International Journal of Applied Research

Roopshah Prajapati
Research Scholar Zoology
Deptt. Pt. S.N.S. Govt. P.G.
College, Shahdol (M.P.) A.P.S.
University, Rewa (M.P.)
486003, India.

Water quality index assessment of Sarfa Dam, Shahdol district (M.P.) India

Roopshah Prajapati

Abstract
The aim of Present study is to estimate the WQI of a water body i.e. Sarfa dam in Shahdol (M.P.). The WQI of any water body is a single number that indicates the weighted average of selected parameters linked to water quality classes. It gives an indication of water quality of whole water body in form of single value of WQI. To determine WQI of Sarfa dam, study of physico-chemical parameters has been analysed such as pH, TDS, TSS, alkalinity, hardness, calcium, magnesium, sulphate, chloride, nitrate, BOD and DO. However WQI values of Sarfa dam reported as 173.038, 170.75 and 171.031 of pre-monsoon, rainy season and post monsoon respectively. It shows trend of change of WQI is almost similar and in pre-monsoon season dam is having less pollution as compare to post monsoon season. The WQI of present study reveals dam water is contaminated and not suitable for drinking purpose without giving treatment.

Keywords: Water quality, Assessment, Sarfa dam, Shahdol district, Madhya Pradesh, India.

1. Introduction

Water is the precious gift of nature to human being and pure water is an important resource of mankind, because it is directly related to human wellbeing. Now a day's water is going to be polluted day-by-day with increasing urbanization. Although three fourth part of earth is being surrounded by water but a little portion of it may be used for significant purposes. This little portion of water is not even safe due to increased pollution. The surface water bodies are the abundant and important sources of biological life. These are unfortunately under lots of environmental stress and getting polluted as consequence of manmade activities. There is a fact about the water bodies as they are the mirror of their environment as well as they reflect the society exists around surface water bodies and collect all Sins of humanity. Surface water is the most common source of consumers in most of the cities through municipal water supply. In this manner, more stringent treatments would-be required to make the surface water potable. The prominent source of surface water pollution is domestic sewage, industrial wastewater and agricultural run-off. There is an importance and need to study about surface water bodies. In many cases, application of fertilizers agricultural lands, pesticides, manure, and lime refuse dumps etc. are the main source of surface water and ground water pollution. Surface water is generally using for drinking and irrigation purposes in India. Therefore, we carried out studies of physicochemical parameters of surface water in Sarfa dam whether it is fit for drinking or some other purposes. Universal access to safe drinking water and sanitation has been promoted as an essential step in reducing the preventable diseases (WHO, 1992; 2006) [1-2].

Correspo ndence
Roopshah Prajapati
Research Scholar Zoology
Deptt. Pt. S.N.S. Govt. P.G.
College, Shahdol (M.P.) A.P.S.
University, Rewa (M.P.)
486003, Indis.

WQI of water can tell us whether the overall quality of water bodies possess a potential threat to various uses of water, such as habitat for aquatic life, irrigation water for agriculture and livestock, recreation and aesthetics, and drinking water supplies. Water quality index (WQI) is a single value indicator to the water quality. It integrates the data pool generated after collecting due weights to the different parameters. The present study is based on the analyses of physiochemical characteristics of dam water as samples of water collected from various locations of Sarfa dam. The advantages of an index include its ability to single number, its ability to combine various measurements in a variety of different measurement units in a single metric and its effectiveness as a communication tool. Water intended for human consumption should be both safe and wholesome. It should also be easily accessible, adequate in quantity, free from contamination and readily available (CCME WQI, 2005)[3].

Study area
The Shahdol district lies in the north-east part of Madhya Pradesh extending from 29º39'28" and 24º16'13" North latitude and from 80º32'56" to 82º12'21" East longitude approximately. The region lies in the heart of the country. The district is surrounded by Sone river and Rewa district in North, Mandla, in South Sidhi, Anuppur in Surguja East and Umaria and Satna in West. It is situated 489 meter above of the sea surface.

The Sarfa dam Shahdol (M.P.) is one of the most important water body of Sarfa river. It is 10 km. away from Shahdol city. The water of the dam is supplied to urban area of Shahdol after giving treatment for drinking purpose.

