Mathematical Model of Water Quality Index for Assessment of Water Quality of Karha River

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Abstract : Domestic and industrial effluentscontaminate the water bodies making it un-drinkable for humans as well as domestic animals. The polluted water causes various water born diseases to consumers. Therefore, it is necessary to check the water quality at regular intervals. In present study assessment of Karha river was carried out at Baramati. The aim of the present work deals with to checking Water Quality of a Karha river in order to assist the quality for public consumption, recreation, agricultural and other uses. This paper deals with the study on the effect of human activity on the water quality of the freshwater body. There are different ways to determine the quality of water for various purposes. Water Quality Index gives the water quality as index number, which help to interprets result easily. It assists the quality of water for public use as well as for pollution controlling programmes and quality management. In this study, Water Quality was determined on the basis of physicochemical Frameworks like pH, total alkalinity, total hardness, dissolved oxygen and total chloride

Index Terms **- Freshwater, Karha river, Ecosystem, physicochemical, Water Quality Index.**

I. INTRODUCTION

Water is the crucial source of life. Survival of each and every organism depends on water quality. The fresh water is the best source of water for all living organism for drinking and daily use. Human beings completely depend on freshwater for survival because it consists of the low concentration of salt. Freshwater sources may be mainly in the form of rainwater, rivers, lakes, groundwater etc. Some human civilization develops around freshwater bodies such as river but human activity changes water quality. Water resources play a vital role not only for drinking purpose also in differentfields of the economy like agriculture, livestock, forestry, industrial activities, fisheries and some other creative activities(Tyagi*et al.* 2013). The change in physical-chemical and biological properties of water which harmful to living organism of earth. The main source of water pollution is diffusion. Diffusion source consists of polluted runoff water of farmland and mine. Point sources include municipal sewage west water treatment plant discharge and industrial plant discharge. Water pollution comes from industrial and domestic wastewater and agricultural drainage (Carpenter *et al.*1998).

Human civilization depends on agriculture. The income of the rural population is depends on agriculture and agriculture-dependent business. The village population of India depends on farming. Farmer of India depends on river water. Farmer uses chemical fertilizers, pesticides and weedicides for increasing productivity but it mixes with water bodies which decrease water quality. Water quality can be affected due to the discharge of domestic wastewater, industrial as well as agricultural drainage to the rivers. Some factors like increasing population, industrialization, urbanization etc cause eutrophication of freshwater bodies (Carpenter *et al.* 1998). Freshwaters are the most vulnerable resource for most activity. Sewage and The industrial wastewater mix with Kara river water resulting in increasing the biological oxygen demand (BOD). Low Dissolved oxygen (DO) level affecting the growth of phytoplankton and microorganisms. Availability of significant amount of nutrients like nitrates, phosphates results in increasing algal blooms. Water is a vital resource used for various activities such as drinking, irrigation, Fish production, industrial cooling, power generation and many others (Sathe *et al.*, 2018).

As water is avital source of life therefore regular checkup of water quality is necessary. For this Mathematical model for the Water Quality Index(WQI) design by Horton in 1965. Horton used commonly used water quality parameters like pH, dissolved oxygen (DO), specific conductance, alkalinity, hardness and chloride in his WQI. Then WQI was accepted by European, African and Asian countries for checking water quality. Then Brown in 1970 develops a new WQI for assessment of water quality which is similar to Horton's index. WQI generates a single numerical value for the water qualities which helps to analyze water quality easily. It reduces the time for analyzing a large amount of water quality data. It helps us to interpret the result with simple inferences like excellent, good, medium and bad attached to it.

II. Material and Methods

Study area:

Karha river is flowing through the Maharashtra of India between the latitude 18°9'12"N and longitude 74°34'3"E. karha river water used for drinking, agriculture, domestic uses. For analysis Baramati station is selected

III. Methodology of collection and assessment of water samples:

For determining physico-chemical conditions, the water samples were collected monthly from October 2017 to march 2018 in sampling bottles. The water sample was fixed immediately on the field and estimated in the laboratory using modified Winkler's method (Golterman et al, 1978). pH and Temperature was recorded on the field by pH meter and centigrade thermometer respectively. The alkalinity andhardness, were investigated by titration on the same day in the laboratory. (Golterman et al, 1978; APHA et al, 1998).

