ISSN Print: 2394-7500
ISSN Online: 2394-5869
Impact Factor: 5.2
IJAR 2017; 3(7): 686-691
www.allresearchjournal.com
Received: 07-05-2017
Accepted: 08-06-2017

KK Sharma
Department of Zoology,
University of Jammu.
Baba sahib Ambedkar road,
Jammu, Jammu and Kashmir,
India

Sarbjeet Kour
Department of Zoology,
University of Jammu.
Baba sahib Ambedkar road,
Jammu, Jammu and Kashmir,
India

Kunal Sharma
Department of Zoology,
University of Jammu.
Baba sahib Ambedkar road,
Jammu, Jammu and Kashmir,
India

Correspondence
Kunal Sharma
Department of Zoology,
University of Jammu.
Baba sahib Ambedkar road,
Jammu, Jammu and Kashmir,
India

Seasonal variations in physico-chemical parameters of dilli pond, sainik colony, J&K

KK Sharma, Sarbjeet Kour and Kunal Sharma

Abstract
The present study reports the assessment of physico-chemical parameters and correlation coefficient of Dilli pond located in Sainik colony of Jammu city. The parameters and correlation coefficient were analysed during May, 2013 to April, 2014. The report revealed marked seasonal changes in its water quality and correlation among various parameters showed positive and negative trends. In spite of the alarm for restoration of water bodies, the ponds in Jammu city are struggling for their existence. Likewise, Dilli pond is facing neglectance. The waste from nearby temple, run-off, dumping of waste material are dilapidating the water quality. There is concrete need for its betterment and management.

Keywords: correlation, dilli, physicochemical, management

1. Introduction
A satisfactory understanding of aquatic source requires knowledge not only of the organisms inhabiting it but also of those external influences which directly or indirectly affect them. Water supports life on earth and it is one of the abundantly available substances which man has exploited more than any other resources for the sustenance of life. Water resources have reached to a point of crisis due to unplanned urbanization and industrialization (Singh *et al*., 2002) [43]. Quality of water can be analysed by physico-chemical parameters which are in turn affected by climatic, geochemical, geomorphologic and pollution conditions.
Accurate and reliable information on the water quality can be vital aid to strategic management of freshwater resources (Gupta and Deshpande, 2004) [14]. Water bodies polluted through non-point sources support diverse algal species, while water bodies polluted through point sources support growth of tolerant blue green algae (Rai *et al*., 2007).
Urban drainage has wide impact on receiving water bodies which is reflected in their water quality, hydrology and habitat conditions (Sonneman *et al*., 2001). Keeping this in view, the present work was undertaken to analyse the physico-chemical parameters of urban pond, Dilli to know its productivity and to make concerned authority aware about the need for its conservation.

2. Material and methods
Jammu, southern part of J&K, is located in the foothills of lower Shiwaliks. Geographically, Jammu district is situated between 74º19' E to 75º20' E longitude and 32 º 27' N to 33 º 50' N latitude at an altitude of 275-410 m.
Dilli pond (Sainik colony) is perennial, shallow water body located near ancient Lord Shiva temple. Devotees use this pond for their religious activities. Localities mainly use this pond for domestic work as bathing and bathing of the cattle (buffaloes). The water is turbid and greenish in colour. Surface of the pond remains covered with *Lemna* sps. for most of the year. Run-off containing fertilizers, sewage, waste, silt, etc. is enriching the pond with nutrients.

2.1 Sampling and analysis
Samples were collected from study area in glass bottles for the period of one year from May, 2013 to April, 2014. Fourteen parameters viz. water temperature, depth, pH, DO, FCO_2, CO_3^{2-},HCO_3^-, BOD, Cl^-, Ca^{2+}, Mg^{2+}, SO_4^{2-}, $NO_3^-$and PO_4^{2-} were analysed. Out of them, water temperature, depth, pH, DO, FCO_2 andCO_3^{2-} were done at the site and rest were determined in the laboratory (APHA, 1985).

3. Results and Discussion

Present study on physico-chemical estimation of Dilli pond gives an overview of well-marked seasonal variations of these parameters in this pond water (Table I).

