ISSN: 0976-3031

Available Online at http://www.recentscientific.com

CODEN: IJRSFP (USA)

International Journal of Recent Scientific Research
Vol. 8, Issue, 12, pp. 22249-22253, December, 2017

International Journal of Recent Scientific Research

DOI: 10.24327/IJRSR

Research Article

ASSESSMENT OF WATER QUALITY INDEX (WQI) FOR RIVER TAWI, JAMMU (J&K)

Gandotra, R., *Jangral, S and Sharma, M

Department of Zoology, University of Jammu, Jammu-180006

DOI: http://dx.doi.org/10.24327/ijrsr.2017.0812.1231

ARTICLE INFO

Article History:

Received 20th September, 2017
Received in revised form 29th October, 2017
Accepted 30th November, 2017
Published online 28th December, 2017

Key Words:

Tawi, Water quality index, alkalinity, chloride, magnesium.

ABSTRACT

The present study aimed at the assessment of water quality Index (WQI) of river Tawi, Jammu (J&K), in order to ascertain its portability for public consumption, recreation and other purposes. In this study, Water Quality Index was determined on the basis of various physicochemical parameters like pH, Electrical conductivity, Total dissolved solids, Total alkalinity, Total hardness, Dissolved oxygen, Chloride, Calcium and Magnesium. The WQI results thus obtained for different seasons viz. monsoon, summer and winter fall in the range 64.5-84.6, 76.7-89.8 and 74.9-85.5 which reveals the water status as poor to very poor according to Weight Arithmetic Water Quality Index method. Thus the untreated river water can be used only for irrigation and industrial needs.

Copyright © Gandotra, R., Jangral, S and Sharma, M, 2017, this is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution and reproduction in any medium, provided the original work is properly cited.

INTRODUCTION

Water is the foremost requirement of for the assistance of life on this earth. It serves as habitat for large number of aquatic organism of various sizes i.e. from microscopic plankton to large aquatic animals and plants. Freshwater bodies like rivers and streams are posing a serious threat due to addition of various organic and inorganic constituents. During last decades, the water quality of Indian rivers has been deteriorating due to inclusion of untreated industrial wastes, domestic garbage. Fishes and all other aquatic organisms are affected by pollutants both directly or indirectly in various ways. The quality of a water body can be determined by analyzing various physicochemical parameters in order to check the quality status of water, whether it is suitable for drinking, irrigation or fishing practices. As river Tawi is the only lifeline for the Jammu people and outskirts area around Jammu and also it flows through the centre of Jammu city. Keeping this in mind, the present study was undertaken to know the water quality of river Tawi at two different stations.

MATERIALS AND METHOD

Study area and collection of water sample: Water sample were collected once in every month from both stations viz. Nagrota as station I (Latitude 32°47' N, Longitude 74°55' E) and Gujjar Nagar as station II (Latitude 32°43' N, Longitude 74°51' E) for the period of one year i.e. from July 2015 to June 2016.

Physico-chemical analysis: The parameters like pH, dissolved oxygen (DO), Electrical conductivity (EC), Total dissolved solids (TDS), Total alkalinity (TA), Total Hardness (TH), Chloride (Cl), Calcium (Ca^{2+}) and Magnesium (Mg^{2+}) were evaluated using standard procedures (APHA, 2005).

Water Quality Index: After assessing the concentration of physico-chemical parameters, calculation of water quality and quality rating has been determined by using Weighted Arithmetic Water Quality Index Method in order to know the pollution status of river Tawi as shown in the Table 2, 3, 4. The first step needed to calculate water quality index is to assign unit weights to each physico chemical parameters. By assigning unit weights, all parameters of different dimensions and units are brought to common scale. The water quality standards recommended by BIS and assigned unit weights to each parameter are given in the Table 1. Maximum weights are provided to DO (0.52) and pH (0.306), thus suggesting the importance of these two parameters in water quality assessment and their impact on the index.

