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EVALUATION OF PHYSICOCHEMICAL PARAMETERS OF RIVER KRISHNA, SANGLI MAHARASHTRA

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Abstract: Krishna river is the major lotic system and has human interference through emersion of idols, irrigation, domestic use, discharge of sewage, sand dredging, etc. by which water quality get changed. Assessment of temperature, pH, total alkalinity, turbidity, chloride, hardness, Carbon dioxide, dissolved oxygen, calcium, phosphate, total solids and total dissolved solids were carried out monthly during January, 2011 to December, 2013. Results showed significant alterations in the physicochemical parameters. The analyzed data of water body was interpreted in relation to pollution status and biodiversity indices for assessment of aquatic fauna.

Keywords: Krishna River, Physicochemical parameters, Pollution, Seasonal variation.

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INTRODUCTION

Water as extraordinary substance, exists in three states as gases, liquid proved important for survivability of life (Simpi *et al.,* 2011). Water quality has direct relation with aquatic productivity (Moses, 1983; Shrestha and Kazama, 2003). Riverine system comprises both main course and tributaries, carrying the one way flow of sediment with load of dissolved matter and particulate phases coming from natural and anthropogenic sources (Rani *et al.* 2011). River also serves for domestic, industrial and agricultural disposal, transportation, getting food resources and for recreational activities (Dhote and Dixit, 2011). Urbanization found to be root cause of water contamination. Animals use same water for drinking and can also contaminate through direct defecation and urination. Immersion of idols during festivals found to be one of the reasons of river pollution (Kamal *et al.,* 1999).Industrial waste including detergents produces mass of white foam in the river waters, on the other hand heavy metals, acids, dyes, alkalies and other chemicals change pH of water which becomes toxic to aquatic fauna. Aquatic organisms need a healthy environment. Maximum productivity depends on optimum level of physicochemical parameters (Sadia *et al.,* 2013). Assessment of riverine water was carried out by assessment of its physicochemical parameters (Rao and Vaidyanadhan, 1979; Muniyan and Ambedkar, 2011). Taking account of vast release of toxicants and other chemical we have decided to analyze the quality of water from Krishna River as is extreme need of time to take a some preventive measures and to sustain the aquatic fauna inhabiting in it.

EXPERIMENTAL

Study area with Geographical Features: Sangli District is present in the western part of Maharashtra. Geographically located at 16.8670˚N latitude and 74.5670˚E longitude, surrounded by Satara and Solapur districts to the north, Bijapur district, Karnataka to the east, Kolhapur and Belgaum, Karnataka to the south, and Ratnagiri district to the west. Sangli district is situated around river basins of the Warna and Krishna. Sangli is district headquarters and acquired total area 8,578

Km² (3,312 sq. m.). The district is with 24.51% urbanization with the industrial area.

Collection Site: Krishna River is the major lotic system of district, considered as longest rivers in India, measuring about 1300 km in length. Approximately 105 Kms of riverine flow covers the district. The river originates at Mahableshwar, passes through Sangli and conjoins the sea in the Bay of Bengal at Hamasaladevi (Andhra Pradesh). The mean annual discharge of water is 67305 mm^3 and its drainage area is 2,68786 sq. Km, of which 26.8% in Maharashtra, 43% in Karnataka and 29.4% in Andhra Pradesh (APHA, 1989).

Sites: i) Sangli ghat site, i) Mhaishal site.

Sampling and Analysis of Water: For the present analysis, water samples were collected at morning 9.00 am to 10.00 am monthly in the period of January, 2011 to December, 2013. Physicochemical parameters such as temperature, pH, Total alkalinity, Turbidity, Chloride, Hardness, CO_2, DO, Calcium and Phosphate were analyzed regularly during all the three seasons by following the standard methods (Trivedy and Goel, 1984; Ahipathi and Puttaiah, 2006). Statistical analysis was made by calculating Standard deviation and Standard Error. Finally readings were interpreted to find out pollution status in the river.