3.1 Water Temperature

It is considered as to be one of the most important factors in an aquatic ecosystem (Welch, 1952) [50] because water density and oxygen content are directly related to temperature. In the present study, mean maximum value of 30^0C was observed during summers due to increased photoperiod, sharp angle of incidence and clear atmosphere (Jawale and Patil, 2009 and Narayana *et al*., 2008) [16, 23] and minimum value of 17.4ºC during winters. The fall in temperatue may be due to restricted illumination and shorter photoperiod in winters (Sawhney, 2008 and Shindey *et al*., 2011) [33].

3.2 Depth

It is minimum vertical distance between the surface and underlying bottom of water body at any point. It has vital bearing on the physico-chemical properties of water. Mean maximum value of 46 cm was observed in monsoons and it is attributed to rains in monsoon season (Sawhney, 2008 and Chowdhary, 2011) [33, 6] whereas minimum value of 35.7 cm was observed in summers which may be due to evaporation at high temperature (Zutshi, 1992 and Sharma, 1999) [53, 36].

3.3 pH

It is negative logarithm of hydrogen ion concentration (pH=-log $[H^+]$). pH values from 0 to 7 are diminishingly acidic, whereas values of 7 to 14 are increasingly alkaline.The importance of water pH to the aquatic life is immense. In freshwater ecosystems, pH fluctuates based on the metabolic activities as well as amount of decomposition of organic matter by the microbes.The water pH obtained in study period fall within the FEPA (1991) [11],WHO (1999) [52], Pandey (1997) [24] and Ragnar (2004) [28] standard range of 6-9.

In various kinds of natural, unmodified waters, pH differs from atleast 3.2 to 10.5. In study period, the mean maximum value 7.65 was observed in winters. The probable reason might be because of various additive factors as diminished water level (Pulugandhi, 2014) [25] but less evaporation results in dilution even with the addition of domestic sewage (Bhandarkar and Bhandarkar, 2013) [4]. Whereas mean minimum value of 6.45 was observed in summers. Acidic pH in summers may be because of low level of water (Dutta and Patra, 2013) [10] and high value of FCO_2 (Langer *et al*., 2007) [20].

3.4 DO (Dissolved Oxygen)

The level of oxygen in aquatic system is dependent on the temperature, photosynthesis of autotrophs, respiration of biota and organic load, etc. The low DO indicate the poor productivity of the water body.

In the presently studied pond, DO ranges between 3.2-6.4 mg/l. Maximum mean value 5.6 mg/l was recorded in winters. Higher DO during winters may be due to increased oxygen solubility at low temperature (Bhandarkar and Bhandarkar, 2013) [4] and low biological activity (Vass *et al*., 1977 and Qadri *et al*., 1981) [48, 26]. Minimum mean value 3.6 mg/l was recorded in summer may be due to high temperature as solubility of oxygen decreases with increase in temperature (Dutta and Patra, 2013) [10].

3.5 FCO_2 (Free Carbon dioxide)

The Carbon dioxide contributes to the fitness of natural waters. Most of the FCO_2 comes from the decomposition of the organic matter and respiration of organisms.

In the present investigation, FCO_2 ranges between 0-46 mg/l. Maximum mean value 36.5 mg/l was observed during summer. Increased respiratory activities and high decomposition rate of organic matter at high temperature may lead to higher production of FCO_2 during summers (Talling, 1957; Singh and Gupta, 2010 and Ahangar *et al*., 2012) [45, 42, 3]. Minimum mean value of 6 mg/l was recorded in winter. Shorter photoperiod and low decomposition rate at low temperature made FCO_2 lower in winters (Kumar *et al*., 1987 and Chowdhary, 2011) [6].

3.6 Carbonates

CO_2 occurs as a part of nearly insoluble monocarbonate such as $CaCO_3^{2-}$ or $MgCO_3^{2-}$ and are known as fixed, combined CO_2. Bound CO_2 has been registered as unavailable to the algae for photosynthesis.

The present investigation revealed that there is direct relationship between pH and carbonate and indirect relationship with free CO_2 (Welch, 1952; Sunil, 1990 and Hutchinson, 2004) [50]. Carbonates were absent throughout the study period except in December being 9.6 mg/l.

3.7 Bicarbonates

Presently recorded bicarbonates ranges between 97.6-212.28 mg/l throughout the study period. Mean maximum value was obtained in winters being 190.9mg/l which might be attributed to the low FCO_2 and reduced photosynthetic rate in winters (Sharma,2013) [37] whereas mean minimum values in summers was recorded to be 114.6 mg/l due to its uptake by phytoplankton during photosynthesis (Harney *et al*.,2013) [15].