The WQI has been calculated by using weighted arithmetic index method (Brown *et al*. 1972) also compared with the standard of drinking water quality recommended by BIS. Further quality rating or sub index was calculated using the expression below:

Qn = 100 [Vn-Vi / Sn- Vi]
Where qn – quality rating for the nth water quality

*Corresponding author: **Jangral, S**
Department of Zoology, University of Jammu, Jammu-180006

Vn- observed value of nth parameter at water sampling station.
Sn- standard permissible value of nth parameter recommended by agencies

Unit weights was calculated by value inversely proportional to recommended standards value Sn of the corresponding parameters (Table 5).

$Wn = K \sum 1/Sn$

The constant of proportionality K in the above equation can be determined from the following equation.

$$K = \frac{1}{\sum 1/S1 + 1/S2 + \ldots\ldots\ldots + 1/Sn}$$

(Where Wn = unit weight, Sn= standard permissible value, K= proportionality constant)

Water quality index (WQI) was calculated by using formula:
$WQI = \sum qnwn / \sum wn$

RESULT AND DISCUSSION

Physico-Chemical Parameters

The mean values of various physico-chemical parameters for the three different season (Monsoon, Winter and Summer) at two different station of river Tawi viz. Nagrota (St. I) and Gujjar Nagar (St. II) has been shown in the Table-1.

Electrical Conductivity (mS/cm)

The conductivity serves as good and rapid measure of total dissolved solids in water. At station I it ranged from 120-310 mS/cm and at station II, it was 190-320 mS/cm. The mean maxima was found during monsoon at both the stations, being 252.5 mS/cm at St. I and 266.25 mS/cm at St. II, while mean minima was obtained during winter season having value 162 mS/cm and 215 mS/cm at St. I and St. II respectively. The increase in electrical conductivity during monsoon may be due to greater ionic concentration of inlet flow as reported by Jha and Bharat, 2003; Dutta and Bhagwati, 2007; Hulyal and Kaliwal, 2011and Ramulu and Benarjee, 2013. The decrease was observed during winter at both the stations that may be due to low rate of evaporation and settling of silts (Ramulu and Banerjee, 2013).

Total Dissolved Solids (TDS, mg/l)

At Station I, the value of TDS ranged between76.8- 198 mg/l having mean maxima (163.5mg/l) during monsoon and mean minima (104mg/l) during winter season. At station II, TDS ranges between 122-205 mg/l with mean maxima (313.31mg/l) during monsoon and mean minima (129.5 mg/l) during winter. The increase in TDS during monsoon may be because of input of soil particles, domestic waste, forest and agricultural fields runoff with rain water during rains (Narain and Chauhan, 2002).

Table 1 Seasonally analyzed results of physicochemical parameters of water body at selected stations (all parameters were expressed in mg/l except EC (mS/cm) and pH)

S.No.	Parameters	Monsoon		Winters		Summers	
		St. I	St. II	St. I	St. II	St. I	St. II
1	pH	8.2	7.2	8.5	7.8	8.3	7.5
2	Electrical conductivity	252.5	266.25	162.5	215	232.5	242.5
3	Total dissolved solids	161.75	170.5	104	129.5	148.75	155.25
4	Total alkalinity	228.4	419.12	257.74	405.98	250.13	526.40
5	Total hardness	163.557	279.30	148.33	313.37	125.06	226.63
6	Calcium	43.45	69.31	40.80	79.97	34.75	62.43
7	Magnesium	13.52	25.86	11.3	27.67	9.8	17.21
8	Chloride	21.75	37.39	19.55	45.12	28.25	42.18
9	Dissolved oxygen	9.3	3.8	8.4	5.3	7.2	3.4

