



ISSN NO. 2320-5407

*Journal homepage: <http://www.journalijar.com>***INTERNATIONAL JOURNAL
OF ADVANCED RESEARCH****RESEARCH ARTICLE****Characterization of Water Quality in Torehalla Watershed, Karnataka, India – Based on Water Quality Index****Manjunath H. N. and Suresh T.S**

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Manuscript Info**Manuscript History:**

Received: 16 October 2014

Final Accepted: 25 November 2014

Published Online: December 2014

Key words:Anthropogenic, contaminants,
health, Torehalla, WQI, water
quality,***Corresponding Author****Manjunath H. N.****Abstract**

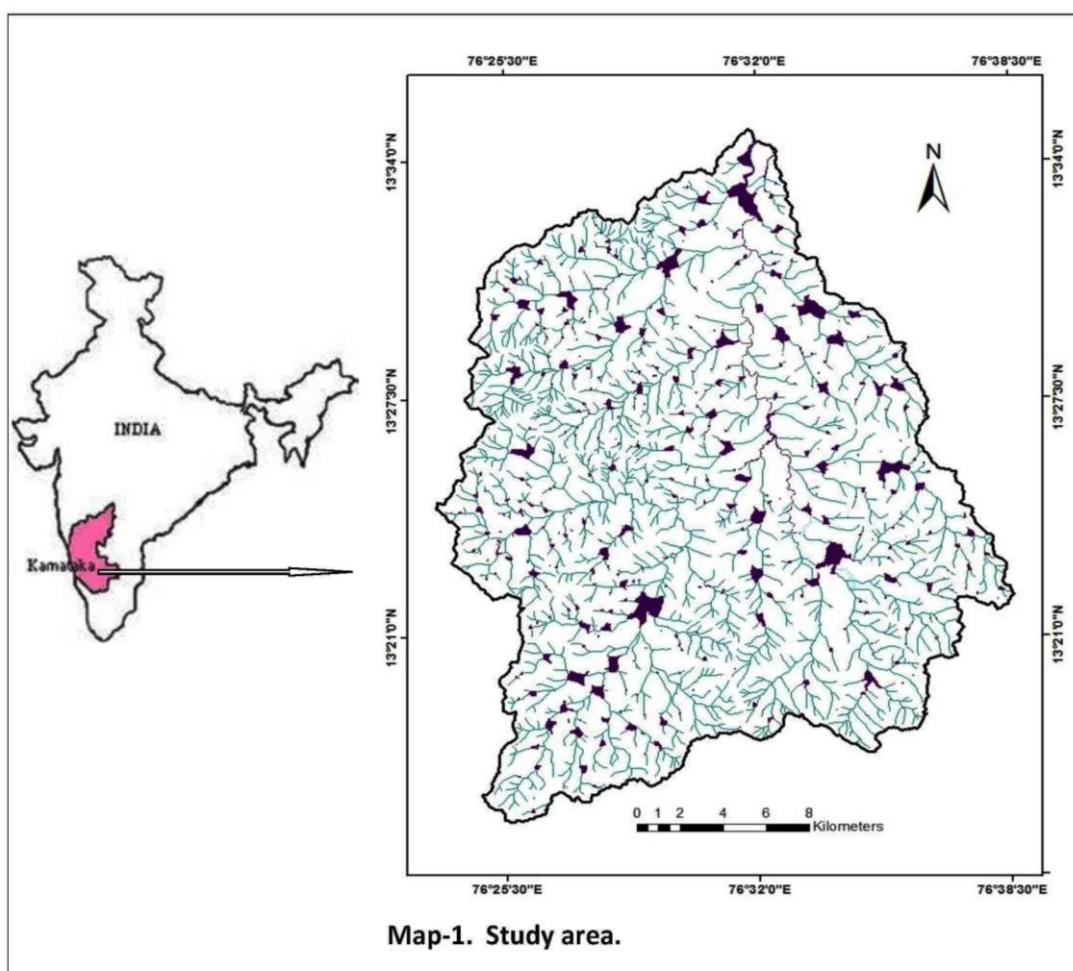
The quality of drinking water is a powerful environmental determinant for human health. Assured drinking water is a foundation for the prevention and control of waterborne diseases. All over the world, human population has inadequate access to potable water and use sources contaminated with disease vectors, 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 Torehalla. In the present investigation 71 groundwater samples have been analysed and interpreted. WQI values in the study area varies between 39.6 to 201.7 with an average of 86.4. According to the WQI classification, about 7% of the total groundwater samples represent excellent water quality, 69.1% as good, 22.53 % as poor and about 1.37% as very poor water in quality. The 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, except in few cases.

*Copy Right, IJAR, 2014.. All rights reserved***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. Horton 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.

