MODELING OF WATER QUALITY INDEX OF SHAHANUR RIVER OF ANJANGAON SURJI REGION IN MAHARASHTRA STATE

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Abstract

The present study was undertaken to assess the water quality of River Shahanur of Anjangaon Surji region, Amravati district in Maharashtra. For the analysis of water quality, various physico chemical parameters are tested and analyzed by Water Quality Index. According to Water Quality Index model, water quality of Shahanur River is good for all sites by aggregative method. But as per multiplicative method, it is medium for all the sites. According to the water quality index of water, quality of water of sites 1 to 9 is moderate ,which is not fit for drinking, even though it can be supplied for 225 villages and 2 towns having a population of about 5,00,000. The quality of water can be used for bathing and other domestic purposes only.

Keywords - waterquality index ,WQI, Physico-chemical parameter

Introduction

India is land of river having about 500 rivers in the country including 14 international rivers. From ancient times, India is known as "Sapta Sindhus Pradesh" means India's socioeconomic, cultural development took place in the region of rivers. River water is main source in India for all the domestic purposes. But with the advancement of civilization, the utility of water has enormously increased. Thus, it is necessary for all countries to build dam on the rivers. Shahanur dam was one of the dams built to supply fresh water for all domestic purposes, electricity generation and irrigation.

River Shahanur is one of important rivers of Vidarbha Region in Maharashtra State. River Shahanur originates near the village Vairat in the proximity of Chikhaldara, Amravati district in Maharashtra. The dam site for Shahanur project is located at latitude 21° 15' 21" and longitude 77° 19' 30". Shahanur dam is an earthen dam constructed

across the Shahanur River. The total catchment area up to the dam site is 53.74 sq. miles (139.187 Km^2). Water stored in the Shahanur dam is supplied daily to 225 villages and 2 towns having a population of about 5,00,000. The main important thing is that for all this purposes gravitation force is applied without any consumption of electricity. This gravitational based Water supply system is only one of its kind in India, which is recorded in Limca book of record.

Aims and Objectives

1. Monitoring of Shahanur River in 15 Kms stretch.

2. Selection of various sampling points.

3. Bio Chemical characterization of sample water.

4. Development of mathematical model for comparing the data.

5. Analyze the obtained data with the help of Water Quality Index Model

Material and Methods

For qualitative assessment of Shahanur river water, a 15 km stretch was selected between the entire stretch of the river and its basin. Nine sampling stations were selected upstream of the dam which is located at latitude 21° 15' 21" and at longitude 77° 19' 30".

For the determination water quality of the Shahanur River, monthly monitoring of water quality at selected stations for a period of two years during May 2007 to April 2009 was done.

Sampling was done once in a month. The climate of the site is continental. It is hot and dry in summer, mild in winter, cloudy and rainy in rainy season. The entire chemicals used in the study were of analytical grade. Double distilled water was used throughout the study. All glass wares and sample containers were thoroughly cleaned and finally rinsed with double distilled water. Standard Methods for the examination of water and waste water published by American Public Health Association (APHA 1989) and "Laboratory Manual on Water Analysis of NEERI" was used as well as "water and waste water for engineering" is used for water quality index.

Temperature was measured by mercury thermometer. pH, EC, TDS and Salinity was measured by analytical mobile kit. DO was analyzed by the spot Iodometric with azid modification method. This also forms the basis for BOD estimation by incubation method using BOD incubator at 27°C for 3 days. The COD values were determined by refluxing the sample with mixture of standard potassium dichromate and concentrated sulphuric acid. The hardness estimated by the conventional EDTA titration method. Sulphate was analyzed by turbidity method using colorimeter. The amount of chloride ions was analyzed by argentometric method, which involves titration with standard $AgNO_3$ solution using potassium chromate as an indicator. Sodium and Potassium was estimated by flame photometer. Bacteriological parameters, FC and TC were estimated through multiple dilution method. (MPN count).