pH

During the present investigation at station I, the value of pH ranged between 7.9-8.6 mg/l showing mean maxima (8.5mg/l) during winter season and mean minima (8.2 mg/l) during monsoon and at station II, it was 5.9-8.3 mg/l with mean maxima (7.8 mg/l) during winter season and mean minima (7.2 mg/l) during monsoon season. During monsoon the mean minimum value of pH was reported which may be attributed due to dilution of water caused by influx of fresh water brought about by heavy rains (Shiddamallaya and Pratima, 2008; Valentine *et al*., 2015).The mean maxima of pH was recorded during winter at both the stations that may be due to various additive factors as low water level (Pulugandhi, 2014, Valentine *et al*. 2015) and also less evaporation results in dilution with addition of domestic sewage (Bhandarkar and Bhandarkar, 2013). The results revealed that during present study pH of river Tawi remains alkaline throughout the year at both the stations.

High level of TDS in water system increases the biological oxygen demand and ultimately depletes DO level in aquatic system (Suthar *et al*., 2009; Hassan *et al*., 2017). The decrease in TDS during the present study revealed similar trend that of Electrical conductivity at both the stations. Also it has direct relationship with electrical conductivity as reported by (Meybeck, 1997).

Total Alkalinity (TA, mg/l)

During the present study the mean value of alkalinity ranged between 197.61-245.64 mg/l at St. I and at St. II, it ranged between378.54- 599.65 mg/l. At station I, the mean maxima (257.74 mg/l) was observed during winter and minima (228.4 mg/l) was found during monsoon and at station II, the mean maxima (526.65 mg/l) was observed during summer and mean minima (405.98 mg/l) was obtained during winter. At station I, the increase in TA during winter season may be because of concentration of nutrients in water and minima was observed during monsoon due to dilution caused by rains (Shinde *et.al*., 2010). At station II, high alkalinity value was recorded during summer season, which is probably due to reduction of water

and also because of steep fall in monsoon due to dilution of water (Jha and Barat, 2003; Singh and Saha, 1987).

Total Hardness, (TH, mg/l)

Hardness of water is due to presence of divalent cations like Calcium, Magnesium, Ferrous ion, manganese etc. The total hardness ranged between 40.18-108.13 mg/l at Station I whereas at Station II, it ranged between 70.56-199.92mg/l. Maximum mean value of 163.5 mg/l was observed during monsoon and mean minimum value of 125.82 mg/l was observed during summer at St. I. At St. II, the mean maximum value was obtained during winter (313.31mg/l) and mean minimum was recorded during summer (226.63mg/l). At St. I, the increase in TH was observed during monsoon which may be due to addition of minerals from catchment area and also due to heavy rains. At St. II, the rise was recorded during winter may be due to settlement of cations and anions. The decrease was observed during summer at both the station due to low value of calcium and magnesium. The present observations are in line with Shinde *et al*. (2010).

evaporation of water (Balasaheb *et al*. 2015, Shinde *et al*. 2010). The low concentration of chloride ions was also observed during winter by Sahni and Yadav, 2012 at Bharawas pond in Haryana, by Shiddamallaya and Pratima, 2008 while analyzing a fresh water body, Majumder and Dutta, 2014. Similar trend was observed by various workers (Mishra and Tripathy, 2003, Zafar and Sultan, 2008; Mohrana and Patra, 2014) while working on different water bodies. At station II, the maxima was recorded during winter season that may be because of low water level and less evaporation and addition of domestic sewage and organic matter of animal origin (Kumar and Jha, 2015) and mean minima was observed during monsoon due to dilution of water (Tripathy, 2014).

Calcium (mg/l)

During the present study period the calcium content ranged from 26.59- 49.4mg/l at St. I and 34.69-92.00 mg/l at St. II. At station I, the mean maxima (43.45 mg/l) was observed during monsoon and mean minimum value of 34.75 mg/l was recorded during summer season.

Table 2 Calculation of water quality index of river Tawi during Monsoon season.

