Biolife 2(4):1268-1273
AN INTERNATIONAL QUARTERLY JOURNAL OF BIOLOGY & LIFE SCIENCES
ISSN (online): 2320-4257
www.biolifejournal.com
BIOLIFE RESEARCH ARTICLE

DETERMINATION OF WATER QUALITY INDEX OF ANNAPURNA RIVER IN DEVGAD TALUKA, DISTRICT SINDHUDURG, MAHARASHTRA

Korgaonkar D. S[1]., D. L. Bharamal[2] and Y. J. Koli[3]*

[1,2] *P. G. Department of Zoology, Shri Pancham Khemraj Mahavidyalaya, Sawantwadi – 416510, (MS) India.*
[3]*Department of Zoology, Sant Rawool Maharaj College, Kudal- 416520, (MS) India*

E-mail: dryjkoli@gmail.com

ABSTRACT

Water has always been an important survival medium for all the living organisms. But the increasing population has resulted into the industrialization, urbanization, constructions, etc., due to which the limited freshwater resources are threatened with pollution. Assessment of Water Quality Index (WQI) is one of the best tool to calculate the pollution status of the waterbody. Hence, the present study was undertaken to calculate the WQI of Annapurna River in Devgad taluka of district Sindhudurg. Annapurna River is the main source of municipal water supply. Water Quality Index in the present study was determined on the basis of physico-chemical parameters like pH, Total Alkalinity, Total Hardness, Chlorides, Dissolved Oxygen and Biological Oxygen Demand.

Key words: Water Quality Index, Annapurna River, Pollution, Sindhudurg.

INTRODUCTION

Freshwater systems are of vital concern to mankind. They provide human and his livestock with the important survival medium that is water. But these water bodies often become polluted or are prone to pollution due to developmental activities of human beings. As stated by Kankal*et al* (2012), the term "water quality" includes the water column and the physical channel required to sustain aquatic life. Hence the goal of the Federal Clean Water Act, "To protect and maintain the chemical, physical and biological integrity of the nation's water" puts forth the prospect of assessing both water quality and the habitat required for maintaining other aquatic organisms. Increasing environmental stress due to pollution has made it necessary to monitor the water body or its quality status. Hence, determining water quality index proves very important to express the overall water quality status of the waterbody, with the help of physico-chemical and biological parameters.

According to WHO (1994; 2001)universal access to safe drinking water and sanitation has been promoted as an essential step in reducing the preventable diseases. Tambekar*et al* (2005) stated that drinking water becomes contaminated due to improper storage of water to be supplied, leakage of water supplypipes, improper handling, distribution and serving methods. Hence, with this prospect, present study was conducted to assess water quality index using

some physico-chemical parameters of Annapurna River in Devgadtaluka.

Devgad (16º22'5"N, 73º49'30"E) is a coastal taluka in Sindhudurg district of Maharashtra state. It's noted for its habour, it's clean beaches and a lighthouse built in 1915 at the Devgad fort. Devgadtaluka spans an area of 756.48 Sq. Km., comprises 70 villages with total population 125288 according to 2001 census. Devgad receives average rainfall upto 2471mm during the period from June to September. Annapurna River, which is one of the major sources of municipal water supply of Devgad remains filled with water throughout the year. Hence the present study was undertaken to determine Water Quality Index of Annapurna River. The river is surrounded by rich vegetation. The present findings may serve as a database for future innovations.

MATERIALS AND METHODS

The water samples were collected monthly for a period of one year from March 2013 to February 2014. Sampling was carried using one liter acid leached polythene bottle. Sample collection was done during morning hours between 7.00 am to 10.00 am and brought to laboratory for further analysis.

The parameters like water; hydrogen ion concentration was estimated on the spot. Sample for dissolved oxygen (DO) and biochemical oxygen demand (BOD) estimation was collected in BOD bottles and DO was fixed on spot while other parameters were estimated in the laboratory as per standard methods prescribed by Trivedy and Goel (1986), APHA (1992), Kodarkar *et al* (1998).

In this study, for the calculation of water quality index (Table-1), nine different physico-chemical parameters were chosen. The WQI has been calculated by using the standards of drinking water quality recommended by the World Health Organization (WHO), Bureau of Indian Standards (BIS) and Indian Council for Medical Research (ICMR).

Table 1: Water Quality Index (WQI) and status of water quality (Chaterjee and Raziuddin, 2002)

Water quality index	Water quality status
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

Further, quality rating or sub index (q_n) was calculated using the following expression.

$$q_n = 100[V_n - V_{io}] / [S_n - V_{io}]$$

(Let there be **n**water quality parameters and quality rating or sub index (q_n) corresponding to **n**th parameter is a number reflecting the relative value of this parameter in the polluted water with respect to its standard permissible value.)