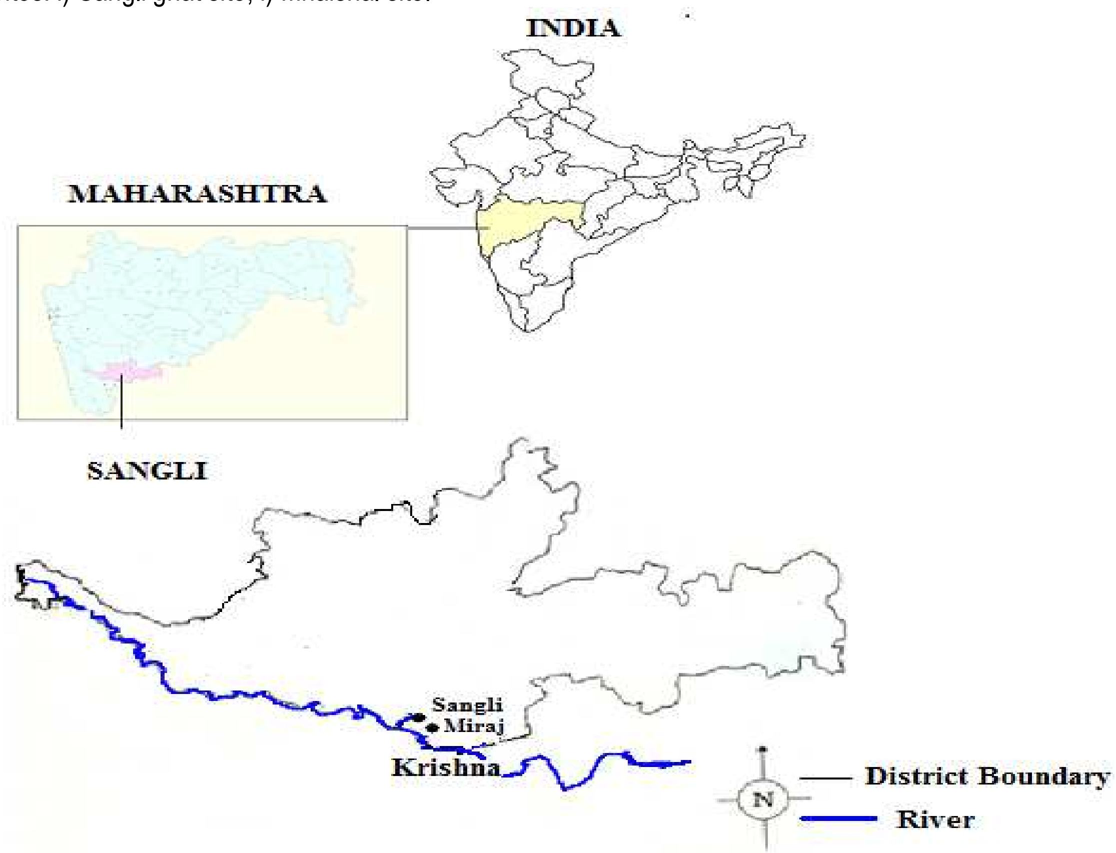


Figure 1. Krishna River from District Sangli

RESULTS AND DISCUSSION

Temperature: Temperature found the most important ecological features also controls behavioral characteristics of organisms, solubility of gases and content of salts in water. The fluctuation of temperature usually depends on the season, geographic location, sampling time and content of effluents entering the stream (Dallas and Day, 2004). The temperature on both the sites of river ranged between 24.66 to 30°C which was decreased in post monsoon and increased in pre-monsoon on both the sites. Temperature exerts a strong influence on many physical and chemical characteristics of water including the solubility of oxygen and other gases, rate of chemical reaction and toxicity, with microbial activity (Duffus, 1980). A higher temperature has depleted solubility of dissolved oxygen in water, and reduced its concentration. Vulnerability of organisms to the toxins *e.g.* cyanide, zinc, phenol and xylene, found intensified as temperature increases (Merritts et al., 1998).