2. material and methods
The methodology of present study is according to the procedure recommended in APHA (2005) [4] and NEERI (1991) [5] guidelines for water quality. The physical, chemical characteristics of Sarfa dam were evaluated and sampling was done for estimate the quality of dam water from different sites. In this study eight grab samples were collected from Sarfa dam. Determination of concentration of different parameters is followed by estimation of water quality index of dam water.

In this study, twelve important parameters considered for calculation of quality index of dam water. The WQI used in this study has been taken from the recommendation giving the drinking water quality standards Bureau of Indian Standards (BIS). In the present study weighted arithmetic index method has been used to fix the WQI of the water body (Brown *et. al.* 1972) [6].

In this method, quality rating is determined first and it can also write as sub index.
It is calculated by using following expression:
$Q_n = 100 \times [V_n - V_{io}] / [S_n - V_{io}]$...… (i)
(Let there are n water quality parameters which have been taken and quality rating or sub index (Q_n) corresponding to nth parameter is a number a value or number indicates the respectively evaluated value of nth parameter in the corresponding polluted water body with respect to the standard permissible value of that parameter.)
Q_n= Parameter quality rating of nth parameter of water
V_n= Observed value of nth parameter at sampling station
S_n= Standard value of parameter within permissible limit
V_{io}= ideally predicted value of nth parameter (i.e., for DO and pH it is 14.6 mg/l and 7 respectively. For all other parameters it should be zero.)
After calculating quality rating, unit weight of water quality parameter should be calculated. It is the ratio of coefficient of proportionality of nth parameter to standard value of that parameter. It is also called relative of water quality parameter.
$W_n = K_p / S_n$ …..(ii)
W_n= relative weight of parameter
S_n= Standard value of parameter within permissible limit
K_p= Coefficient for proportionality.
Finally the Water Quality Index of water body can be calculated by the following equation:
$WQI = \Sigma Q_n W_n / \Sigma W_n$ …..(iii)
After estimation of WQI of Sarfa dam, compare it with the standard WQI values given by Chatterji and Raziuddin, 2002[7] and fix the status of Water Quality on the basis of estimated WQI.

Table 1: WQI Range and water quality on the basis of range (Chatterji and Raziuddin, 2002) [7]

Water Quality Index Range	Water Quality
0-25	Excellent Water Quality
26-50	Good Water Quality
51-75	Poor Water Quality
76-100	Very Poor Water Quality
>100	Unsuitable for Drinking

In this study, different water quality parameters have been analysed and twelve important parameters were taken to determine WQI of Sarfa dam. Standards limit of parameters introduced by recommending agencies BIS [8], WHO and ICMR. Following table contains parameters, their standard limits and unit weights for assessing the WQI. (APHA, AWWA, WPCF, 2003) [9]

Table 2: Standards for drinking water and Relative weight of parameter (all values are in mg/l, except pH)

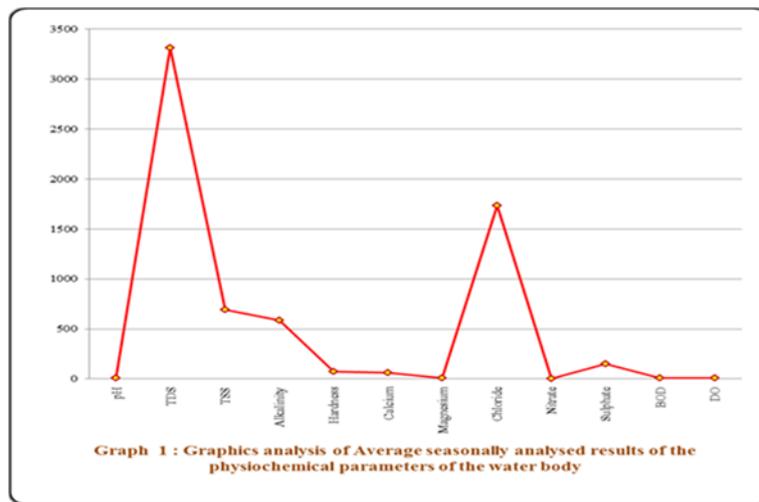| Sr. No.	Parameters	Standards	Concerned Agencies	Relative Weight
1	pH	6.5-8.5	BIS	0.2190
2	TDS	500	BIS	0.0037
3	TSS	500	WHO	0.0037
4	Alkalinity	120	ICMR	0.0155
5	Hardness	300	BIS	0.0062
6	Calcium	75	BIS	0.025
7	Magnesium	30	BIS	0.061
8	Chloride	250	BIS	0.0074
9	Nitrate	45	BIS	0.0412
10	Sulphate	150	BIS	0.01236
11	BOD	5	ICMR	0.3723
12	DO	5	ICMR	0.3723

3. Results and Discussion

In this study, samples have been collected in pre monsoon, rainy and post monsoon season. The study also shows variation in WQI of different season. Important parameters were evaluated from the collected samples in laboratory.

