Seasonal Variations in the Physico Chemical Parameters of Middle Region of Pamba River, Kerala, India

Ninu Thomas, Nelson P. Abraham

Abstract- Water is the essential commodity that organisms need for their survival and growth on earth. The availability of quality drinking water is indispensable for the survival of mankind. So quality of drinking water sources should be checked regularly for both physico-chemical and bacteriological parameters to prevent water born diseases. Since river water is the main water source for drinking and irrigation purpose, its monitoring is very much inevitable. The present study deals with the assessment of seasonal changes in water quality of Pamba River at selected sites in the middle course of the river.

Physico- chemical parameters were studied for a period of one year from February 2013-january 2014. The parameters under study were temperature, total dissolved solids, turbidity, conductivity, salinity, pH, dissolved oxygen, biological oxygen demand, total hardness, alkalinity, acidity. The results obtained for each parameter were analyzed and compared to BSI standards and found that all the parameters are well within the permissible limits.

Keywords- Acidity, chemical parameters, Conductivity, Dissolved Oxygen, Pamba River, Physical parameters, Pollution.

INTRODUCTION

Rivers are the cradle of human civilization. From the time of human civilization, natural resources such as streams, lakes and rivers are used for human consumption. Anthropogenic activities turned many of our aquatic resources as sites for waste disposal. Lack of clean water and sanitation is the second most important risk factor in terms of global burden of disease after malnutrition (WHO and UNICEF, 2000). Regular monitoring of water resources can prevents the outbreak of diseases. The quality of water is usually described according to its physical, chemical and biological characteristics.

The healthy aquatic ecosystem is dependent on the physico-chemical and biological characteristics (Venkatesharaju et al. 2010). Aquatic resources especially rivers have been studied extensively for physicochemical aspects by several authors (Singh and Gupta, 2004; Sanap etal, 2006; Deshmukh et.al 2006; Firozia and Sanalkumar, 2012; Athira and Jaya, 2014). Joseph and Claramma (2010) studied the water quality of river Pennar, a fresh water wetland in Kerala. Physico-chemical parameters of Karamana river water in Trivandrum District were analyzed by s

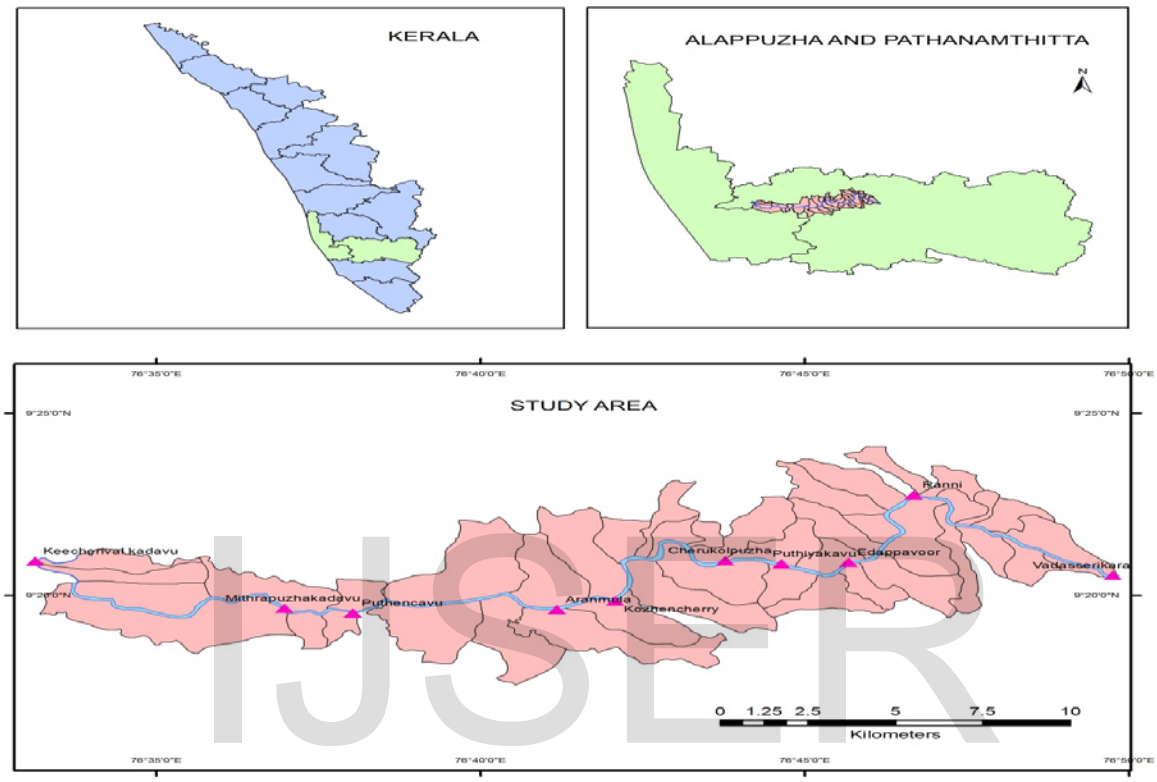
Sujitha et al (2012). Water quality and habitat degradation of Pamba River has been the subject of many researchers, since Pamba River has importance as holy river with regard to Sabarimala Temple (Koshy and Nayar, 2000; Biju Vikram and Jha, 2003). The present investigation was carried out to assess the physico chemical factors of Pamba river in the middle region at 10 selected sites.