Turbidity: Turbidity found measure of water clarity indicates the degree to which light entering a column scattered by suspended solids. The Mhaishal site showed the turbidity in the range of in pre-monsoon 141.16 and in monsoon 81.91 where as post-monsoon showed was 66.99. Comparatively Sangli site showed lower turbidity recorded in pre-monsoon 97.163, in monsoon 69.875 and in post-monsoon 66.99. Turbidity of Mhaishal site was lower as that of Sangli site, which indicated high amount of suspended particles present at the Sangli site and found more polluted than Mhaishal site. As water became more turbid, less sunlight get penetrate, therefore the rate of photosynthetic activity was lowered. In addition, suspended materials absorbed heat from sunlight and raise the water temperature which was limited amount of dissolved oxygen in water (Thorvat *et al.,* 2012).Turbidity of river water can be low or high depending on the water current and sedimentation as turbidity of river on a was low *i.e.* 4–28 where as turbidity of river Kapila was 76–80 (Smitha and Shivashankar, 2013; U.S. EPA, 2004).

Total Solids: Suspended solids in streams are often as a result of sediments carried by the water, whose source includes natural and anthropogenic activities in the water shed, such as natural or excessive soil erosion from agriculture, forestry or construction, urban run-off, industrial effluents or phytoplankton growth (Singh and Gupta, 2010). Total solids refer to the matter which get suspended or dissolved in water. Turbidity and total solids found useful indicators. Average total solids recorded from the Sangli site and Mhaishal site were 351 and 285 mg/l respectively. Mhaishal site showed higher amount of total solids as compared to Sangli site. As turbidity of Sangli site was more as compared to Mhaishal site in all the seasons, hence highly turbid water was full of suspended material. Turbidity due to total solids affects aquatic organisms (Wilcox, 1955).

Total dissolved solids: Total dissolved solid depends on various factors such as geological character of watershed, rainfall and amount of surface runoffs and gives an indication of the degree of dissolved substances (Driche, 2008; Siebert, 2010). According to Wilcox (1955) aquatic media classified based on the concentration of TDS. Water found desirable for drinking up to permissible limit of 500 mg/L, hence it can be said that river water is safe for drinking purpose. TDS in water found due to content of carbonates, bicarbonates, chlorides, phosphates and nitrates of calcium, magnesium, sodium, potassium, manganese, organic matter salt and other particles (Fakayode, 2005). The total dissolved solids found at Mhaishal site ranged between 206.83 to 360.7 mg/L. Comparatively Sangli site showed 284.66 to 479.33 mg/L, throughout the working period.

pH: Change in alkalinity may be result of change in pH. The pH value found increased due activity of photosynthetic algae which consumes CO_2 dissolved in water (Kang *et al.,* 2001). According to Fakayode (2005), the pH of a water body has importance in determination of water quality as it chemically reacts with remaining factors. Aquatic organisms are sensitive to pH fluctuations and their biological treatment requires pH control or monitoring. Significant difference was not found in pH during the assessment period. The pH value was between 7.3 to 7.43 at both the sites which was within the range of WHO as standard of 6.50–6.9.

Total Alkalinity: The alkaline nature of water could be attributed to the buffering properties of some inorganic substances (Hopkinson, 1985). Total alkalinity of water influenced by presence of mineral salt present in it. It is primarily caused by the carbonate and bicarbonate ions. Alkalinity resulted from the dissolution of calcium carbonate ($CaCO_3$) from limestone bedrock which was eroded during the natural processes of weathering. The carbondioxide (CO_2) released from the calcium carbonate into the stream water undergoes several equilibrium reactions (Solis, 1988). The total alkalinity observed at Sangli site recorded in summer season was 290 mg/L and in rainy season 193 mg/L, winter season showed 28.2 mg/L. Similarly Mhaishal ghat showed the same declined in alkalinity towards winter season *i.e.* from 283.3 mg/L to 85.66 mg/L.