Table 3: Seasonally analysed results of the physiochemical parameters of the water body

Sr. No.	Parameters	Pre-Monsoon	Rainy Season	Post-Monsoon	Mean	SD	p
1	pH	8.57	8.52	8.69	8.59	0.087	0.005
2	TDS	3336	3315	3287	3312.67	24.583	402.889
3	TSS	721	667	687	691.67	27.301	496.889
4	Alkalinity	607	564	581	584.00	21.656	312.667
5	Hardness	79	64	73	72.00	7.550	38.000
6	Calcium	67	56	63	62.00	5.568	20.667
7	Magnesium	13	8	10	10.33	2.517	4.222
8	Chloride	1759	1688	1757	1734.67	40.427	1089.556
9	Nitrate	3.16	2.86	2.95	2.99	0.154	0.016
10	Sulphate	157	142	145.33	148.11	7.877	41.364
11	BOD	9.96	9.43	9.527	9.64	0.282	0.053
12	DO	10.12	10.64	10.37	10.38	0.260	0.045

Graph 1 : Graphics analysis of Average seasonally analysed results of the physiochemical parameters of the water body

After assessing the concentration of physiochemical parameters, calculation of quality rating and water quality index has been determined. All important steps of determination of WQI in different seasons are given in following tables.

(i) Water Quality Index of Sarfa dam has been calculated for pre-monsoon season and given in Table 4.

Table 4: Water Quality Index calculation of Sarfa dam in Pre-Monsoon season.

Sr. No.	Parametes	Observed Value	Standard Value	Unit Wt. (Wn)	Quality Rating Qi	Qi×Wi
1	pH	8.57	6.5-8.5	0.2188	114.267	25.002
2	TDS	3336	500	0.0037	667.2	2.469
3	TSS	721	500	0.0037	144.2	0.534
4	T. Alkalinity	607	120	0.0155	505.833	7.840
5	T. Hardness	79	300	0.0062	26.333	0.163
6	C. Hardness	67	75	0.025	89.333	2.233
7	M. Hardness	13	30	0.061	43.333	2.643
8	Chloride	1759	250	0.0074	703.6	5.207
9	Nitrate	3.16	45	0.0413	7.022	0.290
10	Sulphate	157	150	0.0124	104.667	1.298
11	BOD	9.96	5	0.3723	199.2	74.162
12	DO	10.12	5	0.3723	202.4	75.354
				ΣWn =1.1396	ΣQn = 2807.389	ΣQnWn =197.194

Water Quality Index of Sarfa dam in pre monsoon season,
WQI= ΣQnWn/ ΣWn= 197.194/1.1396 = 173.038
(ii) Water Quality Index of Sarfa dam has been calculated for rainy season and given in Table 5.

Table 5: Water Quality Index calculation of Sarfa dam in rainy season.

Sr. No.	Parametes	Observed Value	Standard Value	Unit Wt. (Wn)	Quality Rating Qi	Qi×Wi
1	pH	8.52	6.5-8.5	0.2188	113.600	24.856
2	TDS	3315	500	0.0037	663	2.453
3	TSS	667	500	0.0037	133.4	0.494
4	T. Alkalinity	564	120	0.0155	470.000	7.285
5	T. Hardness	64	300	0.0062	21.333	0.132
6	C. Hardness	56	75	0.025	74.667	1.867
7	M. Hardness	8	30	0.061	26.667	1.627
8	Chloride	1688	250	0.0074	675.2	4.996
9	Nitrate	2.86	45	0.0413	6.356	0.262
10	Sulphate	142	150	0.0124	94.667	1.174
11	BOD	9.43	5	0.3723	188.6	70.216
12	DO	10.64	5	0.3723	212.8	79.225
				ΣWn =1.1396	ΣQn =2680.289	ΣQnWn =194.587

Water Quality Index of Sarfa dam in rainy season,

WQI= ΣQnWn/ ΣWn= 194.587/1.1396 = 170.75

(iii) Water Quality Index of Sarfa dam has been calculated for post-monsoon season and given in Table 6.