S.No.	Parameters	Unit weights (W_n)	Nagrota (Station I)	Quality rating (Q_n)	$Q_n \times W_n$	Gujjar Nagar (Station II)	Quality rating (Q_n)	$Q_n \times W_n$
1	pH	0.306	8.2	80	24.48	7.2	20.00	6.12
2	Electrical conductivity	0.0087	252.5	84.16	0.732	266.25	88.75	0.772
3	Total dissolved solids	0.0052	161.75	32.35	0.168	170.5	34.1	0.1773
4	Total alkalinity	0.022	228.4	190.33	4.187	419.12	349.26	7.68
5	Total hardness	0.0087	163.557	54.5	0.474	279.30	93.1	0.809
6	Calcium	0.0347	43.45	57.93	2.010	69.31	92.41	3.207
7	Magnesium	0.087	13.52	45.06	3.92	25.86	86.2	7.49
8	Chloride	0.0104	21.75	8.7	0.0905	37.39	14.9	0.150
9	Dissolved oxygen	0.52	9.3	55.20	28.708	3.8	112.5	58.5
		$\sum W_n = 1.003$			$\sum Q_n \times W_n = 64.77$			$\sum Q_n \times W_n = 84.91$

Water Quality Index (WQI) :- At station I $= \sum Q_n \times W_n / W_n = 64.57$
At station II $= \sum Q_n \times W_n / W_n = 84.65$

Dissolved Oxygen (DO, mg/l)

The value of DO at St. I ranged between 7.1-9.2 mg/l with mean maximum value of 9.3 mg/l during monsoon and mean minimum value of 7.2 mg/l during summer. High value of DO during monsoon may be attributed to agitation of water due to heavy rains (Chinnahiah *et al*. 2011). At St. II the mean value of DO ranged between 2.8-7.9 mg/l with mean maxima (5.3 mg/l) during winter and mean minima (3.4 mg/l) during summer. The rise during winter may be of greater solubility of oxygen at low temperature (Andotra *et al*., 2008; Bhandarkar and Bhandarkar, 2013). The decrease in DO during summer seasons at both the stations may be due to high temperature and reduced solubility (Dutta and Patra, 2013) and also due to its enhanced utilization by microorganisms in the decomposition of organic matter (Naik *et. al*., 2012, Sangu and Sharma 1987).

Chloride (mg/l)

The value of chloride ranged between 16-30.2 mg/l at Station I and between 32.54- 58.6 mg/l at Station II. The mean maximum value (28.25mg/l) was obtained during summer and mean minimum value (19.55 mg/l) was obtained during winter at St. I. At St. II the mean maximum value of 45.13mg/l was found during winter and mean minima (37.39 mg/l) was during monsoon. The rise during summer season at St. I, could be due to sewage mixing, increased temperature, low water level and

Whereas at St. II, the mean maxima (79.97 mg/l) was found during winter and mean minima (62.43 mg/l) was observed during summer. The rise in concentration of calcium during winter may be because of low water temperature which increases the calcium solubility in water (Borana *et al*. 2013). The increase during monsoon may be due to the addition of contents from catchment area by run off during heavy rains (Bhandarkar and Bhandarkar, 2013) and also due to rapid oxidation of organic matter (Pulugandhi, 2014). The decrease was observed during summer season at both the stations may be because of uptake of calcium by plankton for their growth (Sawhney, 2008) and also due to decreased solubility of calcium at high temperature (Abdel Satar, 2005).

Magnesium (mg/l)

The value of magnesium was ranged between 9.2- 15.4 mg/l at St. I and at St. II it ranged between 11.20-37.52 mg/l. At station I, the mean maxima (13.52 mg/l) was observed during monsoon and mean minima (9.8 mg/l) during summer was noticed. At station II, the mean maximum value of 27.67 mg/l was recorded during winter and mean minima (17.21 mg/l) was observed during summer season. The magnesium content during the present investigation showed similar trend that of calcium at both the stations. The decrease during summer may be due to uptake of Mg^{2+} by phytoplankton for chlorophyll molecules and enzymatic transformation (Wetzel, 2001; Malik and Pandey, 2006).