MATERIALS AND METHODS

Water samples were collected at monthly intervals from ten selected sites of middle region of Pamba River during February 2013 to January 2014. Surface water samples collected in sterilized bottles were brought to laboratory taking necessary precautions and analyzed for various parameters under study using standard methods (APHA, 2005). Parameters such as temperature and pH were recorded from the study sites itself. Sampling was done carefully to avoid bubbling. The investigation period was divided in to 3 seasons; pre monsoon (Feb-May),monsoon (June- September)and post monsoon(Oct-Jan).The detailed analysis of various physico chemical factors such as temperature, total dissolved solids, turbidity, conductivity, salinity, pH,

dissolved oxygen, biological oxygen demand, total hardness, alkalinity, acidity was done in above three seasons.

Map showing the study area



RESULTS AND DISCUSSION

Seasonal variations in the physical and chemical factors of the middle region of Pamba River at 10 selected sites were analyzed for a period of one year.

Water temperature is crucial factor which influences the chemical, biochemical and biological characteristics of a water body (Manjare *et al*., 2010). The water temperature value varied from 27.2°c (during monsoon at site 1) to 28.73°c (during post-monsoon at site 10). The seasonal minimum average of temperature during pre-monsoon was 27.25±0.49 at site 7 and maximum at site1 (28.5±0.88). During monsoon season, minimum average was at site 1 (27.2±0.06) and maximum at site 10 (28.35±0.54). Post-monsoon seasonal average varies from 27.27±0.38 at site1 to 28.73 ±0.51 at site 10. There was only a slight variation in temperature.

A high content of dissolved solids elevates the density of water, influences osmoregulation of fresh water organism, and reduces solubility of gases and water utility for drinking, irrigation and industrial purposes (Swarnaletha and Narsingrao, 1998). The value of total dissolved solids (TDS) ranged between 17.54mg/l (during pre-monsoon season at site7) and 37.86mg/l (during monsoon season at site 6). Decreased amount of total dissolved solids were present in all sites during pre-monsoon compared to monsoon and post-monsoon. TDS can also affect water taste, and often indicates a high alkalinity or hardness (Thompson, 2006). Conductivity measurement is an excellent indicator of TDS that affects the taste of potable water (Unnisa and

Khalilullah, 2004). It provides a rapid means of obtaining approximate knowledge of total dissolved solids concentration and salinity of water sample (Odum,1971).Maximum conductivity observed during pre-monsoon at site 6 (87.53±43.87) μmhos/cm. and minimum at site 1 during monsoon (37.8±3.03) μmhos/cm.

Suspended and colloidal matter such as clay, silt, finely divided organic and inorganic matter, plankton and other microscopic organisms causes turbidity in water (Divya and Manonmani, 2013). During the study period, lowest value of turbidity was noted during pre-monsoon period (3.92±1.16) at site 4 and highest in monsoon period at site 10(8.53±1.10). Turbidity was higher in all sites during monsoon season except at site 4 where monsoon and post monsoon have almost equal values. High value of turbidity in the monsoon season was found due to the agitation of water caused by rainfall (Garg et al. 2006).

Salinity of water sample ranges from 6.77 at site 2 (post- monsoon) to 13.08 at site 10 (post-monsoon).Total hardness of study sites ranged between 6mg/l (site1)in premonsoon and 11mg/l in post monsoon. Fresh water on the basis of hardness value can be classified in the following manner: 0-60mg/l as soft, 61-120mg/l as moderately hard, 120-160mg/l as hard and above 180 very hard (Kannan, 1991). Thus River Pamba can be considered as soft as its value lies between 0-60mg/l. pH of study sites vary between 6.75 and 7.65. Results shows that water has pH in the permissible limits provided by Indian Standards. pH near to neutral is indicator of unpolluted water (Fakayode, 2005).