CO_2: Carbon dioxide is the end product of organic carbon degradation in almost all aquatic environments and its variation is often a measure of net ecosystem metabolism (Wetzel, 2006). Free CO_2 values were found to be maximum during summer in both the sites. CO_2 showed the range of 16.13mg/L minimum and 66 mg/L maximum during the study period. It may be due to decreased in productivity leading to decomposition forming more CO_2 in the water.

DO: Dissolved Oxygen content, has a vital role for maintaining aquatic life and is susceptible to slight environment changes. Oxygen depletion often results during times of high community respiration and hence DO has been extensively used as a parameter delineating water quality and to evaluate the degree of productivity of water (Chapman and Kimstach, 1992). Dissolved oxygen affects the growth, survival, distribution, behavior and physiology of aquatic organisms (Joshi and Bisht, 1993). It found to be is also an important limnological parameter indicating level of water quality and organic pollution in the water body (Kataria *et al.* 1995). DO values ranged in both sites were depleted in summer at Mhaishal site *i.e.* 12.3mg/L and maximum in winter *i.e.* 53.33mg/L at Sangli site. Seasonal variation in DO content was related to temperature and biological activities (Parashar *et al.,* 2003). A high pollution load has decreased the DO values at considerable level. Our results are similar to as result recorded by Chetana and Somasekhar, (1997); Sawyer *et al.,* (2003); Thilaga *et al.,* (2004); Bhattarai *et al.,* (2008).

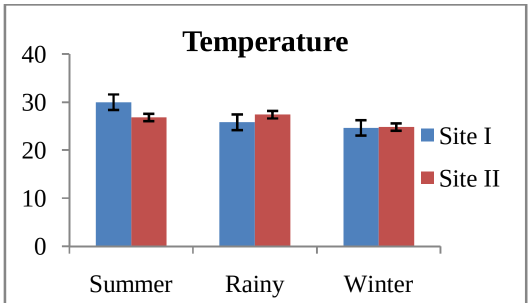
BOD: It is important here to note that, low BOD content indicates of good quality water, while a high BOD indicates polluted water. When BOD level is high, DO level decrease because the oxygen available in the water get consumed by the bacteria (Agarwal and Rozgar, 2010). There were less significant seasonal alterations observed related to BOD at both the sites. The values were ranged between 7.5 to 17.75mg/l during the assessment period. Low BOD was mainly due to higher algal productivity, along with increased solubility of oxygen at low temperatures, while maximum resulted from the rapid utilization of oxygen at higher temperatures (Clair, 2003). The values of BOD clearly showed higher concentration during summer and comparatively low during winter and monsoon respectively (Kumar *et al.,* 2010; Kolhe *et al.,* 2014).

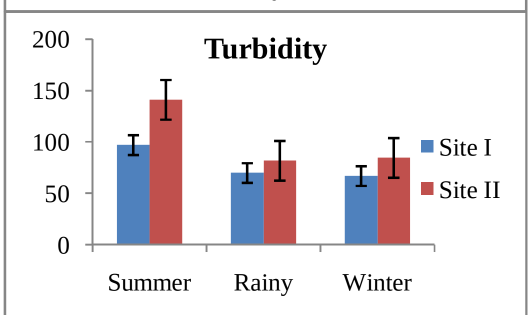
COD: COD is similar in function to BOD, in that both measure the amount of organic compounds in water. COD is a measure of pollution in aquatic ecosystems. It estimates carbonaceous factor of organic matter (Stickney, 2005). COD gives out the amount of organic pollutants found in surface water, proving COD as useful measure of water quality, which indicates the mass of oxygen consumed (Trivedy and Goel, 1986). The value of recorded COD was ranged at Sangli site was between 11.5 to 52.083 mg/l and at Mhaishal site it ranged from 18.91 to 27.83 mg/l showing lower COD values as compared to Sangli site. Similar results were observed (Malik *et al.,* 2012).