Water Quality Index (WQI)

Perusals of Table 2, 3 & 4, revealed the observed values of the selected physico-chemical parameters at the proposed stations for the three seasons and the corresponding WQI values are shown in the Table 2, 3 & 4. At Station I, the value of WQI ranged between 64.57–76.70 which comes under the category of poor water having possible usage only for irrigation and Industrial purpose when compared to water quality status prescribed by Brown *et al*., 1972 and Chatterji and Raziuddin, 2002). At Station II, the WQI value ranged between 84.65 - 89.81 that comes under the very poor category having possible usage only for irrigation and need proper treatment before drinking purpose (Table 6)**.** Also the water quality of river Tawi was found to be suitable for monsoon and winter season except summer season having high values of water quality index.

Table 3 Calculation of water quality index of river Tawi during winter season.

S.No.	Parameters	Unit weights (W_n)	Nagrota (Station I)	Quality rating (Q_n)	$Q_n \times W_n$	Gujjar Nagar (Station II)	Quality rating (Q_n)	$Q_n \times W_n$
1	pH	0.306	8.5	100	30.6	7.8	53.33	16.32
2	Electrical conductivity	0.0087	162.5	54.16	0.471	215	71.66	0.623
3	Total dissolved solids	0.0052	104	20.08	0.108	129.5	25.9	0.134
4	Total alkalinity	0.022	257.74	214.78	4.72	405.98	338.31	7.44
5	Total hardness	0.0087	148.33	49.44	0.43	313.37	104.43	0.908
6	Calcium	0.0347	40.80	54.4	1.887	79.97	106.62	3.699
7	Magnesium	0.087	11.3	37.66	3.27	27.67	92.23	8.024
8	Chloride	0.0104	19.55	7.82	0.081	45.12	18.05	0.187
9	Dissolved oxygen	0.52	8.4	64.58	33.58	5.3	96.87	48.43
		$\sum W_n = 1.003$			$\sum Q_n \times W_n$ =75.15			$\sum Q_n \times W_n$ = 85.76

Water Quality Index (WQI) :- At station I = $\sum Q_n \times W_n / W_n$ = 74.92
(Winter Season)
At station II = $\sum Q_n \times W_n / W_n$ = 85.50

Table 4 Calculation of water quality index of river Tawi during Summer season

S.No.	Parameters	Unit weights (W_n)	Nagrota (Station I)	Quality rating (Q_n)	$Q_n \times W_n$	Gujjar Nagar (Station II)	Quality rating (Q_n)	$Q_n \times W_n$
1	pH	0.306	8.3	86.66	26.51	7.5	33.33	10.198
2	Electrical conductivity	0.0087	232.5	77.5	0.674	242.5	80.83	0.703
3	Total dissolved solids	0.0052	148.75	29.75	0.155	155.25	31.05	0.1614
4	Total alkalinity	0.022	250.13	208.44	4.580	526.40	438.66	9.650
5	Total hardness	0.0087	125.06	41.94	0.364	226.63	75.54	0.657
6	Calcium	0.0347	34.75	46.33	1.608	62.43	83.24	2.89
7	Magnesium	0.087	9.8	32.66	2.842	17.21	57.36	4.99
8	Chloride	0.0104	28.25	11.3	0.118	42.18	16.872	0.175
9	Dissolved oxygen	0.52	7.2	77.08	40.081	3.4	116.66	60.66
		$\sum W_n$=1.003			$\sum Q_n \times W_n$ =76.93			$\sum Q_n \times W_n$ = 90.08

Water Quality Index (WQI) :- At station I = $\sum Q_n \times W_n / W_n$ = 76.70
At station II = $\sum Q_n \times W_n / W_n$ = 89.81

Table 5 Relative weights (Wn) of the parameters used for WQI determination (all values are in mg/l, except pH and electrical conductivity).