Dissolved oxygen and biological oxygen demand (BOD) is important in pollution monitoring. Maximum dissolved oxygen level encountered during monsoon 8.9mg/l (site1) and minimum at 5.65mg/l during pre-monsoon at site10. High rainfall and increased water during monsoon results in high DO due to turbulence and oxygenation (Hannan, 1979). Low levels of dissolved oxygen during pre-monsoon can be attributed to the decomposition of organic matter, decreased flow of water and increased evaporation due to increased temperature and warm climate(Gonzalves and Joshi,1946). Maximum seasonal average of BOD during g/l and 2.2mg/l and in post monsoon it lies between 0.77mg/l and 1.82mg/l. When BOD level is high, DO level decrease because the oxygen available in the water is being consumed by the bacteria (Sawyer *et al*., 2003). Waters with BOD levels less than 4 mg/l are regarded as clean and those with BOD levels greater than 10 mg/l are considered as polluted as they contain large amounts of degradable organic matter (Mc Neely *et al*., 1979). Thus water quality of selected sites can be considered as clean.

Alkalinity is important for life in water. Alkalinity value ranges from 9mg/l to 14mg/l in the study sites during different seasons. Acidity ranges between 4.5mg/l-5.5mg/l, 2.5mg/l-6mg/l, and 3mg/l-7mg/l during pre-monsoon, monsoon and postmonsoon seasons respectively.

Sl.No.	Parameter	SITE NUMBER										
			1	2	3	4	5	6	7	8	9	10
1	Temperature (^{0}C)	Premonsoon:	28.5 ±0.88	28.35 ±1.13	28.1 ±0.42	28.03 ±0.55	27.73 ±0.68	27.7 ±0.74	27.25 ±0.49	27.45 ±0.44	27.88 ±0.75	28.13± 0.65
		Monsoon:	27.2 ±0.60	27.45 ±0.59	27.7 ±0.62	27.37 ±0.56	27.77 ±0.69	27.57 ±0.84	27.75 ±0.64	27.75 ±0.76	28.25 ±0.7	28.35± 0.54
		Postmonsoon:	27.27 ±0.38	27.42 ±0.39	27.4 ±0.41	27.75 ±0.38	27.8 ±0.36	27.85 ±0.25	28.2 ±0.64	28.4 ±0.62	28.6 3±0.56	28.73± 0.51
2	Total dissolved solids (mg/l)	Premonsoon	20.95 ±3.24	20.61 ±5.26	20.45 ±5.96	20.09 ±6.98	19.44 ±5.18	19.91 ±6.70	17.54 ±4.13	19.68 ±6.02	19.56 ±2.35	19.22± 5.27
		Monsoon	30.66 ±11.56	32.63 ±6.37	30.49 ±10.49	32.75 ±6.95	34.44 ±11.31	37.86 ±10.52	31.8 ±14.58	33.93 ±11.01	33.16 ±11.95	31.87± 13.66