(q_n) = Quality rating for the **n**th water quality parameter.
V_n = Estimated value of the **n**th parameter at a given sampling station.
S_n = Standard permissible value of the nth parameter.
V_{io} = Ideal value of **n**th parameter in pure water. (i.e., 0 for all other parameters except the parameter pH and Dissolved oxygen 7.0 and 14.6 mg/l respectively).

Table 2: Drinking Water Standards recommending Agencies and unit weights. (All values except pH are in mg/lit)

Sr. No.	Parameters	Standards	Recommended agency	Unit Weight
1	pH	6.5-8.5	ICMR/BIS	0.2211
2	Total Alkalinity	120	ICMR	0.0156
3	Total Hardness	300	ICMR/BIS	0.0062
4	Chlorides	250	ICMR	0.0075
5	Dissolved oxygen	5.00	ICMR/BIS	0.3759
6	Biological oxygen demand	5.00	ICMR	0.3759

Unit weight was calculated by a value inversely proportional to the recommended standard value S_n of the corresponding parameter.

$W_n = K/S_n$
W_n = unit weight for the n^{th} parameters.
S_n =Standard value for n^{th} parameters.
K = Constant for proportionality.

The overall Water Quality Index was calculated by aggregating the quality rating with the unit weight linearly.

$WQI = \sum q_n W_n / \sum W_n$

RESULT AND DISCUSSION

The results obtained from the present study are shown in table 3, 4, 5, 6, 7 respectively.

Water Quality Index (WQI) of Annapurna River was calculated with the help of six physico-chemical parameters during year March 2013 – February 2014. Season wise WQI is presented in table 4, 5, 6 respectively.

The results revealed that the water quality of Annapurna River is poor and unfit for direct consumption of humans. However, it can be subjected to purification treatments and made contamination free before consumption. The average WQI of Annapurna River was 55.43. Water Quality Index was higher in summer (57.28) season while minimum in winter (52.69) season.

pH:
The pH recorded during the study varied from 7.3 in rainy season to 8.3 in winter season

Table 4: Calculation of WOI in rainy season

Sr. No.	Parameters	Observed values (V_n)	Standard value (S_n)	Unit weight (W_n)	Quality rating (q_n)	q_nW_n
1	pH	7.3	6.5-8.5	0.2211	20	4.422
2	Total Alkalinity	57.65	120	0.0156	48.04	0.749
3	Total Hardness	43.25	300	0.0062	14.41	0.089
4	Chlorides	38.71	250	0.0075	15.48	0.116
5	Dissolved oxygen	7.35	5.00	0.3759	75.52	28.387
6	Biological oxygen demand	3.02	5.00	0.3759	60.4	22.704
				$\sum W_n$ = 1.002		**$\sum q_nW_n$= 56.467**

Water Quality Index = $\sum q_nW_n/\sum W_n$= 56.34

Table 5: Calculation of WQI in winter season

Sr. No.	Parameters	Observed values (V_n)	Standard value (S_n)	Unit weight (W_n)	Quality rating (q_n)	q_nW_n
1	pH	8.3	6.5-8.5	0.2211	86.66	19.160
2	Total Alkalinity	53.25	120	0.0156	44.37	0.692
3	Total Hardness	38	300	0.0062	12.66	0.078
4	Chlorides	37.12	250	0.0075	14.84	0.111
5	Dissolved oxygen	8.38	5.00	0.3759	64.79	24.354
6	Biological oxygen demand	1.12	5.00	0.3759	22.4	8.420
				$\sum W_n$ = 1.0022		**$\sum q_nW_n$ = 52.815**

Water Quality Index = $\sum q_nW_n/\sum W_n$= 52.69

indicating alkaline nature of the waterbody. The nature of water body whether alkaline or acidic, is determined by measuring pH. Pollution can induce change in pH of a waterbody harming the aquatic life. Similar results were also reported by Khan and Khan (1985) at SeikhaJheel in Aligarh, Moundiotiya*et al* (2004) at Jamwa Ramgarh Lake in Jaipur**,** Mane and Pawar (2007) at Manar River in Nanded. Wetzel (1975) stated that Indian waters show higher pH values indicating alkaline nature of water body.