3.8 BOD

It followed the conventional trend of being inverse to DO in the presently studied water body. Higher the BOD, more is the pollution load.

In study period, BOD ranges between 1.5 - 3.2 mg/l. Mean maximum value 2.4 mg/l was in summer due to the decomposition of dead organic matter with increase in temperature (Das and Acharya, 2003 and Garg *et al*., 2009) [7, 12] and minimum value 2.1 mg/l in winters due to decrease in temperature which leads to decrease in microbial activity and algal blooms (Sachidanamurthy and Yajurvedi, 2004 and Shiddamallayya and Pratima, 2008) [32, 41].

3.9 Chloride

Chlorides in water are generally due to salts of sodium, potassium and calcium. According to BIS, permissible limit of chloride is 250 mg/l. The chloride content normally increase as the mineral content increases (Dubey, 2003) [8]. High chloride content has been ascribed to human interference and cattle population. Chloride enrichment due to excreta has earlier been reported by Dutta (1978) [9], Sehgal (1980) [34] and Malhotra *et al*., (1986) [22]. High amount of chloride is indicative of pollution load of animal

origin (Thresh *et al*., 1949) [46]. The significance of chloride ions lies in its potential to regulate salinity of water and exert osmotic stress on biotic communities.

In the present water body, it ranges between 22-91 mg/l. Mean maximum value 54.5 mg/l was during summers which might be the result of increased evaporation rate (Shinde *et al*., 2011) [39] whereas mean minimum value 27.25 mg/l was obtained during winters could be attributed to dilution effect and renewal of water mass (Shinde *et al*., 2011) [39] and also may be due to high sedimentation rate on relatively stable environment condition. Similar results were also reported by Narayana *et al*., 2008 [23].

3.10 Calcium

Calcium along with magnesium contribute temporary hardness and imparts foul odour to the water body. As per BIS, maximum permissible limit for water calcium is upto 75 mg/l.

The calcium content in the presently studied water body ranges from 21.02 to 42.89 mg/l. It was found to increase during the winter with mean maximum value being 37.32 mg/l due to the low temperature which increase the Calcium solubility in water (Borana *et al*., 2013). Some workers like Sunil (1990), Veena (1990) and Kumar (1990) held rains responsible for rise in calcium content from the catchment area by run -off and decrease during the summer with mean minimum value of 29.5 mg/l due to the uptake of Ca^{2+} by plankton for their growth (Sawhney, 2008) [33] and also decreased solubility of calcium at high temperature (Abdel Satar, 2005).

3.11 Magnesium

It is used by the plants in the formation of chlorophyll-porphyrin metal complex. So is useful for the entire aquatic ecosystem dynamics.

Mg^{2+} content ranges between 14.5-48 mg/l in the present investigation. Mean maximum value 36.1 mg/l was in winters. Minimum value 21.1 mg/l was recorded in summers might be due to uptake by phytoplankton for chlorophyll molecules and enzymatic transformation (Wetzel, 2001 and Malik and Pandey, 2006) [21]. The magnesium content during the present study revealed the similar pattern to that of calcium. So, it behaves sympatric to calcium; being minimum in summer and maximum in winters.

3.12 Sulphate

Sulphate come from run-off water, fertilizers which contain relatively large quantities of organic and mineral sulphur compounds. SO_4^{2-} ions in water under natural conditions are due to the reactions of water with sulphate containing rocks, oxidation of sulphides and other sulphur containing compounds.

In study period, the mean maximum value 0.002 mg/l was observed during monsoons. The probable reason for maximum concentration of sulphates in monsoon may be the accumulation from the catchment area while mean minimum value 0.0017 mg/l was recorded during winters might be due to low temperature resulted in reduced decomposition rate and conversion of sulphate to sulphides (Tripathy and Pandey, 1990 and Kaur, 2006) [47, 18]. Similar trend has been observed by Reddy *et al*., 2009 [30] and Shanthi *et al*., 2006 [35].

3.13 Nitrate

It is the most oxidized form of nitrogen compounds. Sources of nitrates are dead and decaying matter of plant and animal origin, fertilizers, effluents from industries and residential areas and atmospheric washouts. As per BIS, the maximum limit for nitrate is 45 mg/l.