IV. Water Quality Index (WQI):

Water quality index is easiest method to assess water quality by using the most commonly measured water quality variables. Weighted arithmetic water quality index method classified the water quality into single value which we can analyze with standard value (Tyagi et al,2013, Kumar et al,2012). This methodis commonly used by the various countriesfor the calculation of WQI in which following equation was used:

$WQI = \sum qiwi \sum wi$

The quality rating scale of water samples are for every parameter is obtained by using this expression:

qi= 100[(Vi – Vo Si −Vo)]
Where,
Vi- is estimated concentration of the ith parameter in the analysed water
Vo- is the ideal value of this parameter in pure water Vo = 0 (value except for pH =7.0 and DO = 14.6 mg/l)
Si- is recommended standard value of the ith parameter
Wi is the unit weight for each water quality parameter is calculated by using the following formula:
Wi= K Si
Where,Kisproportionality constant and can be calculated by using the following equation:
K =1 ∑(1 Si)
The rating of water quality according to this WQI is given in first Table

Table 1. Value of Water Quality on basis of Weight Arithmetic Water Quality Index.

WQI value	Water quality rating	Grades
0-25	Excellent water quality	A
26-50	Good water quality	B
51-75	Poor water quality	C
76-100	Very Poor water quality	D
Above 100	Unsuitable for drinking purpose	E

Table 2: Standard value of Water Quality Index (WQI) from recommending agency.

Sr. no	Parameter	Standard	Recommended Agency
1	pH	6.5-8.5	ICMR\BSI
2	Dissolve oxygen	5 mg\ lit	ICMR\BSI
3	Alkalinity	120 mg\lit	ICMR\BSI
4	Total hardness	300 mg\lit	ICMR\BSI
5	Chloride	250 mg\ lit	ICMR\BSI