		Postmonsoon	28.48 ±11.69	28.98 ±13.30	32.75 ±16.16	33.38 ±16.21	31.8 ±12.54	31.28 ±11.25	29.18 ±11.40	31.05 ±16.20	31.4 ±15.59	31.08± 14.96
3	Turbidity (NTU)	Premonsoon	4.02 ±0.49	4.98 ±1.31	4.75 ±0.85	3.92 ±1.16	4.22 ±1.69	5.02 ±1.13	4.03 ±1.57	5.28 ±1.96	5.80 ±2.1	6.06 ±1.86
		Monsoon	6.78 ±1.43	6.63 ±0.8	6.72 ±2.64	6.53 ±1.39	7.40 ±1.13	7.71 ±1	8.03 ±1.20	8.34 ±1.27	8.52 ±0.79	8.53 ±1.07
		Postmonsoon	6.28 ±1.76	5.09 ±0.39	6.75 ±1.99	5.83 ±1.15	6.68 ±2.11	5.52 ±2.30	6.70 ±1.30	6.4 ±1.93	6.29 ±1.58	7.05 ±1.47
4	Conductivity (µmhos/cm)	Premonsoon	37.8 ±3.03	48.78 ±20.01	38.95 ±4.73	45.32 ±14.43	41.48 ±8.36	78.11 ±45.72	45.78 ±9.48	64.9 ±21.49	60.28 ±17.85	45.7 ±2.76
		Monsoon	62.68 ±15.66	55.25 ±17.59	54 ±32.09	70.35 ±16.88	85.28 ±35.28	87.53 ±43.87	60.88 ±29.28	53.53 ±20.77	45.25 ±7.52	44.85± 10.06
		Postmonsoon	47.7 ±7.28	47.42 ±15.05	56.67 ±18.72	54.5 ±28.29	46.65 ±22.78	68.55 ±28.95	54.15 ±15.50	48 ±18.14	44.57 ±7.40	45.72± 14.34
5	pH	Premonsoon	6.75 ±0.13	6.82 ±0.15	7 ±0.27	6.95 ±0.24	6.77 ±0.05	7.07 ±0.38	7.45 ±0.37	7.5 ±0.08	7.65 ±0.24	7.6 ±0.29
		Monsoon	6.82± 0.05	6.85±0.06	6.9 ±0.24	6.85 ±0.06	6.75 ±0.17	6.82 ±0.15	7.05 ±0.39	7.05 ±0.39	7.05 ±0.39	7 ±0.24
		Postmonsoon	6.87 ±0.05	6.9 ±0.08	6.87 ±0.12	6.92 ±0.12	6.9 ±0.08	6.97 ±0.15	7.05 ±0.06	7.02 ±0.21	7.1 ±0.41	7.13 ±0.39
6	Total hardness (mg/l)	Premonsoon	6 ± 2.31	8 ±3.65	9.5 ±2.52	11 ±3.46	8.5 ±4.12	10 ±3.65	10 ±2.83	9.5 ±2.52	8.5 ±3.42	10 ±2.31
		Monsoon	10 ±3.65	9.5 ±4.12	8.5 ±3.79	8 ±5.42	7.5 ±3.42	8.5 ±2.52	9.5 ±1.91	8.5 ±1.91	7 ±2.58	7 ±2.58
		Postmonsoon	9.5 ±1.91	8.5 ±3	9 ±2.58	9 ±3.83	11 ±3.46	11 ±4.16	9 ±4.16	9.5 ±5	9.5 ±4.3	7.33 ±5.77
7	Alkalinity (mg/l)	Premonsoon	12 ±0	10.67 ±2.31	12 ±0	11 ±2	12±3.265	11 ±2	10 ±2.31	12 ±3.27	14 ±2.31	12 ±3.27
		Monsoon	9 ±2	10 ±4	9 ±3.83	11 ±2	10 ±4	9 ±2	10 ±2.31	12 ±0	11 ±2	9 ±2
		Postmonsoon	9 ± 3.83	10 ± 2.31	8 ±3.27	11 ±2	11 ±2	10 ±4	10 ±5.16	8 ±3.27	7 ±3.83	10 ±4
8	Acidity (mg/l)	Premonsoon	5 ± 1.15	4.5 ±1	5 ±1.15	5.5 ±3.42	5 ±1.15	5 ±1.15	4 ±1.63	4.5 ±1.91	4.5 ±1	5 ±1.15
		Monsoon	3.5 ±1	5.5 ±1	2.5 ±1	6 ±2.82	5.5 ±1.91	5 ±1.55	5.5 ±1	6 ±2.82	5 ±1.15	4 ±1.63