In study period, maximum value 0.5726 mg/l was observed during monsoons which may be due to surface run-off and domestic sewage and specially washing activities (Shinde *et al*., 2011) [39] whereas minimum value 0.5724 mg/l was observed during summers. During summer months, reduction in nitrates could be due to algal assimilation and reduction by denitrifying bacteria (Sabae and Abdel Satar 2001 and Sharma, 2013) [37]. Similar results reported by Gohram, 1961 and Rajashekhar *et al*., 2007 [29].

3.14 Phosphate

Phosphorus is vital nutrient for metabolic reaction of plant and animal. It ranges from 0.005-0.02 mg/l in most natural waters. The maximum permissible limit as per BIS was upto only 0.2 mg/l. Only Phosphorus controls algal growth and primary productivity. Excess Phosphorous can cause eutrophication of water body leading to algal blooms.

In Dilli pond, maximum value was observed in monsoons being 0.0605 mg/l which might be due to surface run-off from catchment utilizing fertilizers and domestic sewage containing detergents (Shinde *et al*., 2011) [39] and minimum in summers being 0.005 mg/l. During summer, relatively low level of phosphate reported may be attributed to abundance of phytoplankton (Kaul *et al*., 1978) [17].

The statistical analysis of this data revealed that correlation among parameters showed both positive and negative trends. Depth showed negative correlation with water temperature. pH showed negative correlation with water temperature but positive with depth. DO showed negative correlation with water temperature whereas positive with depth and pH. FCO_2 expressed positive correlation with water temperature and negative with depth, pH and DO. CO_3^{2-} showed negative correlation with water temperature, depth and FCO_2 whereas showed positive with pH and DO. HCO_3^{2-} showed negative correlation with water temperature, depth, FCO_2 whereas positive with pH, DO and CO_3^{2-}. Cl^- showed positive correlation with water temperature, FCO_2 and negative with depth, pH, DO, $CO_3^{2-}$and HCO_3^-. BOD showed positive correlation with water temperature, depth,Cl^-, FCO_2 and negative with pH, DO, CO_3^{2-} and HCO_3^-. Ca^{2+} showed positive with pH, DO, CO_3^{2-}, HCO_3^- and Cl^-, whereas negative with water temperature, depth, FCO_2 and BOD. Mg^{2+} showed positive with pH, DO, CO_3^{2-}, HCO_3^- and Ca^{2+} whereas negative with water temperature, depth, FCO_2, BOD and Cl^-. Sulphate in the present study showed positive correlation with depth, DO, BOD and negative with water temperature, pH, FCO_2, CO_3^{2-}, HCO_3^-, Cl^-, Ca^{2+} and Mg^{2+}. In the present investigation, NO_3^- showed positive correlation with depth, pH, DO, BOD, Ca^{2+}, Mg^{2+} and $SO_4^{2-}$and negative with water temperature, FCO_2, CO_3^{2-}, HCO_3^-, Cl^-. PO_4^{2-} showed positive correlation with depth, pH, DO, HCO_3^-, BOD, Ca^{2+} and NO_3^-,whereas negative with water temperature, FCO_2, CO_3^{2-}, Cl^-, Mg^{2+} and SO_4^{2-}.

4. Conclusion

Present investigation showed detailed physico-chemical parameters of Dilli pond, J&K. The study concludes that the

water quality of Dilli pond is polluted as many parameters were above prescribed limits. The surface run off, sewage discharge, dumping of waste material, religious activitiesetc. may be the causative factor for deteriorating the water status. To improve the quality of water, there should be regular monitoring of water body. Of the technologies available, phytoremediation is promising due to

- less ill effects
- low cost
- removal of pollutants at large scale

Government, Municipal Corporation and Localities all have to come together to protect such impoundments from eutrophication.

Table 1: Physico-chemical analysis of Dilli pond (May, 2013- April, 2014).