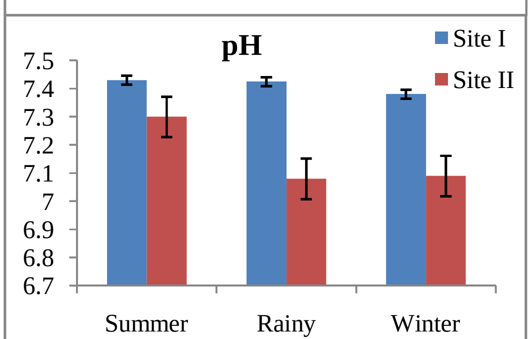
Phosphate: Phosphorus has proved one of the limiting nutrients for floral growth in freshwater bodies which regulate the phytoplankton production (Sharma *et al.,* 2004). The phosphate level showed in winter season at Mhaishal site was 0.225 and 0.825 mg/L in summer season. The major source of potassium in natural fresh water is weathering of rocks but the quantities increase in the polluted water due to disposal of waste water (Kumar *et al.,* 2010).

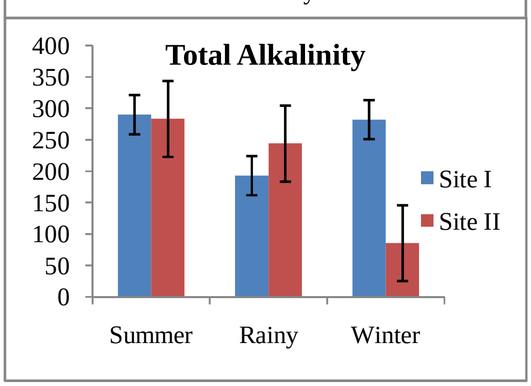
Chloride: Content of chloride in water found most important indicators of pollution. Higher amount of chloride reacts with sodium making the water salty and also increases TDS values of water (Taylor, 1949). Chloride showed lower value at Mhaishal site in rainy season *i.e.* 66.62 mg/L as compared to summer *i.e.* 91.09 mg/L and in winter it was 131.6 mg/l may be due to dilution affect of rain water. Similar result was observed by Sharma *et al.,* (2004).

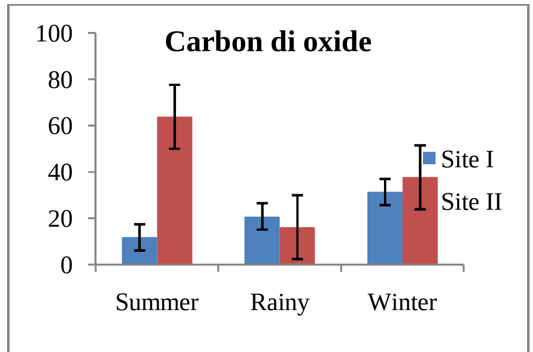
Hardness: Total hardness of water is due to the presence of bicarbonate, sulphates, chloride, and nitrates of Ca and Mg (Kumar *et al.,* 2010). The hardness of water depends on the dissolved minerals present in it which determines water quality for all purposes. Hardness ranged as maximum in summer at both the sites showing 302 mg/L at Sangli site and 269 mg/L at Mhaishal site may be due to low level of water and lower in winter at Mhaishal site *i.e.* 212 mg/l due to increased inflow of water.