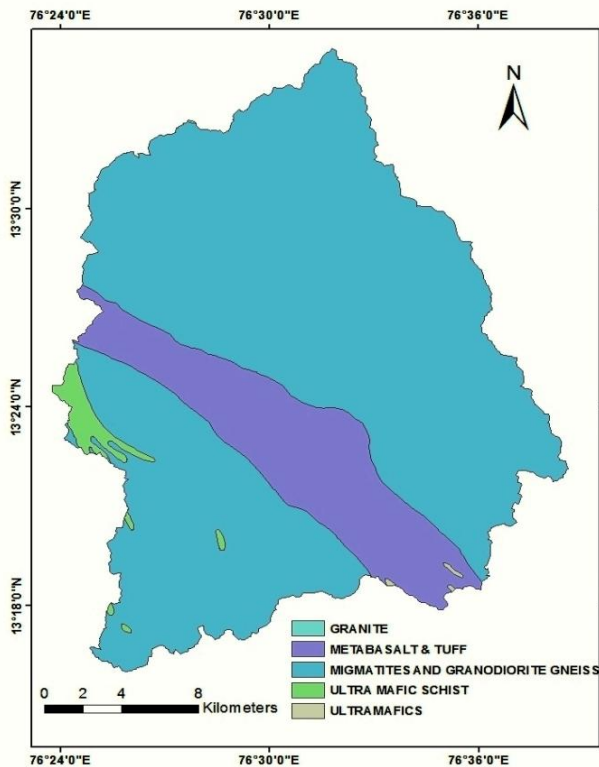
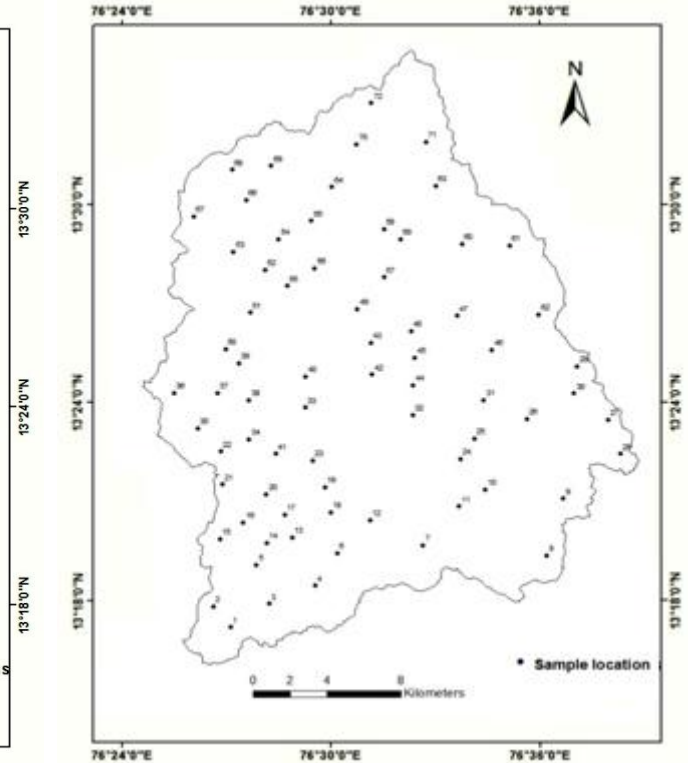
STUDY AREA

The Torehalla watershed lies between latitude $13^{\circ}15'$ to $13^{\circ}34'$ N and longitude $76^{\circ}18'$ to $76^{\circ}42'$ E, covering an area of 569 Sq.kms (Map -1). The watershed comprises parts of Tiptur, Chikkanayakanahalli and Huliya taluks of Tumkur district. The Drainage pattern is Dendritic to semi -Dendritic and is structurally controlled. The main Torehalla channel flows in northerly direction and is Perennial only during monsoon season. The area is made up of plain lands and residual dome shaped hillocks and hill ranges. In general the area forms an undulating topography with sparse vegetation, wide valley and plains. The highest elevation in the area is 892 m at Buraganahatti peak and lowest is 711m. The main lithology in the watershed are Peninsular Gneiss, Chloritic Schist and Granites (Map-2). The soils seen in the study area are red loamy, red sandy, mixed red and black soils.



METHODOLOGY

In Torehalla watershed 71 groundwater samples were collected from various locations (Map-3). The samples so collected were analysed for pH, electrical conductivity (EC), major cations and anions by adopting standard analytical procedures. The pH was measured with pH meter and EC was measured with Conductivity meter. Calcium, magnesium, bicarbonate and chloride were estimated by titrimetric method. Sodium and Potassium were determined by flame photometer. 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).