Parameters	Units	May	June	July	Aug	Sep	Oct	Nov.	Dec.	Jan.	Feb.	Mar.	April
Water Temp.	^oC	33	33.5	28	30	23	23	18	17	17	17.5	23	30.5
Depth	cm	36	32	43	39	58	44	42	38	37	38	35	40
p H		6.4	6.3	7.1	7.2	6.9	7.2	7.8	8.2	7.5	7.2	6.6	6.5
DO	mg/l	4	3.2	3.6	4.4	5.6	4.8	5.2	5.8	6.4	5.2	3.6	3.6
FCO_2	mg/l	46	28	26	18	16	8	6	-	8	10	44	28
CO_3^{2-}	mg/l	-	-	-	-	-	-	-	9.6	-	-	-	-
HCO_3^-	mg/l	141.6	97.6	122	114.6	117.12	114.7	143.9	202.52	204.9	212.28	117.1	102.4
Cl^-	mg/l	91	65	41	40	28	27	22	29	28	30	34	28
BOD	mg/l	2.8	2.1	2.4	2.1	2.4	2.1	2.4	1.6	1.5	3.2	2.5	2.4
Ca^{2+}	mg/l	33.64	30.28	27.87	39.53	29.18	28.9	27.7	38.68	42.89	40.22	33.3	21.03
Mg^{2+}	mg/l	21.47	20.83	28.99	27.61	14.53	18.73	32.62	48.02	35.54	28.25	23.24	18.70
SO_4^{2-}	mg/l	.0018	.00174	.0019	.00183	.00284	.00177	.001775	.001766	.00172	.00178	.00172	.00176
NO_3^-	mg/l	.5725	.57241	.57269	.57267	.572575	.57253	.572552	.572466	.57247	.572562	.57247	.57241
PO_4^{2-}	mg/l	.0140	-	.048	.0205	-	.1738	-	.0149	.0091	.1738	-	.0083

Table 2: Correlation among various physico-chemical parameters of Dilli pond.

	Water Temp	Depth	pH	DO	FCO_2	CO_3^{2-}	HCO_3^-	Cl^-	BOD	Ca^{2+}	Mg^{2+}	SO_4^{2-}	NO_3^-	PO_4^{2-}
Water Temp.	1	-0.19	-0.79	-0.82	.71	-0.37	-0.75	0.71	0.19	-0.43	-0.58	-0.01	-0.07	-0.26
Depth		1	0.15	0.36	-0.30	-0.10	-0.18	-0.41	0.07	-0.33	-0.33	0.88	0.44	0.06
pH			1	0.75	-0.85	0.61	0.64	-0.59	-0.45	0.41	0.82	-0.09	0.28	0.13
DO				1	-0.77	0.36	0.74	-0.50	-0.38	0.54	0.50	0.25	0.08	0.13
FCO_2					1	-0.42	-0.53	0.68	0.44	-0.29	-0.54	-0.06	-0.19	-0.33
CO_3^{2-}						1	0.46	-0.15	-0.47	0.29	0.74	-0.10	-0.20	-0.11
HCO_3^-							1	-0.22	-0.11	0.73	0.73	-0.20	-0.05	0.25
Cl^-								1	0.25	0.03	-0.25	-0.12	-0.20	-0.21
BOD									1	-0.23	-0.48	0.12	0.19	0.35
Ca^{2+}										1	0.56	-0.20	0.11	0.13
Mg^{2+}											1	-0.41	0.04	-0.10
SO_4^{2-}												1	0.30	-0.16
NO_3^-													1	0.25
PO_4^{2-}														1

5. References

1. APHA. Standard method for the examination of water. 17th edition, American Public Health Association, 1985.
2. Abdel-Satar AM. Water quality assessment of River Nile from IDFO to Cairo, Egyptian Journal of Aquatic Research. 2005; 31(2):200-223, 29.
3. Ahangar JA, Saksena DN, Mir MH, Ahangar MA. Seasonal variations in physico-chemical characteristics of Ancharlake, Kahmir. International Journal of Advanced Biological Research. 2012; 3(2):352-357.
4. Bhandarkar SV, Bhandarkar WR. A study on seasonal variation of physico-chemical properties in some freshwater lotic ecosystems in Gadchiroli District Maharashtra, Int. j. of Life Sciences. 2013; 1(3):207-215.
5. 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. 2013; 1(2):17-23.
6. Chowdhary S. Diversity of Macro-benthic invertebrate fauna in some water-bodies of Jammu. Ph. D Thesis, University of Jammu, Jammu, 2011.
7. Das J, Acharya BC. Hydrology and Assessment of Lotic water quality in Cuttack City, India. Water Air and Soil Pollution. 2003; 150:163-175.
8. Dubey NA. comparative status of quality of drinking water of Bhopal city filtration plants and ground water with special reference to heavy metals and organo chemical. Ph.D. Thesis, Barkatullah University, Bhopal, 2003.
9. Dutta SPS. Limnology of Gadigarhstream (Miran–Sahib Jammu) with special reference to consumers inhabiting the streams. Ph.D Thesis, University of Jammu, Jammu, 1978.
10. Dutta TK, Patra BC. Biodiversity and seasonal abundance of Zooplankton and its relation to physico – chemical parameters of Jamunabundh, Bishnupur, India. Int. J. Sci. Res. Pub. 2013; 3(8):1-7.
11. FEPA. National Environmental Protection (Effluent Limitation) Regulations of 1991. Federal Environmental Protection Agency, Lagos, Nigeria. Ref. S. 1991, 1-8.
12. Garg RK, Rao RJ, Saksena DN. Water quality and conservation management of Ramsagar Reservoir, Datia, Madhya Pradesh. Journal of Environmental Biology. 2009; 30(5):909-916.