BSI 2012 Guidelines for Drinking Water Quality WHO 2011

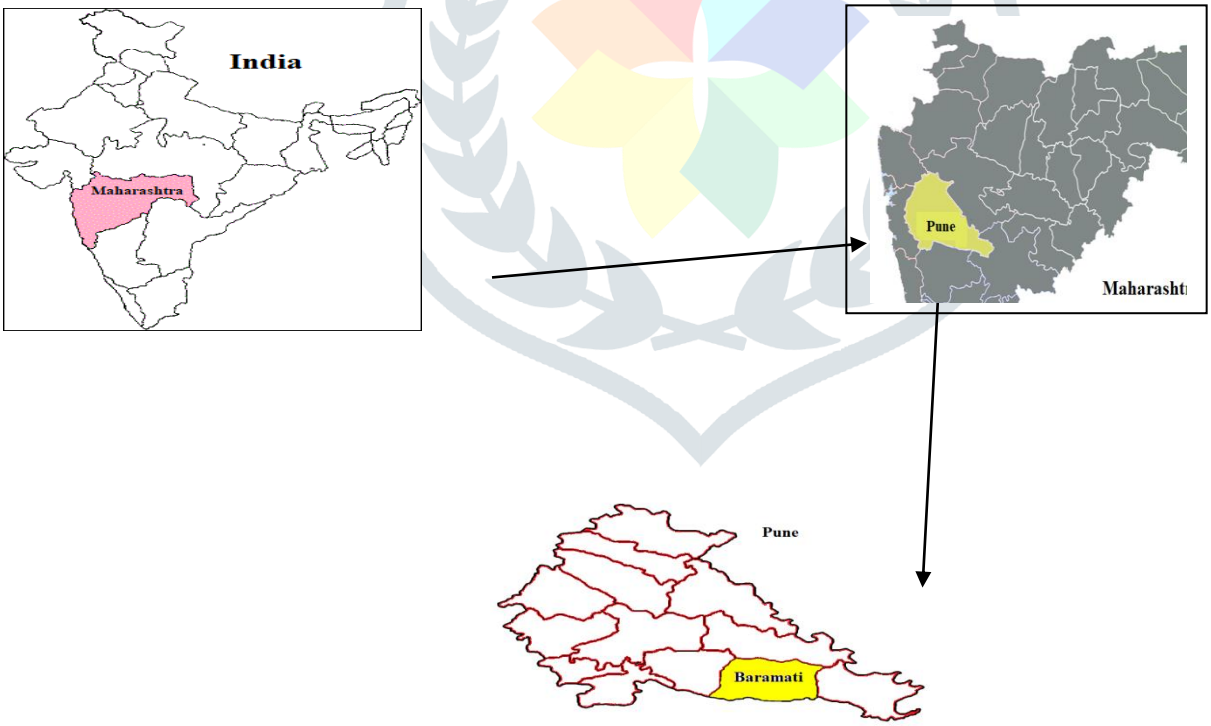

Figure 1: Location of Karha river in India

Table 3: Karha River Water Quality Index (WQI).

Parameter	Observed values (V_i)	Standard values (S_i)	Unit weights (W_i)	Quality rating (q_i)	w_iq_i
pH	6	6.5 - 8.5	0.36	-56.67	-20.20
Dissolved Oxygen	4 mg/L	5 mg/L	0.61	110.42	66.92
Alkalinity	169mg/L	120mg/L	0.03	140.83	3.56
Total Hardness	271mg/L	300 mg/L	0.01	90.00	0.91
Chlorides	183 mg/L	250 mg/L	0.01	74.34	0.90
			$\sum w_i$=1.01		$\sum$wiqi=52.08
WQI = $\sum$ qiwi /$\sum$wi					
= 51.57					

V. Results and Discussions:

The water quality of the Karha river was calculated by using the weighted arithmetic index formula as follows:

WQI(Water quality index) = $\sum$ qiwi / $\sum$wi

= 52.08/ 1.01

=51.57

After calculation Index value of water is 51.57 which come within range 51-75, Grade "C" of the range of water quality on basis of weighted arithmetic WQI method as given in Table 1. It was found that water from the Kahra river is of poor quality thereforeit is necessary to treat the water before use to prevent waterborne diseases and health problems.

Water quality of the Karha river is determined from different physicochemical properties in different months. The standard values of different physicochemical properties are compared with water quality index value of (WHO) World Health Organization, 2011 and BSI standard values of third table. After calculation we found that the water quality of Karha river is poor.

The poor water quality is may be due to the various human activities such as industrial discharge along the riverside, domestic sewage discharge, daily cloth and veterinary pet washing in river increase alkalinity and microbial load in water. Heavy metals are released from developing industrial have also been recognized as major pollutants for fauna, flora and humans.(Sharma*et al*, 2009) Industrial discharge increase metallic pollutant in water which damage ecosystem and reduce water quality. Domestic animal consume river water sewage increases microorganism of water which leads into veterinary disease of domestic animal, The agricultural runoff contain pesticide herbicides and chemical fertilizer which damage water quality.Water pH is acidic due to industrial discharge. Alkalinity of water is high because use of detergent in cloth washing.

Drainage water dischargeincreasewater pollution. Along with the industrial discharge various metals, minerals are get mixed with river water results in the eutrophic condition in river. With the background of raining conditions of past few years may be the chances of draught conditions in future are increased and humanity may suffer by water scarcity. In that point of view making the freshwater bodies clean and pollution free is necessary. Low dissolve oxygen damage ecosystem it will have high chance of eutrophication in feature,this all parameter shows us water need treatment otherwise karha river will extinct from India.

VI. Conclusion

The main purpose of study was to calculate the WQI of Karha river station Baramati, Maharashtra India in order to assess its suitability for various purposes like for drinking, irrigation, agricultural and industrial. The result of WQI analysis is 51.57. It is a clear indication that water quality is poor and untreated water from the Karha river need treatment before use. Sewage water is measure region behind poor quality of water. Domestic animal drink river water therefore veterinary diseases to domestic animal are common. To avoid water related diseases to humans and domestic animals, we need to create awareness about water pollution and for improving water quality we need to make strategies for water treatment of Karha river.

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