		Postmonsoon	7 ±2	5.5 ±1	5.5 ±1	6 ±2.31	5.5 ±1.91	5.5 ±1	4.5 ±1.91	3± 1.15	3± 1.15	3± 1.15
9		Premonsoon	8.57 ±0.9	8.12 ±1.04	9.02 ±0	8.57 ±0.9	10.38 ±1.73	10.38 ±1.73	10.83 ±2.09	12.19 ± 0.90	12.64 ±1.47	12.63± 1.47
		Monsoon	8.12± 1.04	7.66 ±1.73	7.22 ±1.47	7.22 ±1.47	9.22 ±0.41	8.42 ±2.76	9.02 ±2.08	10.43 ±1.82	11.39 ±1.85	11.46± 1.73
		Postmonsoon	7.22 ±1.48	6.77 ±0.91	7.22 ±1.47	8.15 ±1.008	9.92 ±1.04	9.47 ±1.73	10.48 ±1.85	11.79 ±1.85	12.19 ±0.91	12.24± 0.95
10	Dissolved oxygen (mg/l)	Premonsoon	7.9 ±0.76	7.9 ±0.76	7.7 ±0.46	7.9 ±0.4	6.7 ±0.4	7.15 ±0.91	6.87 ±1.07	6.37 ±0.55	6.17 ±0.93	5.65 ±0.98
		Monsoon	8.9 ±0.59	8.05 ±0.51	8.25 ±0.46	7.55 ±0.37	6.97 ±0.97	7.25 ±0.66	8.15 ±0.54	7.27 ±0.37	7.17 ±0.71	7.25 ±0.57
		Postmonsoon	8.1 ±0.16	8.17 ±0.5	7.95 ±0.25	8.12 ±0.33	7.9 ±0.28	8.12 ±0.37	7.8 ±0.53	7.55 ±0.52	7.5 ±0.54	6.87 ±0.29
11	BOD (mg/l)	Premonsoon	1.9 ±0.87	1.4 ±0.23	1.2 ±0.56	1.25 ±0.96	1.05 ±0.5	1.4 ±0.4	2.25 ±0.79	1.87 ±0.41	1.85 ±1.07	1.45 ±0.6
		Monsoon	2.5 ±1.16	2.55 ±0.86	1.87 ±0.48	1.32 ±0.94	1.62 ±0.56	2.25 ±1.84	0.95 ±0.40	1.75 ±1.30	1.42 ±0.51	0.57 ±0.23
		Postmonsoon	1.05 ±0.1	1.12 ±0.43	2.48 ±1.05	2.45 ±1.03	1.92 ±1.02	2.42 ±0.91	1.9 ±0.96	2.42 ±1.54	2.82 ±0.92	3.02 ±0.41

Table1. Seasonal variations in physico chemical parameters during the study period.

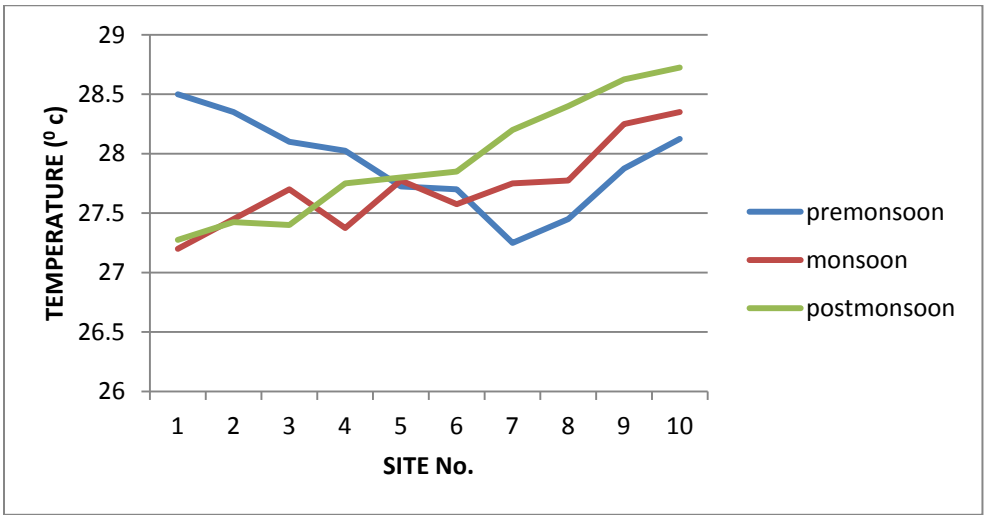


Fig.1. Seasonal variations of temperature.

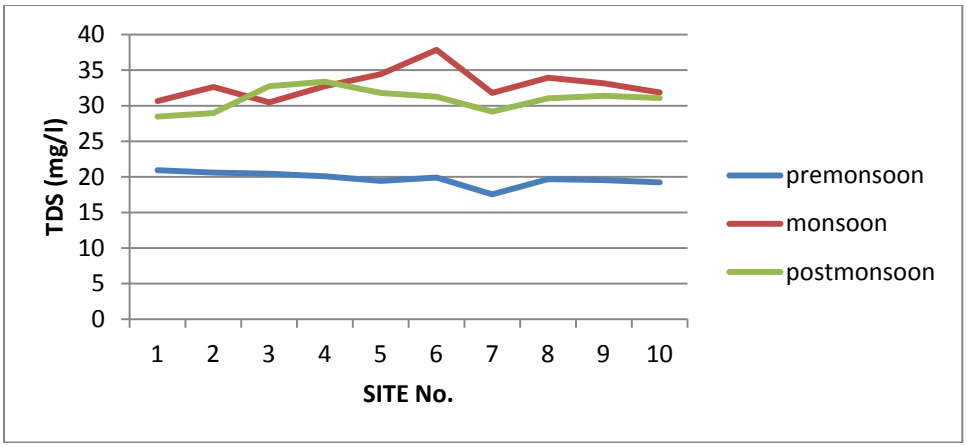


Fig. 2. Seasonal variation of TDS.