Parameters	ICMR/BIS standard (V_s)	Unit weights (Wn)
pH	6.5-8.5	0.306
Electrical conductivity	300	0.0087
Total dissolved solids	500	0.0052
Total alkalinity	120	0.022
Total hardness	300	0.0087
Calcium	75	0.0347
Magnesium	30	0.087
Chloride	250	0.0104
Dissolved oxygen	5	0.52

Table 6 WQI range, status and possible usage of the water sample (Brown et al. 1972, Chatterji and Raziuddin, 2002)

WQI	Water Quality Status	Possible usage
0-25	Excellent	Drinking, irrigation and industrial
26-50	Good	Drinking, irrigation and industrial
51-75	Poor	irrigation and industrial
76-100	Very poor	Irrigation
Above 100	Unsuitable for drinking and fish culture	Proper treatment required before use

CONCLUSION

All the physico-chemical parameters investigated during present study were in the desirable limits prescribed by BIS except DO, TA, TH and Ca^{2+}. Some are very near to desirable limits and may cross it in near future as pollution is increasing day by day. On comparison, the concentration of all the physico-chemical parameters studied showed high values at station II than station I, showing that Station II is more polluted than Station I. Based on observed WQI results, it can be concluded that the river Tawi requires appropriate water quality management plan for its sustainable usage. It can also achieved by adopting measure like limiting the direct discharge of domestic sewage, industrial effluents and preventing unabated dumping of solid waste near its banks . Also there is need to check the status of river water regularly by involving various stakeholders.

Acknowledgements

The author is very thankful to UGC-RGNF-JRF/ SRF for providing financial support. Also, I would like to thank UGC-SAP for providing necessary infrastructural facilities in the Department of Zoology for research purpose.

References

Abdel-Satar, A.M. 2005. Water quality assessment of River Nile from IDFO to Cairo, *Egyptian Journal of Aquatic Research.;* 31(2), 200-223.

APHA 2005. Standard method for the examination of water and waste water.21st edition, APHA, AWWA, WPCF, Washington DC, USA.

Balasaheb, R., Bhalchandra, W. and Resham, B. 2015. Assessment of seasonal variations in water quality of Girna, Reservoir in Nasik district.(M.S.). *International journal of recent scientific research,* 6(10), 6570-6573.

Bhandarkar, S.V and Bhandarkar, W.R. 2013. A Study on seasonal variation of Physico-chemical properties in some freshwater lotic ecosystems in Gadchiroli District, Maharashtra. *Int. J. of Life Sciences*, 1(3), 207-215.

Borana K, Fayaz FA, Singh M, Romde R. Seasonal variations in physic-chemical parameters of Bishleri stream, Banihal, Jammu and Kashmir. *Indian Journal of Biotechnology and Pharmaceutical Research.* 1(2), 17-23

Brown, R.M., McClelland, N.I., Deininger, R.A., O'Connor, M. F.A. 1972. A water quality index- crossing the physicochemical barrier. *Indic Environ. Qual*., 1, 173-182.

Chaterjee, C. and Raziuddin, M. 2002: Determination of water quality index (WQI) of a degraded river in Asanol Industrial area, Raniganj, Burdan, West Bengal. Nature, *Environment and pollution Technology*, 1(2), 181-189.S

Chinnaiah, B., Madhu, V. and Bahu, R.M. 2011. Physico-chemical characteristics of Khanjana and Darm asagar lakes in Adilabad, Andhra Pradesh, India. International *Journal of Pharmacy & Life sciences*, 2(4), 674-676.

Dutta O. K. and Bhagwati S. K. 2007. Limnology of Ox-bow Lake of Assam, NSL, pp. 3-7.

Dutta, T.K. and Patra, B. 2013. Biodiversity & seasonal abundance of zooplankton and its relation to physicochemical parmeters of Jammunabundh, Bishnupur, India. *International Journal of Scientific 7 Research Publications*, 3(8), 2250-3153.

Tripathi, B, Pandey, R., Raghuvanshi, D. Singh, H., Pandey, V. and Shukla, D.N. 2014. Studies on physico-chemical parameters and correlation coefficient of the River Ganga at holy place Shringverpur, Allahbad, 8(10),29-36.