13. Gohram. The chemical composition of some waters from Dune slacks at Sand scale, North Lancashire, J. Ecol. 1961; 49(1):79-82.
14. Gupta SK, Deshpande RD. Water for India in 2050: First order assessment of available options. Curr. Sci. 2004; 86:1216-1224.
15. Harney NV, Dhamani AA,Andrew RJ. Seasonal Variations In The Physico-chemical of Pindavani Pond of Central India. Weekly Science. 2013; 1(6):2321-7871.
16. Jawale AK, Patil SA. Physico-chemical characteristics and Phytoplanktons abundance of Mangrul dam, Dist-Jalgaon, Maharashtra. J. Aqua. Biol. 2009; 24(1):7-12.
17. Kaul Tristal, CL. Handoo JK. Distribution and production of macrophytes in some aquatic bodies of Kashmir. in Singh JS. Gopal B. (eds.) Glimpses of Ecology. Prakash Publishers, Jaipur. 1978, 313-334.
18. Kaur S. Studies on the impact of tourism on stream Ban Ganga and the indwelling micro and macro organisms. Ph.D Thesis, University of Jammu, Jammu, 2006.
19. Kumar S. Limnology of Kunjwani Pond, Jammu with referances to Plankton and Macrophites.M.Phil Dissertation, submitted to University of Jammu, 1990.
20. Langer S, Jan N, Bakhtiyar Y. Effect of some abiotic factors on zooplankton productivity in a subtropical pond in Jammu, India. Current World Environment. 2007; 2(1):27-34.
21. Malik A, Pandey AK. Physico-chemical characteristics of BrariNambal basin of Dal lake, Kashmir.Journal of Research & Development. 2006; 6:87-95.
22. Malhotra YR. Dutta SP. SandSahi DN. Matsya. 1986; 12-13:174.
23. Narayana J, Puttaiah ET, Basavaraja D. Water quality characteristics of Anjanapura reservoir near Shikaripur, District Shimoga Karnataka. Journal of Aquatic Biology. 2008, 53-64.
24. Pandey GN. Environmental Management. Vikas Publishing House, New Delhi, India. 1997, 33-37.
25. Pulugandhi C. Analysis of water quality parameters in Vembakottai Water Reservoir, Virudhunagar District, Tamil Nadu – AReport. Research Journal of Recent Sciences. 2014; 3:242-247. (ISC-2013).
26. Qadri MY, Naqash SA, Shah GM, Yousuf AR. Limnology of two streams of Kashmir. J. Indian. Inst. Sci. 1981; 63:137-141.
27. Rai UN, *et al*. Screening and identification of early warning algal species for metal contamination in fresh water bodies polluted from point and non-point sources. Environmental monitoring and assessment. 2008; 144(1-3):469-481.
28. Ragnar R. Environmental Load, CharnetAquafarmer, 2004. www.holar.is/aquafarmer, accessed 05.08.2009.
29. Rajashekhar AV, Lingaiah A, Rao Satyanarayana, Piska Ravi Shankar. The studies on water quality parameters of a minor reservoir, Nadergul, Rangareddy district andhra Pradesh. J. Aqua. Biol. 2007; 22(1):118-122.
30. Reddy Vasumathi K, LaxmiPrasad K, Swamy M, Ravinder Reddy. Physicochemical parameters of Pakhal Lake of Warangal district andhra Pradesh, India. J. Aqua.Biol. 2009; 24(1):77-80.
31. Sabae SZ, Abdel Satar AM. Chemical & Bacteriological studies on El-Salam canal, Egypt. J. Egypt. Acad. Soc. Environ. Develop. 2001; 2(1):173-197.
32. Sachidananda murthy KL, Yajurvedi HN. Monthly variations in water quality parameters (physicochemical) of a Perennial lake in Mysore city. Indian Hydrobiol. 2004; 7:217-228.