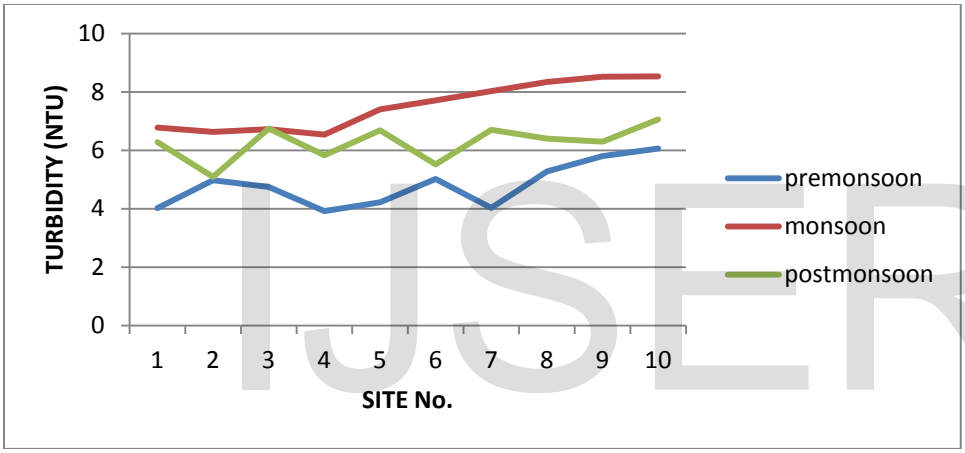


Fig. 3. Seasonal variations of turbidity

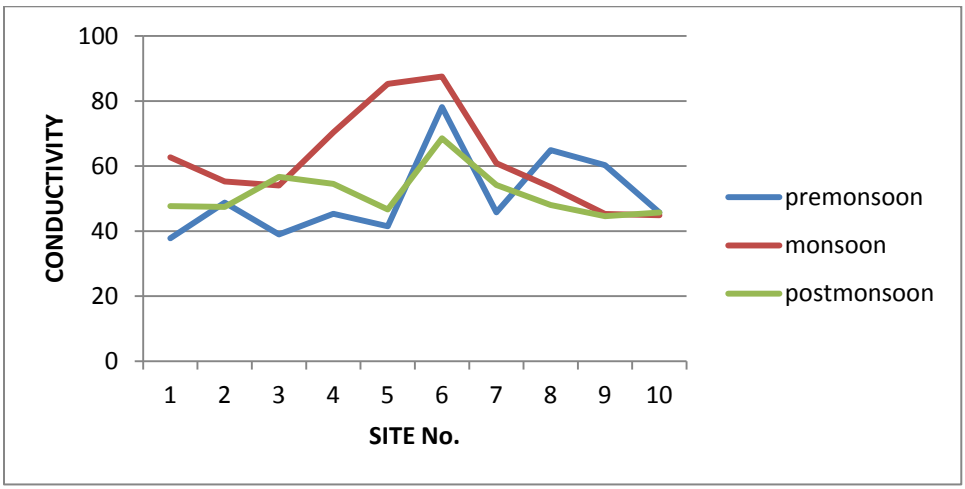


Fig. 4. Seasonal variation in conductivity.

Fig. 5. Seasonal variations of pH.

