Water Quality Indices For Surface Water Inhebbal Valley, Bengaluru, Karnataka, India

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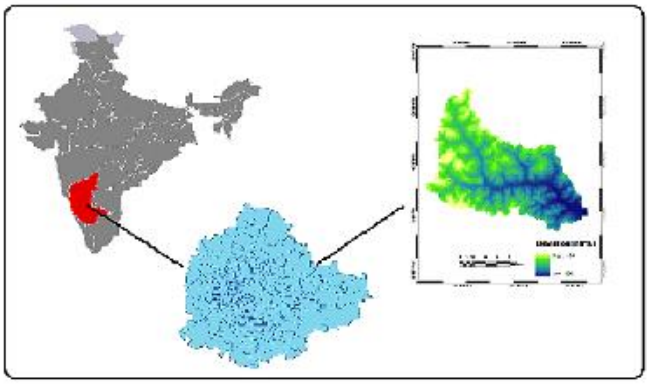
Abstract- *The growing population and increased water demand has resulted in depletion of available fresh water resources and the same has caused imbalances in the ecosystem. This challenge of managing available water resources needs new approaches which should include social, economical and environmental factors. The quality of the available water must be evaluated to see how it fits the intended use. Water quality refers to the characteristics of a water supply that will influence its suitability for a specific use. One of the method to evaluate water quality is Water Quality Index (WQI).WQI are computed for surface water quality parameters in Hebbal valley for three seasons Viz., rainy, winter and summer. In the present investigation surface water samples from ten different locations have been collected and analysed for various physico-chemical parameters and same have been interpreted. WQI values in the study area vary between 34.07 to 52.62 with an average of 39.46for rainy season,31.08 to 55.54 for winter with an average of 38.36 and 36.71 to 58.61 for summer season with an average of 43.89 respectively. According to the WQI classification, most of the water samples analysed had good water quality except in few samples. In general higher percent of WQI values in poor and very poor water quality classes is mainly due to anthropogenic factors. The results obtained from the study indicates that water quality is generally good with few exceptions.*

Keywords- Population, depletion, environmental, WQI, approaches.

I. INTRODUCTION

Water has always been anvital and life-sustaining drink which is essential for 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. Humans have inadequate access to potable water and use sources contaminated with disease vectors, pathogens or unacceptable levels of toxins or suspended solids. The water table which was at minimum feet deep below a few years back, is today at a greater depth in some areas. Indiscriminate discharge of untreated domestic sewage, industrial effluents, leachates from solid waste dumps, agricultural runoffs. etc into streams, lakes has resulted in water pollution. The lakes which catered to the water supply needs of some localities have become useless due discharge of effluents and many lakes have vanished due to silting, solid waste dumping and also encroachments. This is also true in case of the study area. In this context an attempt has been made to assess the surface water quality in the study area using Water Quality Index coupled with Remote sensing and GIS. 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.

