calculation of Groundwater quality Index involves the assigning of Relative weight to each chemical parameter based on their impact on health, computation of Weighed parameter to know the relative share of each water quality measure and calculating status of chemical concentration of each parameter. Then finally by integrating all the values to obtain an overall groundwater quality index.

Relative Weight (Wi)

Each Chemical parameter is assigned a weightage based on its impact on human health. The range of numerical magnitude of Relative weight ranges from 1 to 5, for instance the parameters like pH, acidity, alkalinity and EC are assigned the Wi 2, Cl and DO as 3 and hardness as 4 and F as 5 respectively (Table - 1). The lower values of Wi indicates lesser impact of respective chemical parameters on health and higher values have more impact over human health on consumption.

Computation of Weight Parameter(Wp)

Weight parameter is the ratio of Wi of every water quality measure to the sum of all relative weights. Weight parameter enables to know about the relative share of each water quality measure on overall water quality. The Wp is given by the equation;

$$Wp = Wi / \sum Wi$$

Quality Rating Scale (Qi)

Quality rating is the ratio of concentration of each water quality measure of every water sample (C) to its respective drinking water quality standards (Ds) and the result is multiplied by 100. The Qi of each water quality measure is computed by the equation;

$$Qi = C / Ds$$

Sub index calculation (Si)

Sub index is computed by taking the product of each water quality measure with its corresponding status of concentration. Si reflects overall water quality and also enables to understand the nature of weight parameter with respect to concentration of each water quality measure. Si is calculated by;

$$Si = Wp * Qi$$

Groundwater Quality Index (WQI)

WQI is calculated by the addition of all the values of Si contributed by all the water quality measures of each water sample. WQI is given by;

$$WQI = \sum Si$$

RESULT AND DISCUSSION

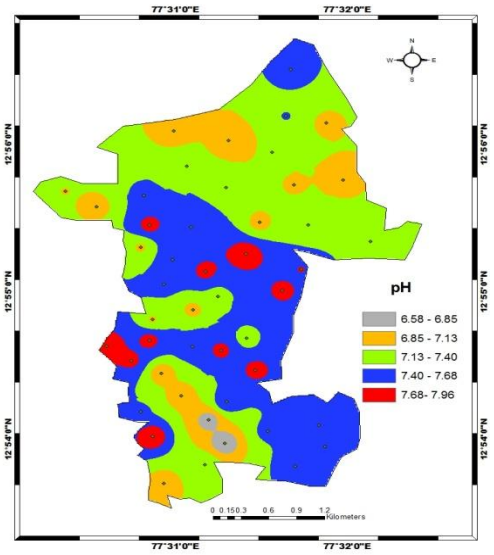
The study area has pH varying from 6.5 to 7.9 with an average of 7.3. The desirable limit of pH for drinking water is 7 to 8.5. EC of the groundwater varies from 140 to 1720 microsiemens/cm at 25^{o}C with an average of 1023. Chloride concentration in the study area ranges from 29.9 mg/l to 175 mg/l, with an average of 114.5 mg/l. Fluoride concentration ranges from 0.04 mg/l to 0.19 mg/l, with an average of 0.1 mg/l. Statistical parameter of the analytical results of groundwater is given in Table – 2.

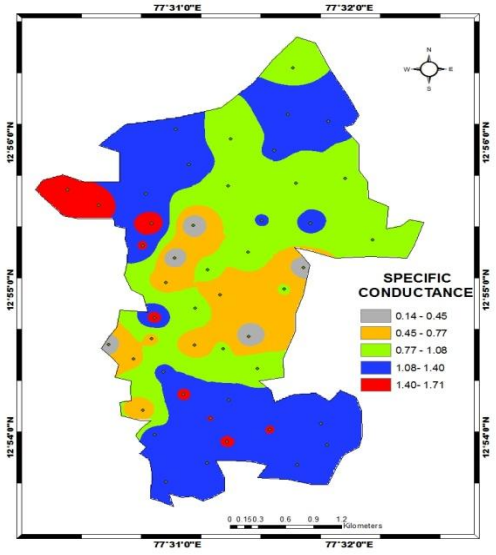
Constituents (mg/l.)	Relative Weight	Weighted Parameter	Drinking water Standards (BIS)	Mean value of study area (mg/l.)
pH	2	0.086	7.5	7.3
Alkalinity	2	0.086	200	492
Acidity	2	0.086	-	74.3
Hardness	4	0.173	300	465
Chloride	3	0.130	250	114.5
DO	3	0.130	5	7.04
EC	2	0.086	1400	1023
Fluoride	5	0.217	1.20	0.10

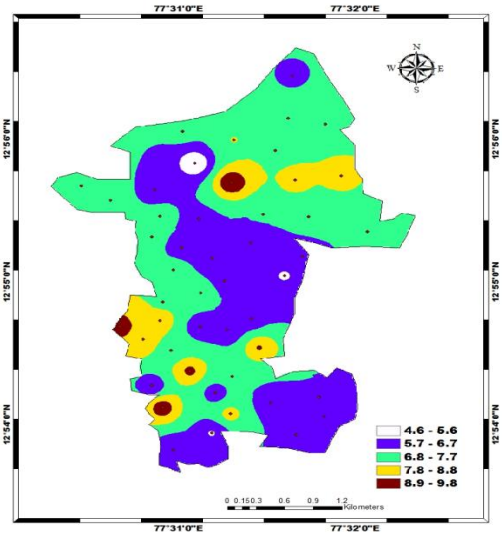
Table - 1: Weightage scheme for drinking water quality