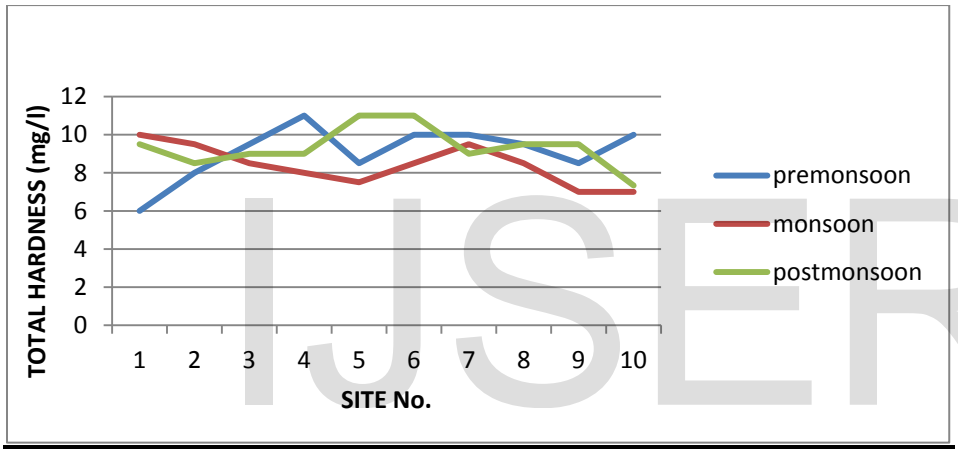


Fig. 6. Seasonal variation in total hardness

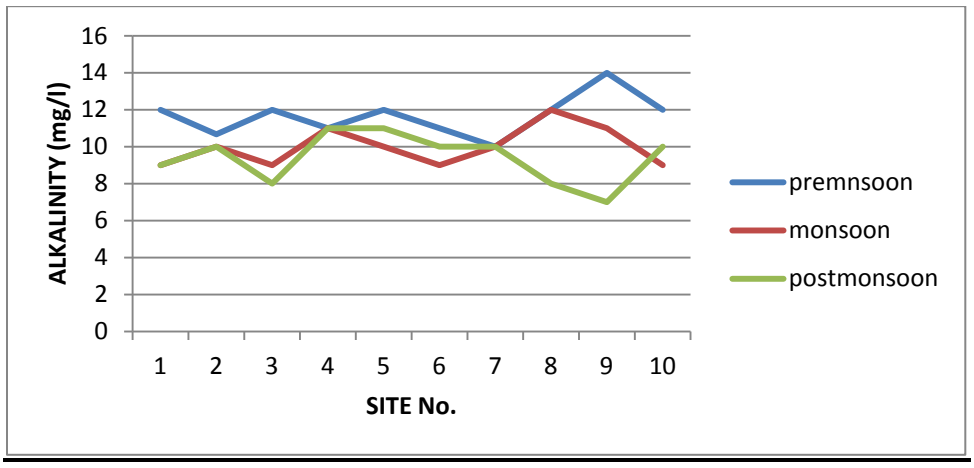


Fig. 7. Seasonal variations of alkalinity.

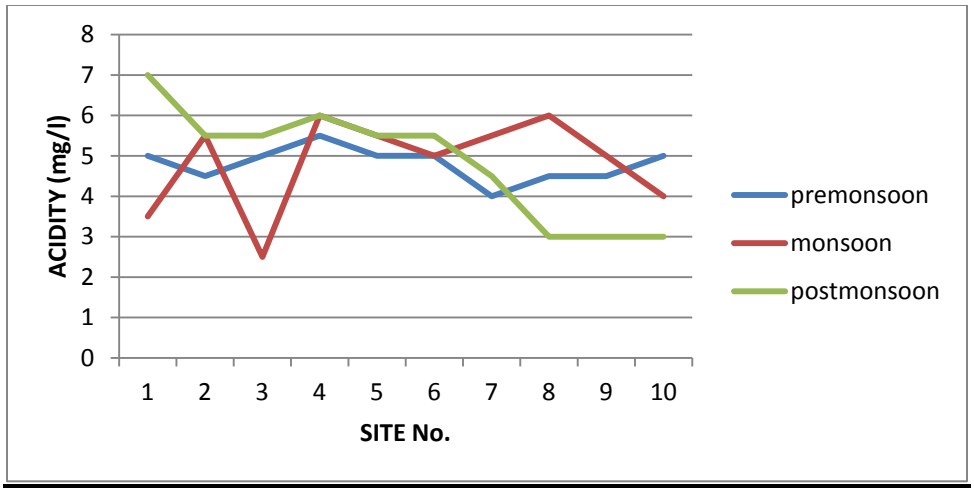


Fig. 8. Seasonal variations of acidity.