Table 6: Water Quality Index calculation of Sarfa dam in Post-Monsoon season

Sr. No.	Parametes	Observed Value	Standard Value	Unit Wt. (Wn)	Quality Rating Qi	Qi×Wi
1	pH	8.69	6.5-8.5	0.2188	115.867	25.352
2	TDS	3287	500	0.0037	657.4	2.432
3	TSS	687	500	0.0037	137.4	0.508
4	T. Alkalinity	581	120	0.0155	484.167	7.505
5	T. Hardness	73	300	0.0062	24.333	0.151
6	C. Hardness	63	75	0.025	84.000	2.100
7	M. Hardness	10	30	0.061	33.333	2.033
8	Chloride	1757	250	0.0074	702.8	5.201
9	Nitrate	2.95	45	0.0413	6.556	0.271
10	Sulphate	145.33	150	0.0124	96.887	1.201
11	BOD	9.527	5	0.3723	190.54	70.938
12	DO	10.37	5	0.3723	207.4	77.215
				ΣWn =1.1396	ΣQn =2740.682	ΣQnWn =194.907

Water Quality Index of Sarfa dam in post monsoon season,

WQI= ΣQnWn/ ΣWn= 194.907/1.1396 = 171.031

Graph 2 : Graphics analysis of WQI.
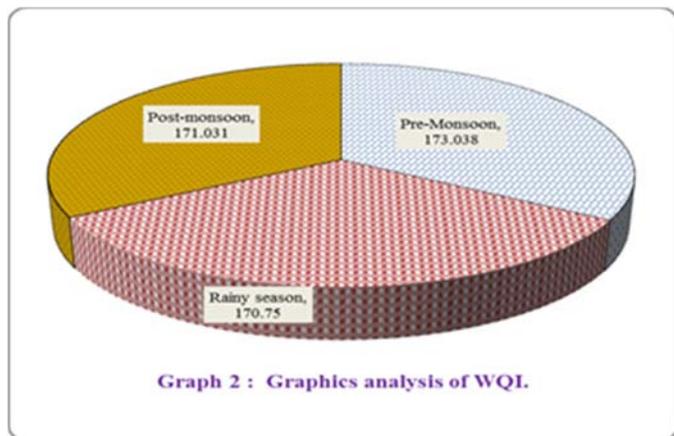
Quality Index of Sarfa dam water is established from assessment of water quality in different seasons. In this manner various physiochemical parameters has been calculated. The concentration of various physiochemical parameters for calculation of WQI are presented in Table no 3. The water quality indices that were found in three different seasons have been estimated. Table no. 4, 5, 6 shows WQI calculations in Pre Monsoon, Rainy and Post Monsoon season respectively. The water quality index estimated for Sarfa dam in Pre Monsoon, Rainy and Post Monsoon seasons are 173.038, 170.75 and 171.031 respectively. High values of water quality index of Sarfa dam indicates the poor water quality. The water quality index value of this study exhibits that, the water body contains high organic matter and eutrophic conditions. The values of water quality index also indicate water quality is very poor in pre-monsoon season as compared to rainy and post-monsoon season.

pH is an important parameter among all other parameters because on the basis of pH we can decide the different uses of water. In the present study, dam is alkaline in nature as the pH of water ranged 8.52 to 8.69 (Ambasht, 1971[10]; Petre, 1975[11]; Shardendu and Ambasht, 1988[12]; Swarnalatha and Narasinga Rao, 1993 [13] and Sinha, 1995 [14]). Chloride is an important parameter of the status of water quality. In this study, chloride was present in higher concentration which shows dam is having high level of organic pollution (Munawar, 1970) [15]. In the present study chloride ranged 1688 to 1759 mg/l. There is an observation that chloride was high in pre monsoon season as compared to rainy and post monsoon season (Sinha, 1995; Kushram, 2013; Sharma, 2015 and Rana, 2015) [14, 16-18].