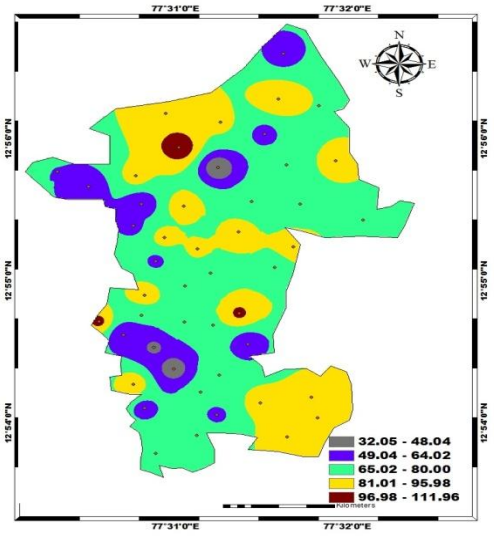
Constituents (mg/l.)	Max.	Min.	Mean	Stdv.
pH	7.96	6.58	7.3	0.35
Alkalinity	868	100	200	178
Acidity	112	32	74	18.18
Hardness	724	164	465	142
Chloride	175	29.9	114.5	26.29
DO	9.9	4.6	7.04	1.19
EC	1720	140	1023	390
Fluoride	0.19	0.04	0.10	0.03

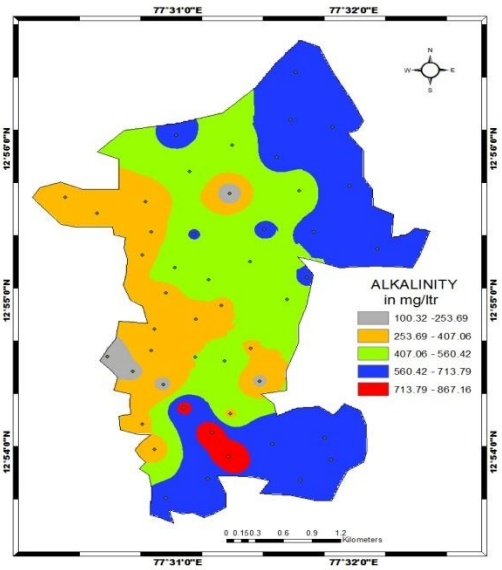
Table – 2: Chemical Composition of groundwater in the study area

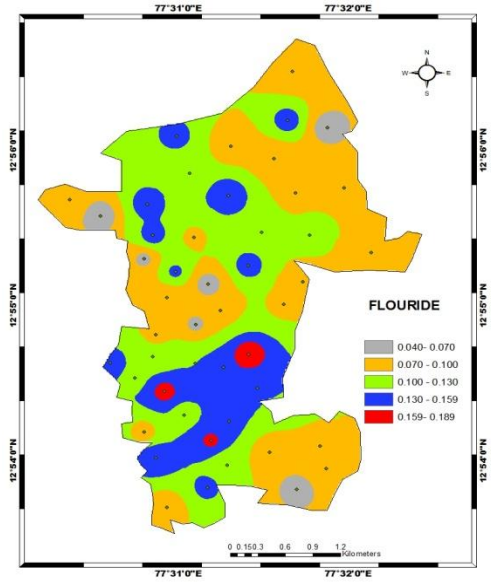












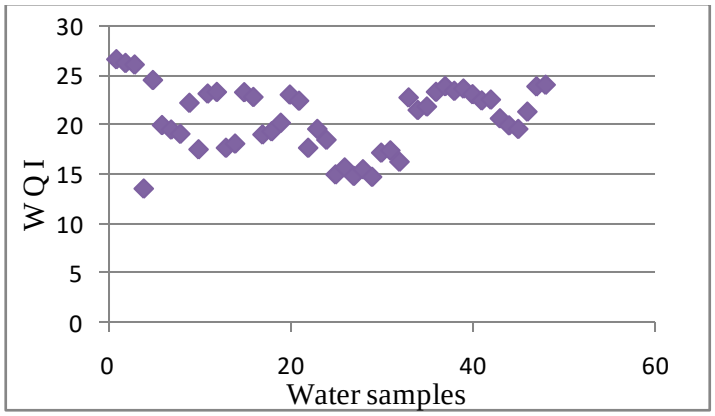
Iso concentration maps **Iso concentration maps**

WQI CLASSIFICATION

The classification of WQI is based on water quality standards for drinking purpose in the study area is as below. The computed value of WQI for the study area are grouped into different classes *Viz*., excellent, good, poor and very poor. If the range of WQI is < 50, its water quality is excellent, if the values are between 50 – 100, 100-200 and > 200 then the water quality is good, poor and very poor respectively. In the study area the WQI values varies between 14.6 to 26.7 with an average of 20.5. According to the WQI classification, all the groundwater samples fall under excellent category indicating their suitability for both drinking and domestic activity.

WQI value	Water quality	% of water samples
< 50	Excellent	100
50 – 100	Good	-
100 – 200	Poor	-
> 200	Unfit	-

WQI based Classification



Water samples v/s Water Quality Index

CONCLUSIONS

It is essential to ascertain the quality of water available from the various sources to whether the water is potable or not. So to know the portability conditions various parameters like Ph, EC, Chloride, Total Hardness, Total Alkalinity, Acidity and Fluoride were analysed for the study area and tabulated.WQI values are computed to know the water quality in the study area. In the study area the WQI values vary between 14.6 to 26.7 with an average of

20.5. According to the WQI classification, all the groundwater samples represent excellent to good water quality. Generally the higher WQI values in the poor and very poor water quality class is due to contribution from geogenic and anthropogenic factors. Although the water quality is mainly controlled by aquifer chemistry and soils, excessive utilization of agro inputs has also compounded to the problem. Hence it can be concluded that groundwater in the study area is suitable for both drinking and domestic purpose based on water quality index of groundwater.

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