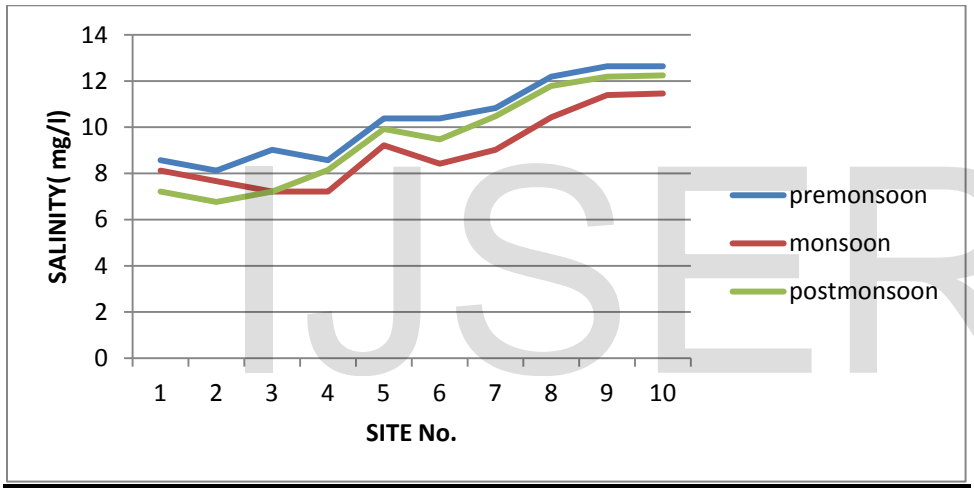


Fig. 9. Seasonal variations of salinity

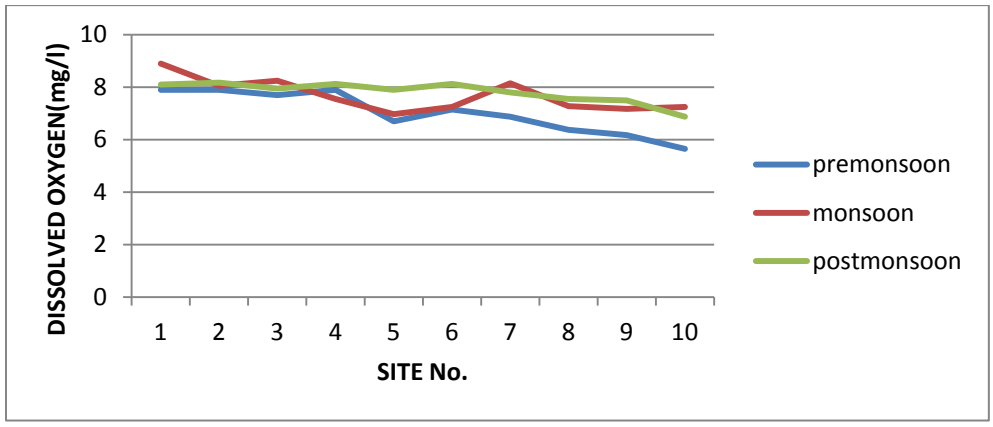


Fig. 10. Seasonal variations of dissolved oxygen.

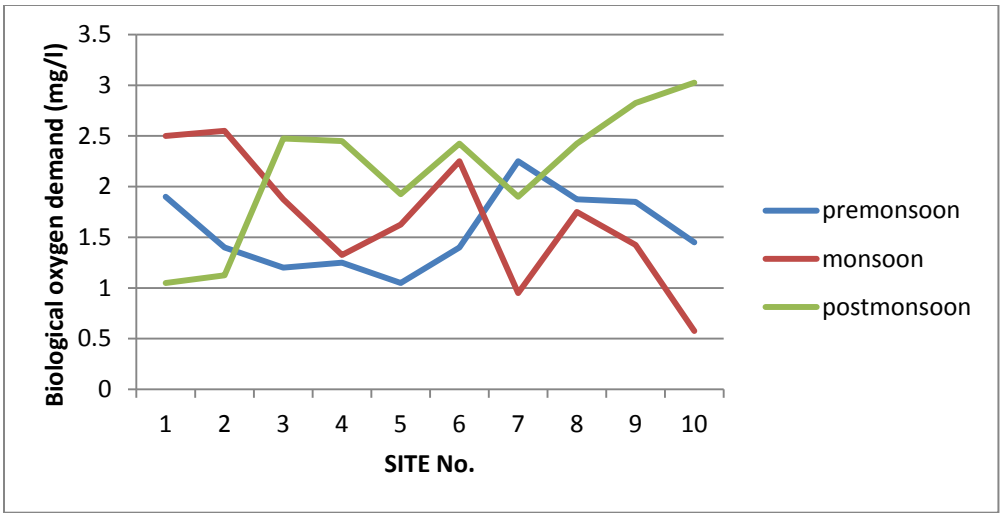


Fig. 11. Seasonal variations of BOD.

CONCLUSION

The present study reveals that water quality in terms of physico chemical parameters at studied sites is well within the limits and can be used for irrigation and bathing without any treatment and, can be used for domestic purposes, after treatment.. Since the quality of water is usually described according to its physical, chemical and biological characteristics, it is desirable to monitor water resources regularly to prevent the outbreak of diseases.

ACKNOWLEDGEMENT

The author acknowledges University Grants Commission of India for awarding FDP to carry out this research work.

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