Total Alkalinity:
Total alkalinity values in the present study fluctuated from 52 mg/L to 57.65 mg/L. Manivasakam (1980) stated alkalinity and pH as the factors responsible for determining the amenability of water to biological treatment. In present investigation, higher alkalinity (57.65 mg/L) in rainy season while lower values were observed (52mg/L) in summer season. Alkalinity is measure of productivity, is stated by Hulyal and Kaliwal (2011).

Total Hardness:
Total hardness of Annapurna River ranged in between 31.5 mg/L to 43.25 mg/L. Higher values were found in rainy season. The water of the Annapurna River can be included in soft category (0-60mg/L) according to classification of water on basis of hardness values done by Kannan (1991).

Chlorides:
Chlorides ranged in between 37.12mg/L to 40.82 mg/L with little fluctuations throughout the year. Little higher chlorides were observed in summer season which may be due to the evaporation of water due to increase in the temperature. The chloride values recorded were within permissible limits according to ICMR (1975), BIS (1993) and WHO (1992). Similar results were observed by **Jana (1973)** in fresh water ponds in West Bengal and Govindan and Sundaresan (1979) in Adyar River.

Dissolved Oxygen:
In the present study dissolved oxygen ranged in between 6.19 mg/L to 8.38 mg/L. Higher values were recorded in winter season and this may be due to lower temperature in winter season. Similar results were observed by Shanthi*et al* (2002) at Siganallur lake in Coimbatore, Moundiotiya *et al* (2004) at Jamwa Ramgarh Lake in Jaipur. Also Sreenivasan (1972) at Odathuari tank and Bahura (1998) at Bikaner depicted higher values of dissolved oxygen in winter season proving inverse relationship of dissolved oxygen with temperature.

Biochemical Oxygen Demand:
Biochemical oxygen demand values during the study of Annapurna River ranged in between 1.12mg/L to 3.02mg/L. Higher values were observed in rainy season while minimum values were observed in winter season. PrasannaKumari*et al* (2003) stated inflow of organic wastes during rainy season enhances the bacterial activity, hence increase in biochemical oxygen demand values during this season is

Table 6: Calculation of WQI in summer season

Sr. No.	Parameters	Observed values (V_n)	Standard value (S_n)	Unit weight (W_n)	Quality rating (q_n)	q_nW_n
1	pH	7.7	6.5-8.5	0.2211	46.66	10.316
2	Total Alkalinity	52	120	0.0156	43.33	0.675
3	Total Hardness	31.5	300	0.0062	10.5	0.065
4	Chlorides	40.82	250	0.0075	16.32	0.122
5	Dissolved oxygen	6.19	5.00	0.3759	87.60	32.928
6	Biological oxygen demand	1.77	5.00	0.3759	35.4	13.306
				$\sum W_n$ = 1.0022		**$\sum q_nW_n$= 57.412**

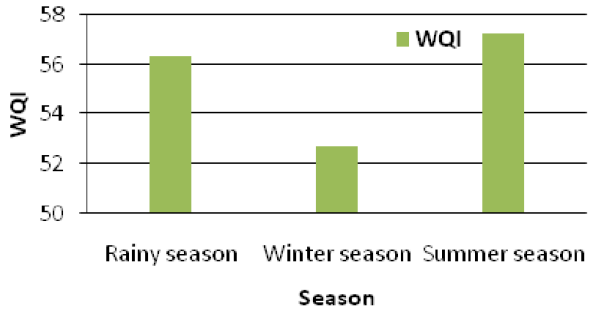
Water Quality Index = $\sum q_nW_n/\sum W_n$= 57.28

observed. Biochemical oxygen demand can be regarded as a important chemical parameter to determine the pollution status of aquatic ecosystem, Jain and Dhanija (2000). Similar results were observed by Yadav et al (2013) at fresh water pond of Orai in Uttar Pradesh.

Table 7: Water Quality Index of Annapurna River.

Sr. No.	Season	WQI
1	Rainy Season	56.34
2	Winter Season	52.69
3	Summer Season	57.28
		Average : 55.43

Figure-1. Statistical analysis of WQI of Annapurna River.



CONCLUSION

The present analysis revealed that average WQI was 55.43 and is poor for drinking purpose as per the water quality index. Hence, this water should be subjected to purification treatment and made contamination free before supplied to public.

ACKNOWLEDGEMENTS

The authors express their sincere sense of gratitude to Principal and Head, Department of Zoology,ShriPanchamKhemrajMahavidyalaya, Sawantwadi, Sindhudurg (M.S.) for providing laboratory facilities in connection with this work and for encouragement during the completion of the work.