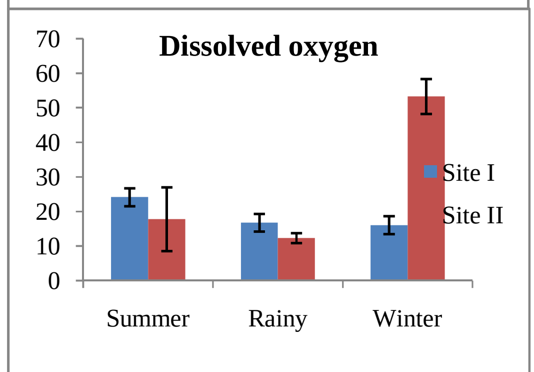


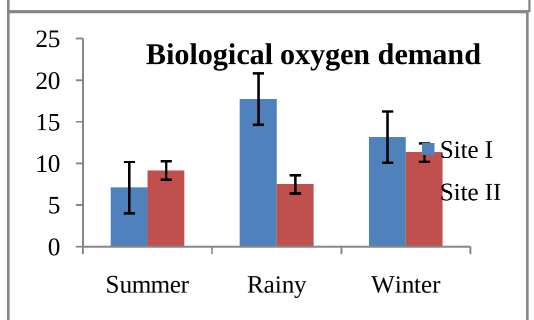


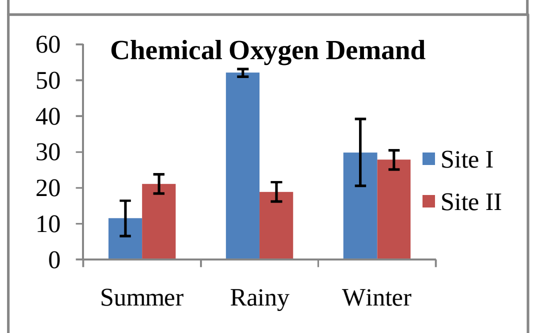


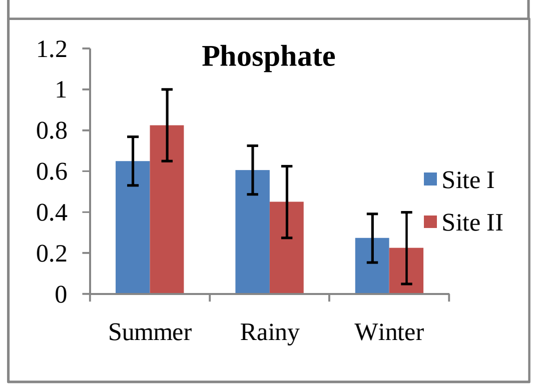












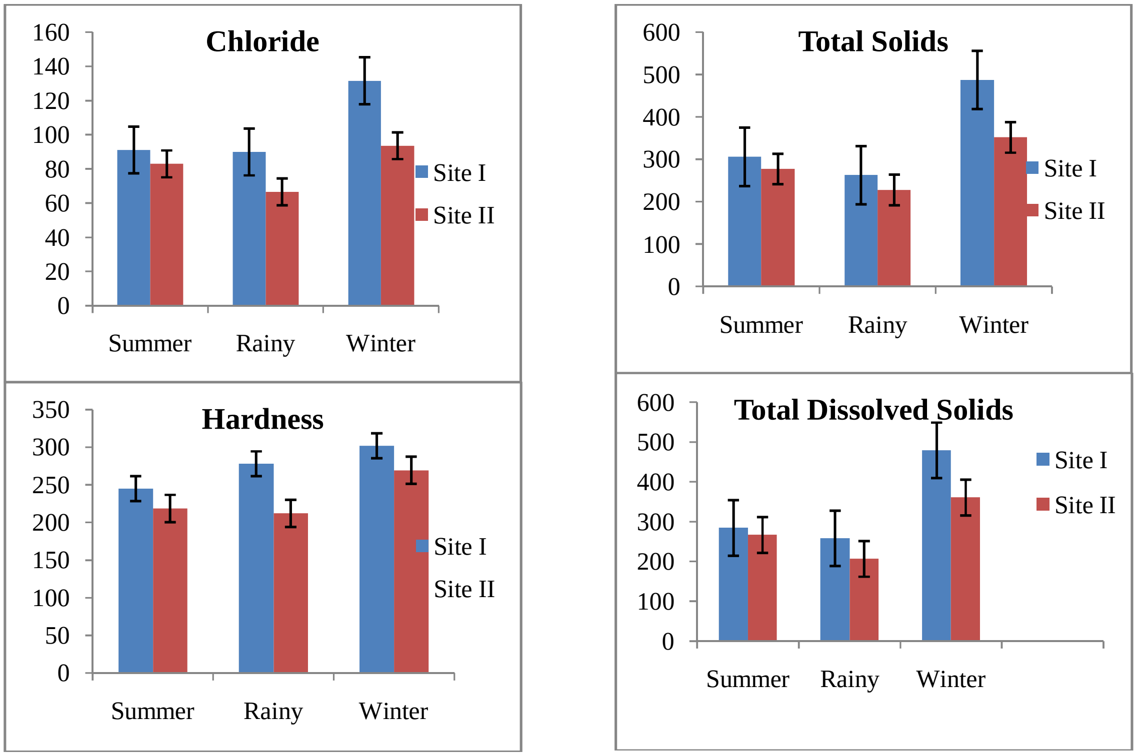


Figure 1. Comparison of Physicochemical Parameters

Table 1. Summer, Rainy and Winter seasonal changes in the physicochemical parameters in Krishna River (Site I – Sangli Ghat), Miraj Tahsil, Maharashtra (Feb 2011 – Jan 2014).

S. No.	Parameters (mg/L)	Summer (Feb-May)	Rainy (June - Sep)	Winter (Oct - Jan)
1	Temperature (˚C)	30± 1.089	25.83 ± 1.506	24.66 ± 0.288
2	Turbidity	97.163 ±21.69	69.875 ± 8.35	66.99±12.814
3	pH	7.43 ± 0.312	7.425 ± 0.129	7.38 ± 0.144
4	Total Alkalinity	290 ±14.6	193 ± 3.627	282±8.89
5	CO_2	11.76 ± 9.65	20.8 ± 5.726	31.4 ±11.84
6	DO	24.13 ± 9.875	16.76 ± 3.491	16.05 ±4.24
7	BOD	7.1 ± 1.23	17.75 ± 1.776	13.166±4.140
8	COD	11.5 ±4.92	52.083 ± 1.09	29.916±9.328
9	Phosphate	0.65 ± 0.175	0.606 ± 0.004	0.273 ± 0.025
10	Chloride	91.09 ±26.115	89.93 ± 21.417	131.6±46.507
11	Hardness	245 ± 6.082	278 ± 10.34	302 ± 11.59
12	TS	306.08 ± 6.69	262.91 ± 17.98	487.16±73.08
13	TDS	284.66 ±13.852	258.33±7.50	479.33±58.32

Table 2. Summer, rainy and winter seasonal changes in the physicochemical parameters in Krishna river (Site II– Mhaishal), Miraj Tahsil, Maharashtra (Feb 2011 – Jan 2014).