II. STUDY AREA



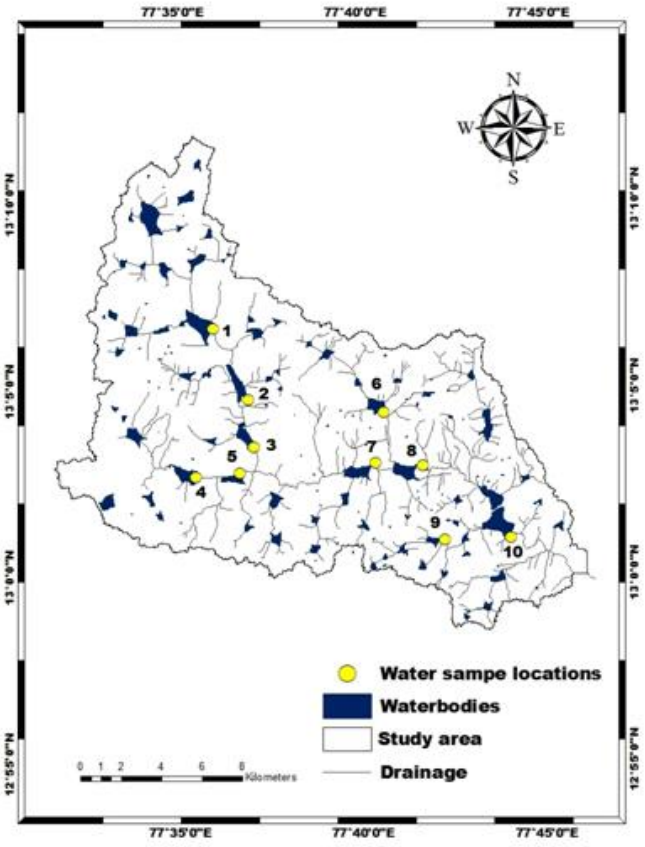
Map 1 - Study area

The study area is located between 12º 50’ to 13º 5’N Latitudes and 77º 30’ to 77º 40’E Longitudes forming a part of Cauvery river basin. The study area covers an area of 310.24 km2 and drains into river Pinakini in Bangalore district of Karnataka. Physiographically the area is characterized by undulating topography with plains and shallow valleys. The study area is located at the north eastern parts of Bangalore. Bangalore is the capital of Karnataka state. However the

district does not have any major river flowing. The district falls in Cauvery river basin. The study area attains maximum elevation of 940 mtrs. and a minimum of 880 mtrs. above mean sea level. The study area is well connected by highways and main roads. The average annual rainfall in the study area is 820 mm.

III. METHODOLOGY

In the study area surface water samples have been collected from various locations for three different seasons Viz., rainy, winter and summer. The sampling points were located in areas where there was no treated water supply. The samples so collected were analysed for pH, Electrical Conductivity (EC), Chloride, DO, BOD, Calcium, Magnesium, Nitrates, Sulphates, Total hardness and TDS by adopting standard analytical procedures. 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 – Water sample locations.

IV.WQI CALCULATION

Calculation of water quality index involves 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 water 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, alkalinity and EC are assigned the Wi 3, Clas 4 and DO as 3 and hardness as 3 and so on(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). 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;

$Si = Wp * Qi$

Water 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 = ∑Si

V. RESULTS AND DISCUSSION

The study area has an average pH varying from 7.2 to 7.6 in rainy, winter and summer seasons. The desirable limit of pH for drinking water is 7. Average EC values vary from 1143 to 1481microsiemens/cm at 25oC. Chloride concentration in the study area ranges from 237 mg/l to 278 mg/l.Similarly the average values for all the three seasons are calculated. Statistical parameters of the analytical results is given in Table – 1.

Constituents (mg/L)	Relative Weight	Weighted Parameter	Drinking water Standards (BIS)	Mean value of Study area (mg/L)		
				Rainy	winter	summer
Calcium	2	0.05	75	41.5	37.8	39.7
Magnesium	2	0.05	30	38.4	41.2	57.4
Nitrate	3	0.07	45	11.9	13.1	12.5
Sulphate	4	0.10	150	16.4	18.9	19.7
Chloride	4	0.10	250	237	260	278
Hardness	3	0.07	300	296	280	283
TDS	4	0.10	500	607	501	657
Alkalinity	3	0.07	200	253	248	250
pH	3	0.07	7.5	7.2	7.4	7.6
EC	3	0.07	1400	1328	1143	1481
DO	3	0.07	5	4.3	3.3	3.6
BOD	3	0.07	5	16.3	16.9	20.4

Table - 1: Weightage scheme for water quality

WQI Classification

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

WQI value	Water quality	% of water Samples (Rainy)	% of water samples (Winter)	% of water samples (Summer)
0 - 25	Excellent	-	-	-
26 - 50	Good	70	80	60
51 - 75	Poor	30	20	40
76 - 100	Very poor	-	-	-
>100	Unfit	-	-	-

Table – 2.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 value 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 32.1to 58.61with an average of 38.5. According to the WQI classification, all the water samples fall under good to poor category indicating their suitability for domestic activity.