REFERENCES

1. APHA (1992). Standard method for the Examination of water and waste water. APHA AWWA, WPET Washington DC, U. S. A. 18th edition.
2. Bahura(1998). A study of physico-chemical characteristic of a highly eutrophic temple tank, Bikaner. J. Aqua. Biol., 13(1&2):47-51.
3. BIS (1993). Standards for Water for Drinking and other purposes, Bureau of Indian Standards, New Delhi.
4. Chaterjee, C. and Raziuddin, M(2002). Determination of water quality index (WQI) of adegraded river in Asanol Industrial area, Raniganj, Burdwan,West Bengal. Nature, Environment and pollution Technology.,1(2):181-189.
5. Govindan and Sundaresan, B. B(1979). Seasonal succession of algal flora in polluted region of Adyar River. Indian Journal of Environment and Health, 21:131-142.
6. Hulyul, S. B. and Kaliwal B.B(2011). Seasonal variations in physico-chemical characteristics of Almatti Reservoir of Bijapur district, Karnataka state, IJPE(1):58-67.
7. ICMR (1975). Manual of standards of quality for drinking water supplies. Indian Council of Medical Research, Spe.Rep., No. 44:27.
8. Jain, Y and Dhanija, S. K(2000). Studies in a polluted centric water body of jabalpur with special reference to which physico-chemical and biological parameters. J. Envi. Biol., (7):83-88.
9. Jana, B. B(1973). Seasonal periodicity of plankton in fresh water ponds, West Bengal, India. Journal of International Rev. Ges. Hydrobiology.,58:127-143.
10. Kankal, N. C., Indurkar, S. K., Gudadhe, S. K. and Wate S. R(2012). Water quality index of surface water bodies of Gujarat, India.Asian J. Exp. Sci.,26(1), 39-48.
11. Kannan, K (1991). Fundamentals of Environmental Pollution. S. Chand and Company Ltd., New Delhi.
12. Khan, I. A. and Khan, A. A(1985). Physico-chemical conditions in SeikhaJheel at

Aligarh.Journal of Environment Ecology,3:269-274.
13. Kodarkar, M.S., Diwan, A.D., Murugan, N., Kulkarni K.M., Anuradha, R (1998). Methodology for water analysis, Indian Association of Aquatic Biologists, IAAB, Publication No. 2.
14. Mane, A. M. and Pawar, S. K(2007). Some physico-chemical properties of Manar River of Nanded District, Maharashtra. J. Aqua. Biol., 22(2):88-90.
15. Manivasakam, N(1980). Physico-chemical examination of water, sewage and industrial effluents. PragatiPrakashan, Meerut, India.
16. Moundiotiya, C., Sisodia, R., Kulshreshtha, M. and Bhatia, A.L(2004). A case study of the JamwaRamgarh Wetland with special reference to physic-chemical properties of water and its environs. Journal of Environmental Hydrology. 12:p.24.
17. Prasannakumari, A. A., Gangadevi T. and Sukeshkumar C. P(2003). Surface water quality of river Neyyar-Thiruvananthapuram, Kerala, India. Poll. Res.,22(4):515-525.
18. Shanthi, K.K., Ramasamy and Lakshmanaperumalsamy, P(2002). Hydrobiological study of Siganallur Lake at Coimbatore, India. Journal of Nature Environment and Pollution Technology.,1(2): 97-101.
19. Sreenivasan, A(1972). Limnology of seepage type impoundment Odathuri tank. *J. Inland Fish. Soc. India* 4:162-168.
20. Tambekar, D. H., Gulhane, S. R. and Vaidya, P. B(2005). Bacteriological quality index of drinking water in villages of Purna valley of Vidarbha by H_2S methods. Nature Env. Poll. Technol.4(3): 333-337.
21. Trivedy, R.K. and Goel, P.K(1986). Chemical and Biological methods for water pollution studies. Environmental publications, Karad.
22. Wetzel, R. G(1975). Limnology. W. B. Saunders Co., Philadelphia, U.S.A. 743.
23. WHO(2001). Guidelines standards and Health: Assessment of Risk Management for water related infectious diseases. World Health Organization, Geneva.
24. WHO (1992). International Standards for Drinking water. World Health Organization, Geneva, Switzerland.
25. WHO(1994). Guidelines for drinking water quality (Recommendations). World Health Organization, Geneva.
26. Yadav, P., Yadav, V. K., Yadav, A. K. and Khare, P. K(2013). Physico-chemical characteristics of a fresh water pond of Orai, U. P., Central India. Octa. J.Biosci., 1(2):177-184.

*****