Map - 2. Lithology**Map - 3. Sample Locations****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, F, NO₃, SO₄ are assigned the Wi 5, Na, Cl as 4 and Ca, Mg as 2 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;

$$W_p = \frac{W_i}{\sum W_i}$$

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;

$$Q_i = \frac{C}{D_s}$$

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;

$$S_i = W_p * Q_i$$

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 7 to 8.2 with an average of 8. The desirable limit of pH for drinking water is 7 to 8.5. EC of the groundwater varies from 480 to 6400 microsiemens/cm at 25°C with an average of 1524. The Calcium value in the study area ranges from 11 mg/l to 314 mg/l, with an average of 91 mg/l. The Magnesium value ranges from 7 mg/l to 196 mg/l, with an average of 41 mg/l. The average Sodium content in the study area is 147 mg/l, ranging from 25 mg/l to 460 mg/l. Potassium concentration is found to vary from traces to 90 mg/l, with an average of 14 mg/l in groundwater. The Sulphate concentration varies from 7 mg/l to 583 mg/l, with an average of 102 mg/l. Chloride concentration in the study area ranges from 22 mg/l to 840 mg/l, with an average of 190 mg/l. Nitrate concentration varies from 5 mg/l to 204 mg/l, with an average of 52 mg/l. Fluoride concentration ranges from 0.15 mg/l to 2.2 mg/l, with an average of 1 mg/l. Statistical parameter of the analytical results of groundwater is given in Table – 2.

Table - 1: Weightage scheme for drinking water quality

Constituents (mg/l.)	Relative Weight	Weighted Parameter	Drinking water Standards	Mean value of Torehalla (mg/l.)
Ca	2	0.052	75	91
Mg	2	0.052	30	41
Na	4	0.105	200	147
K	1	0.026	10	14
Cl	4	0.105	250	190
SO ₄	5	0.131	150	102
NO ₃	5	0.131	45	52
F	5	0.131	1.20	1
HCO ₃	3	0.026	300	387
EC (ms/cm)	2	0.052	1400	1524
pH	5	0.131	7.5	8

Table - 2: Chemical Composition of groundwater in Torehalla

Constituents	Max.	Min.	Mean	S.D
Ca	314	11	91	62.12
Mg	196	7	41	33.51
Na	460	25	147	92.00
K	90	0	14	17.00
Cl	840	22	190	157.00
SO ₄	583	7	102	101.00
NO ₃	204	5	52	40.00
F	2.2	0.15	1	0.36
EC	6400	480	1524	987.00
pH	8.2	7	8	0.31

*All values in mg/l except EC and pH

WQI Classification

The classification of WQI is based on water quality standards for drinking purpose in Torehalla is as below:

WQI Value	Water Quality	Percent of water samples
< 50	Excellent	7 % (5)
50 – 100	Good	69.1% (49)
100 – 200	Poor	22.53% (16)
> 200	Very Poor	1.40%(1)

WQI based Classification

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 39.6 to 201.7 (Fig.1) with an average of 86.4. According to the WQI classification, about 7% of the total groundwater samples represent excellent water quality, 69.1% as good, 22.53 % as poor and about 1.37% as very poor in water quality for the study area.

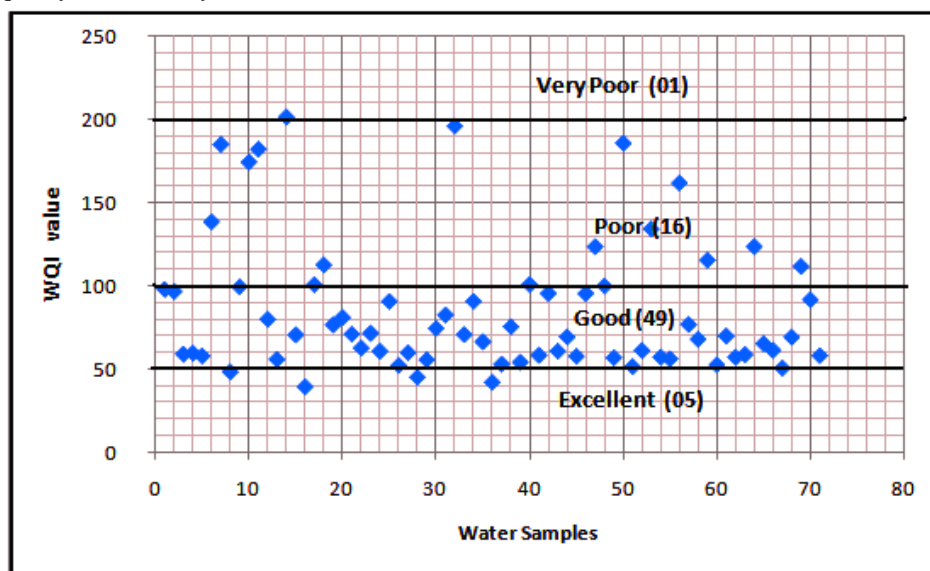


Fig.1: WQI values and water samples

Conclusion

WQI values are computed to know the water quality in Torehalla watershed. In the study area the WQI values vary between 39.6 to 201.7 with an average of 86.4. According to the WQI classification, about 76% of the total groundwater samples represent excellent to good water quality and 24 % as poor to very poor in water quality in the study area. Thus the overall water quality by and large falls under good. 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.

Acknowledgement

The authors acknowledge the financial assistance received from the University Grant Commission, New Delhi as a Major Research Project in carrying this research work.

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