33. Sawhney N. Biodiversity of river Tank in the vicinity of Jammu City. Ph.D. thesis, University of Jammu, Jammu, 2008.
34. Sehgal HS. Limnological studies of lake SurinsarJammu,with reference to zooplanktons and fisheries. Ph.D thesis, University of Jammu, Jammu, 1980.
35. ShanthiV, Muthumeena S, Jeyaseeli, Florence Borgia VJ. Physico-chemical status of Varaga River at Theni district, Tamil Nadu. 2006; 1(2):123-127.
36. Sharma J. Effect of Industrial wastes and domestic sewage on abiotic and biotic (planktons &macrophytes) components of BehlolNullah, Jammu. Ph.D Thesis, University of Jammu, Jammu, 1999.
37. Sharma R. Biomonitoring of BehlolNullah (A Tributary of River Tawi) in Jammu. Ph.D Thesis, University of Jammu, Jammu, 2013.
38. Shinde SE, Kantikar VN, Muley SP, Nimbalkar RK. Studies on the physico-chemicalparameters of water and zooplankton diversity in Khan river, Aurangabad district (MS) India. Bioscience Discovery. 2011; 2(2):207-213.
39. Shinde SE, Patha TS, Raut KS, Sonawane DL. Studies on the Physico-chemical Parameters and Correlation Coefficient of Harsool-savangi Dam, District Aurangabad, India. Middle-East Journal of Scientific Research. 2011; 8(3):544-5549
40. Shinde SE, Kantikar VN, Muley SP, Nimbalkar RK. Studies on the physico-chemicalparameters of water and zooplankton diversity in Khan river, Aurangabad district (MS) India. Bioscience Discovery. 2011; 2(2):207-213.
41. Shidda mallayya N, Pratima M. Impact of domestic sewage on fresh water body. Journal of Environmental Biology. 2008; 29(3):303-308.
42. Singh MR, Gupta A. Seasonal variations in certain physico-chemical parameters of Imphal, Irial and Thoubal Rivers from Manipur River System, India, Eco. Env. And Cons. 2010; 16(2):197-207.
43. Singh SP, Deepa P, Rashmi S. Hydrobiological Studies of two ponds of Satna (M.P.), India, Eco. Environ. Cons. 2002; 8(3):289-292.
44. Sunil, (1990), Limnology of Kunjwani pond Jammu, with special reference to planktons and macrophyte. M. Phill Dissertation, University of Jammu.
45. Talling JF. The longitudinal succession of the water characteristic in White Nile. Hydrobiologia. 1957; 9:73-89.
46. Thresh JK, Beale JF, Suckling EV. the examination of water and water supplies (Ed. E.W. Taylor). London, 1949.
47. Tripathy AK, Pandey SN. Water pollution. Published by Ashish publishing house. 1990, 326.
48. Vass KK, Raina HS, Zutshi DP, Khan MA. Hydrobiolgical studies on River Jhelum. Geobios. 1977; 4:238-242.
49. Veena. Limnology of kunjwani pond, Jammu with special refrence to macrophytes and macro invertebrates.M.Phill Dissertation, University of Jammu, Jammu, 1990.

50. Welch PS. Limnology: McGraw Hill book Company, New York, Toronto and London (2nd Ed). 1952, 538.
51. Wetzel RG. Limnology: Lakes and Rivers, 3rd edition, Academic Press A Harcourt Science and Technology Company, 525B Street, Suite 1900, San Diego, California. 2001, 1000.
52. WHO. Limits for Effluents Discharge into Surface Waters. World Health Organization, Geneva, CH, 1999.
53. Zutshi N. Effect of Jammu city sewage on abiotic and biotic factors of River Tawi, Jammu. Ph.D Thesis, University of Jammu, 1992.