Sarfa dam has the concentration of dissolved oxygen is 10.12 to 10.64 mg/l. DO level in any water body is a regulator of distribution of Flora and Fauna. The dissolved oxygen level is high in rainy season. Bio-chemical oxygen demand of any surface water body is an indicator of organic load in the water body. Many researches show higher values of BOD in highly polluted Water bodies. The BOD concentration in Sarfa dam ranged between 9.43 to 9.96 mg/l. Seasonally it is high during pre-monsoon season, which was also observed by Chatterjee (1992) [19]. Alkalinity in water body ranged as

564 to 607 mg/l which was very high as compare to BIS specifications of 120 mg/l. Higher value of alkalinity in pre-monsoon season indicates existence of free CO_2 while Nitrate is an important nutrient for the plant and algal growth. It may enter in dam through river. During this study as it was observed Nitrate 2.86 to 3.16 mg/l. Sulphur and sulphate in dam was 142 to 157 mg/l. which are within the range.

4. Conclusion
The results obtained from physiochemical parameters which were analysed to calculate WQI, dam is having organic load which comes through Sarfa dam. It can also be concluded that dam is eutrophic in nature. The WQI values of Sarfa dam clearly show the unsuitability of water of human being. Comparatively high level of chloride and sulphate indicates water is not suitable for domestic use without giving treatment. Dam can be used for boating or other recreational activities because of the good dissolved oxygen concentration. Water quality of water body is an important and significant technique for complete assessment of water body. It is an important tool and can summarize the water quality status in a single number from which uses can find out about the water body.

5. Acknowledgement

6. References
1. WHO. World Health Organization. International standards for drinking water. Geneva, 1992.
2. WHO. Burden of Disease and cost effectiveness estimates. World Health Organization, Geneva, 2006.
3. Canadian Council of Ministers of the Environment (CCME), WQI, Standard Methods for the examinations of water and wastewater, American Public Health Association, Washington, DC, 2005.
4. APHA. Standard methods for examination of water and waste water. 21 st Ed., Washington D.C., 2005.
5. NEERI, Manual of water pollution and control, 1991, 1, 9.
6. Brown RM, McCleiland NJ, Deininger RA, O‟Connor MF. A Water Quality Index – Crossing the Psychological Barrier (Jenkis, S.H., ed.) Proc. Int. Conf. on Water Poll. Res., Jerusalem, 1972; 6:787-797.
7. Chaterjee C, Raziuddin M. Determination of water quality index (WQI) of a degraded river in Asanol Industrial area, Raniganj, Burdwan, West Bengal. Nature, Environment and pollution Technology. 2002; 1(2):181-189.
8. BIS, Indian standard Drinking water Specification, Bureau of Indian Standard, Indian Standard (10500), 1991.
9. APHA, AWWA, WPCF Standard Methods for Examination of Water and Wastewater, 20th Edition, American Public Health Association, Washington, DC, 2003.
10. Ambasht RS. Ecosystem study of a tropical pond in relation to primary production of different vegetation zones, Hydrobiologia. 1971; 12:57-61.
11. Petre T. Limnology and Yamuna Fisheries of Nyumba Yamunag, a manmade lake in Tanzania, J Trop Hydrobiol Fish. 1970; 4:39-50.
12. Shardendu, Ambasht RS. Limnological studies of a rural pond and an urban tropical aquatic ecosystem, oxygen enforms and ionic strength, J Tropical Ecology. 1988; 29(2):98-109.
13. Swarnalatha N, Narasingrao A. Ecological investigation of two lentic environments with reference to cyanobacteria and water pollution. Indian J Microbial Ecol. 1993; 3:41-48.
14. Sinha SK. Probability of some rural pond water at Muzaffarpur (Bihar), A note on water quality index, J Pollution Research. 1995; 14(1):135-140.
15. Munawar M. Limnological studies on fresh water ponds of Hyderabad, India-II, J. Hydrobiologia. 1970; 35:127-162.
16. Kushram, Parvati. Study of physico-chemical and biological analysis of drinking water of Dindori town with special reference to quality status Unpublished thesis A.P.S. University, Rewa (M.P.), 2013.
17. Sharma, Pankaja. Seasonal Variations in Physico-Chemical Properties of Narmada River in Dindori Madhya Pradesh, India, International Journal for Research in Applied Science & Engineering Technology (IJRASET). 2015; 3(XII):285-288.
18. Rana Smt, Phul Kunwar Singh. Physicochemical Study of Ground Water of Shahdol City (Madhya Pradesh) With Special Reference to Status of WQI. International Journal for Research in Applied Science & Engineering Technology (IJRASET). 2015; 3(XI):458-461.
19. Chatterjee AA. Water quality of Nandakanan lake India., J Environ Hlth. 1992; 34(4):329-333.