Gandotra,R., Sharma, J.P., Hina, Andotra, P. 2008. Evaluation of water quality of river Tawi with reference to physico-chemical parameters of district Jammu (J&K), India. *Curr world Environ*, 3(1), 55-66.

Hassan, T., Parveen, S. Bhat, B.N. and Ahmad, U. 2017. Seasonal variations in water quality parameters of river Yamuna, India. *Int. J.Curr. Microbiol. App. Sci.,* 6(5), 694-712.

Hulyal S. B. and Kaliwal B. B. 2011. Seasonal variations in Physico-chemical Characteristics of Almatti Reservoir of Bijapur district, Karnataka State, IJEP, 1(1),58-67.

Jha ,P., Barat, S. 2003**.** Hydrobiological study of lake Mirik in Darjeeling, Himalayas*. J.Environ.Biol*. 24(3), 339-344.

Kumar, R. and Jha, A.K. 2015. Physicochemical studies on Kamla river water. *International Journal of Advanced Research in Computer Science and Software Engineering,* 5(5), 1411-1415.

Majumder, S. and Dutta, T.K. 2014. Studies on seasonal variations in physico-chemical parameters in Bankura segment of the Dwarakeshwar River (W.B) India. *International journal of advanced research*, 2(3), 877-881.

Malik, A. and Pandey, A.K. 2006. Physico-chemical characteristics of Brari Nambal basin of Dal lake, Kashmir. *Journal of Research & Development*, 6,87-95.

Naik T.P., Ajayan K.V. and Lokesh G.H..2012. Physico-chemical characteristics of Kunigal lake in Tumkur Dist., Karnataka, *India.Int.J.Chem.Sci*.,10(2),655-663.

Pulugandhi, C. 2014. Analysis of water quality parameters in Vembakottai Water Reservoir, Virudhunagar District, Tamil Nadu – A Report. *Research Journal of Recent Sciences,* 3 (ISC- 2013), 242-247

Ramulu, N.K.and Banarjee,G. 2013. Physico-chemical factors influenced plankton biodiversity and fish abundance. A case study of Andhra Pradesh. *Int. J. Life science. Bt. & Pharm. Res*.,2(2), 248-260.

Sahni, K. and Yadav, S. 2012. Seasonal variation in physicochemical parameters of Bharawas pond , Rewari, Haryana. *Asian J. Exp. Sci.,* 26(1) 61-64.

Sangu, R.P.S. and Sharma, S.K. 1987. An assessment of water quality of river Ganga at Gamokteshwar (Ghaziabad), *Ind. J. Ecolo.* 14 (1),278-287.

Sawhney N. Biodiversity of river Tank in the vicinity of Jammu City. Ph.D. thesis, University of Jammu, Jammu, 2008.

Shiddamallayya, N. and Pratima, M. 2008. Impact of domestic sewage on fresh water body. *Journal of environment biology,* 29(3), 303-308.

Shinde, S.E., Patha, T.S., Raut, K.S. and Sonawane, D.L. (2010). Studies on the Physico-chemical Parameters and Correlation Coefficient of Harsool-savangi Dam, District Aurangabad, India. *Middle-East Journal of Scientific Research*, 8(3):544-554.

Singh B.,and Saha, P.K. 1987. Primary productivity in a composite fish culture pond at Kulia fish farm, Kalyani, West Bengal. *Prod. Nat. Acad,Sci. India*, 57,1: 24-30.

Suthar, S., Sharma, J., Chabukdhara, M. and Nema, A.K. 2009. Water quality assessment of river Hindon at Ghaziabad, India: impact of industrial and urban wastewater. Environ. *Monitoring and assessment*, 165(1), 103-112.

Wetzel, R.G. 2001. Limnology: Lakes and Rivers, 3rd edition, Academic Press; A Harcourt Science and Technology Company, 525B Street, Suite 1900, San Diego, California, 1000

****