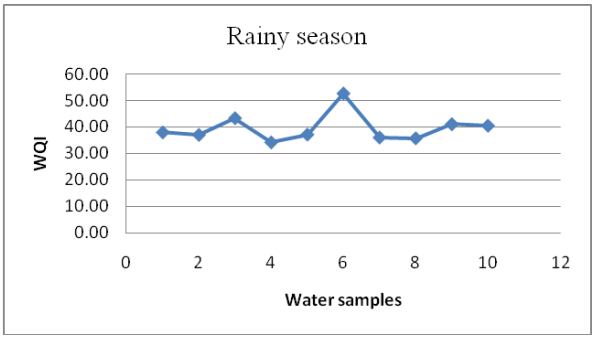


Fig. 1: Water quality values v/s water samples

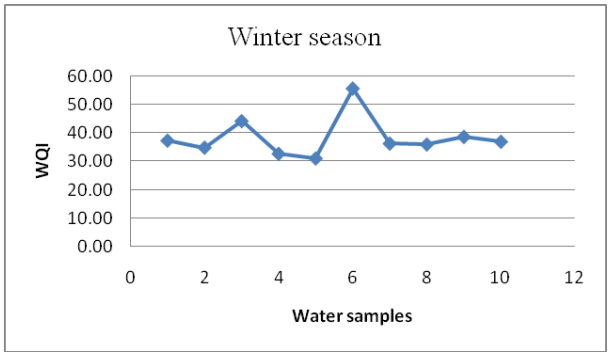


Fig. 2: Water quality values v/s water samples

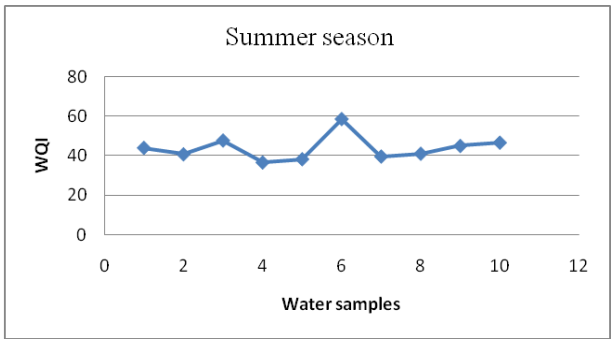


Fig. 3: Water quality values v/s water samples

VI. CONCLUSION

It is essential to ascertain the quality of water available from the various sources to evaluate whether the water is potable or not. So to know the potability conditions various parameters like pH, EC, Chloride, Total Hardness, Calcium, Magnesium, TDS, DO, BOD, Sulphates and Nitrates were analysed for the study area and are tabulated in Table - 1.WQI values are computed to know the water quality in the study area and are tabulated in Table - 2. WQI values in the study area varies between 34.07 to 52.62 with an average of 39.46 for rainy season, 31.08 to 55.54 for winter with an average of 38.36 and 36.71 to 58.61 for summer season with an average of 43.89 respectively. According to the WQI classification, most of the water samples represent good water quality. The graphs are plotted to represent the WQI data in the study area for all the three seasons (Fig.1- 3). According to

WQI classification, most of the water samples in the study area represents good water quality i.e.,70,60 and 80% in rainy, winter and summer seasons respectively.30, 20 and 40% as poor quality. Generally the higher WQI values in the poor and very poor water quality class is by the contribution from anthropogenic factors. Thus from water quality indices it can be concluded that surface water quality in the study area is generally good with few exceptions.

REFERENCES

[1] BIS (2003). Drinking water - specification, Bureau of Indian Standards: New Delhi IS;10500.
[2] Davis S.N. and Dewiest R.J.M., (1966). Hydrogeology, John Wiley & Sons Inc.,New York.
[3] Holden W.S., (1970). Water Treatment and Examination, Churchill Publishers: London.
[4] Horten R.K., (1965). An Index number for rating water quality, J. Water Poll. Cont. Fed.37 (3): 300-306.
[5] Mishra P.C and Patel R.K., (2011). Study of the pollution load in the drinking water of Rairangpur, a small tribal dominated town of North Orissa, Indian J. Environ. Ecoplan. 5(2), 293 - 298.
[6] Subba Rao N.,(1997). Studies on the water quality index in hard rock terrain of Guntur district, Andhra Pradesh, India. National Seminar on Hydrology of Precambrian Terrains and hard rock areas, pp 129-134.