S. No.	Parameters (mg/L)	Summer (Feb-May)	Rainy (June - Sep)	Winter (Oct - Jan)
1	Temperature (˚C)	26.83 ± 0.57	27.41 ± 0.57	24.83 ± 0.14
2	Turbidity	141.16±19.40	81.91 ± 2.24	84.62 ± 4.33
3	pH	7.3 ± 0.332	7.08 ± 0.104	7.09 ± 0.11
4	Total Alkalinity	283.3 ±5.58	244 ± 71.021	85.66 ± 8.23
5	CO_2	66 ± 3.90	16.13 ± 10.852	37.76 ± 26.40
6	DO	17.75 ± 9.219	12.3 ± 1. 44	53.33 ± 5.05
7	BOD	9.16 ± 3.68	7.5 ± 2.179	11.31 ± 2.06

8	**COD**	21.083 ±6.22	18.91 ± 1.376	27.83 ± 9.504
9	**Phosphate**	0.825 ± 0.261	0.45 ± 0.217	0.225 ± 0.09
10	**Chloride**	82.96 ±11.319	66.62 ± 33.64	93.60 ± 43.0
11	**Hardness**	218.6 ± 19.34	212 ± 1.45	269.3 ± 23.35
12	**TS**	277.5 ± 23.815	228 ± 12.12	351.9 ± 48.35
13	**TDS**	266.91 ± 5.917	206.83±42.6	360.7 ± 57.53

CONCLUSION

From the study we concluded turbidity and alkalinity were high in summer, while TS and TDS were high in winter. Results showed significant alterations in physicochemical parameters. From water analysis Sangli Ghat site showed contamination and comparatively found polluted among the reservoir. There is a need to take action plan against polluted site for sustainability of aquatic fauna.

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