Observations

From the collected data,Water Quality Indices are calculated. Observations of seasonal variation as well as Water Quality Index modeling are given in the **Table 2**

Calculation of Water Quality index

Table no 1 Calculation of weights (Wi)					
Parameters	Actual Rank	Mean Rank	Temp weight	Sum of temp weight	Final weight
pH	2	0.4	5	60	0.08
DO	2	0.4	5	60	0.08
BOD	1	0.4	2.5	60	0.04
COD	3	0.4	7.5	60	0.13
Alkalinity	3	0.4	7.5	60	0.13
C.Hardness	5	0.4	12.5	60	0.2
TDS	4	0.4	10	60	0.17
Turbidity	2	0.4	5	60	0.08
FC	1	0.4	2.5	60	0.04
TC	1	0.4	2.5	60	0.04

	6-Sep
pH	
DO	0-9
COD	0-300
Alkalinity	200
C.Hardness	0-600
TDS	0-500
Turbidity	0-100
FC	1800
TC	400

Calculation of Water Quality Index

Aggregative method for WQI

Calculation for water quality index by an aggregative method

WQI_a=	$\Sigma q_i * w_i$
where,	
WQI_a=	aggregative Water Quality Index, a number between 0 to100;
q_i=	the quality of ith parameter between 0 to 100;
w_i=	the weight of ith parameter, a number between 0 to 1
n=	is the total number of parameters

Classification of Water Quality Index with respect to WQI

(Aggregative method)		
WQI	Class	Description
63-100	A	Good to Excellent
50- 63	Bridge	Good to Moderate
38-50	C	Bad
Below 38	D,E	Bad to Very bad

Multiplecative Method of WQI

WQI_m=	$\pi(q_i)^{w_i}$
where,	
WQI_m=	Multiplecative Water Quality Index, a number between 0 to100;
q_i=	the quality of ith parameter between 0 to 100;
w_i=	the weight of ith parameter, a number between 0 to 1
n=	is the total number of parameters in following table.

Classification of Water Quality Index with respect to WQI					
(Multiplecative method)					
WQI	**Description**				
0-20	Bad				
21-50	Medium				
51-80	Good				
81-100	Very good				

Table no 2 : Calculation of WQI of Shahanur river.

Parameter/ Location	Site -1	Site -2	Site - 3	Site - 4	Site - 5	Site- 6
pH	8.4	8.51	8.33	8.31	8.33	7.5
Q1 rating	30	24.5	33.5	34.5	33.5	75
W1 rating	0.08	0.08	0.08	0.08	0.08	0.08
q1w1	2.4	1.96	2.68	2.76	2.68	6
$\Pi(qi)^{wi}$	4.12	4.06	4.16	4.17	4.16	4.44
DO (mg/L)	7.72	7.48	7.85	7.8	7.65	7.62
Q1 rating	85.78	83.11	87.22	86.67	85.00	84.67
W1 rating	0.08	0.08	0.08	0.08	0.08	0.08
q1w1	6.86	6.65	6.98	6.93	6.80	6.77
$\Pi(qi)^{wi}$	4.48	4.47	4.49	4.49	4.48	4.48
B.O.D (mg/L)	4.86	4.95	4.25	4.51	4.79	3.91
Q1 rating	95.14	95.05	95.75	95.49	95.21	96.09
W1 rating	0.04	0.04	0.04	0.04	0.04	0.04
q1w1	3.81	3.80	3.83	3.82	3.81	3.84
$\Pi(qi)^{wi}$	3.77	3.77	3.77	3.77	3.77	3.77
C.O.D(mg/L)	87.62	102.37	90	81.12	89	93.62
Q1 rating	70.79	65.88	70	72.96	70.33	68.79
W1 rating	0.13	0.13	0.13	0.13	0.13	0.13
q1w1	9.20	8.56	9.10	9.48	9.14	8.94
$\Pi(qi)^{wi}$	5.46	5.41	5.45	5.48	5.46	5.44
Alkalinity (mg/L)	153.5	148.75	153.85	141.25	137.62	131.25

Q1 rating	23.25	25.625	23.075	29.375	31.19	34.375
W1 rating	0.13	0.13	0.13	0.13	0.13	0.13
q1w1	3.02	3.33	3.00	3.82	4.05	4.47
$\Pi(qi)^{wi}$	4.73	4.79	4.72	4.87	4.91	4.97
C. hardness (mg/L)	98.75	105.87	113.87	93.25	92.25	90.62
Q1 rating	83.54	82.36	81.02	84.46	84.63	84.90
W1 rating	0.2	0.2	0.2	0.2	0.2	0.2
q1w1	16.71	16.47	16.20	16.89	16.93	16.98
$\Pi(qi)^{wi}$	7.61	7.59	7.56	7.63	7.63	7.63

Parameter/ Location	Site - 1	Site - 2	Site - 3	Site - 4	Site - 5	Site- 6	Site - 7	Site - 8	Site -9
TDS (mg/L)	164.22	169.5	168.53	167.62	162.15	149.78	149.93	160.58	162.6
Q1 rating	67.156	66.1	66.294	66.476	67.57	70.044	70.014	67.884	67.48
W1 rating	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
q1w1	11.42	11.24	11.27	11.30	11.49	11.91	11.90	11.54	11.47
$\Pi(qi)^{wi}$	6.42	6.40	6.41	6.41	6.43	6.47	6.47	6.43	6.43
Turbidity (NTU)	40.43	36.52	26.13	31.77	27.13	33.61	33.53	34.6	38.9
Q1 rating	59.57	63.48	73.87	68.23	72.87	66.39	66.47	65.4	61.1
W1 rating	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
q1w1	4.77	5.08	5.91	5.46	5.83	5.31	5.32	5.23	4.89
$\Pi(qi)^{wi}$	4.35	4.38	4.43	4.40	4.43	4.39	4.39	4.39	4.36
F.C (per 100 ml)	161.25	394.87	335.5	157.5	120.62	53.87	29.62	22.37	21.37
Q1 rating	91.04	78.06	81.36	91.25	93.30	97.01	98.35	98.76	98.81
W1 rating	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
q1w1	3.64	3.12	3.25	3.65	3.73	3.88	3.93	3.95	3.95
$\Pi(qi)^{wi}$	3.76	3.74	3.74	3.76	3.76	3.77	3.77	3.77	3.77
T.C (per 100 ml)	87.12	73.62	92.62	68.78	47	31.37	18.87	15.87	13.12
Q1 rating	78.22	81.60	76.85	82.81	88.25	92.16	95.28	96.03	96.72
W1 rating	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
q1w1	3.13	3.26	3.07	3.31	3.53	3.69	3.81	3.84	3.87
$\Pi(qi)^{wi}$	3.74	3.74	3.74	3.75	3.76	3.76	3.77	3.77	3.77
WQI=Σq1w1	64.95	63.48	65.3	67.43	67.99	71.79	72.93	72.57	72.68
WATER QUALITY	Good	Good	Good	Good	Good	Good	Good	Good	Good
WQI=ΣΠ(qi)wi	48.44	48.34	48.47	48.72	48.78	49.12	49.23	49.18	49.19
WATER QUALITY	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium

Results and Discussion

The fecal and total coliform bacterial count in Shahanur river water was as low as 7 coliform per 100ml except 1600 coliform per 100ml in May i.e. during summer. This is because of the less water flowing in river during summer and more human activities. However throughout the year, the bacterial count was low and fluctuating. In India most of the holy river like Godavari, Ganges, Yamuna, have more fecal coliform count (Gautam 1990; Khanna and Bhutiyani; 2006).

The overall study of physio-chemical and microbial parameters of Shahanur rivers water reveals that the water quality is changing gradually due to certain anthropogenic activities in and in the vicinity of river. The agricultural run off may also be responsible for changing the water quality. If these activities are not banned at right time, the potability of water may be hampered in near future. Today also, it is recommended that the Shahanur river water should be used only after proper treatment. In fact public awareness has to be evolved to make people conscious of water pollution, in order to control the same.

Conclusion

According to Water Quality Index model, water quality of Shahnur River is good for all sites by aggregative method. As per multiplicative method, it is medium for all the sites. According to the water quality index of water, quality of water at sites 1, 2,3,4,5,6,7,8 and 9 are moderate, which is not fit for drinking, even though it is being supplied for 225 villages and 2 towns. The quality of water can be used for bathing and other domestic purposes only.

Acknowledgement-

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