Environment Conservation Journal 16(3) 1-8, 2015
ISSN 0972-3099 (Print) 2278-5124 (Online)
Abstracted and Indexed

Comparative analysis of seasonal variations in physico-chemical parameters from Girna, Ozarkhed, Chankapur and Gangapur reservoirs in Nasik district.(M.S.)

Rahane Balasaheb[1]✉, Waykar Bhalchandra[2] and Bhalla Resham[3]

Received: 30.07.2015 **Revised: 28.09.2015** **Accepted: 5.10.2015**

Abstract

The seasonal physico-chemical parameters like temperature, pH, total alkalinity, dissolved oxygen, total hardness, chlorides, salinity and electrical conductivity were determined seasonally from Girna, Ozarkhed, Chankapur and Gangapur reservoirs of Nasik district. Results of the present study indicated that the mean values of temperature, pH and total alkalinity were highest in summer season and lowest in winter season, mean values of dissolved oxygen was highest in winter season and lowest in summer season. The mean values of total hardness, salinity, chloride and electrical conductivity were highest during summer season and lowest during monsoon, in surface water sampled from four studied reservoirs. Thus result clearly indicated that the surface water of Girna reservoir was more polluted than other three reservoirs, while surface water of Gangapur reservoir was less polluted than other three studied reservoirs.

Keywords: Physico-chemical parameters, reservoir, seasonal variations

Introduction

Water quality is affected by both point and non-point sources of pollution. These include sewage discharge, discharge from industries, run-off from agricultural fields and urban run-off containing various organic and inorganic pollutants, such as solvents, oils, heavy metals, pesticides and fertilizers are invariably discharged into small rivers, streams without their proper treatments (Pandey et.al., 2003). Such contaminants change the water quality and may affect the aquatic life and humans (Chang et.al., 1998; Kara and Comlekci, 2004) and is not suitable for drinking, industrial and irrigation. Therefore, regular monitoring of water quality is essential. The monitoring and assessment of water quality is depending upon the basic physico-chemical properties of water. Therefore in the present study the physico-chemical parameters like temperature, pH, total alkalinity, dissolved oxygen, total hardness, chlorides, salinity and electrical conductivity were determined seasonally from Girna, Ozarkhed, Chankapur and Gangapur reservoirs of Nasik district.

Author's Address

[1] Department of Zoology, Swami Muktanand College of Science, Yeola, District.Nashik Maharashtra, India.

[2]Department of Zoology, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad, Maharashtra, India.

[3] Department of Zoology**,** LVH Arts, Sci. & Comm. College, Panchavati, Nashik-3 Maharashtra, India.

E-mail: balasahebrahane2011@rediffmail.com

Study Area

Four reservoirs of Nasik district were selected for the study. The details are given below:

Girna reservoir: Girna reservoir is earthen dam constructed in 1969 on Girna river at Nandgaon in Nasik district of Maharashtra state, India. Geographically, reservoir is located at 20°29'16" N and 74°39'41" E. The total capacity of reservoir is 525,920 Km^3 (126,170 cu mi) and surface area is 60,040 Km^2 (23,180 sq mi). The height of reservoir is 54.56 m and the length is 963.17m. The volume content of reservoir is 2,042 Km^3 (490 cu mi) and gross storage capacity is 608,980.00 Km^3 (146,102.07 cu mi). The reservoir water is used for irrigation, industrial as well as for drinking purpose.

Ozarkhed reservoir: Ozarkhed reservoir is earthen reservoir, constructed in 1982 on Unanda river at Dindori in Nasik district of Maharashtra state, India. Geographically, Ozarkhed reservoir is located at 20° 16′ 48.11″ N and 73° 52′ 33.2″ E. The surface area of reservoir is 6880 Km^2 (2660 sq mi). The height of reservoir is 35.3m and the length is 3266m. The volume content of reservoir is 2052 Km^3 (492 cu mi) and gross storage capacity is 67950.00 Km^3 (16302.07 cu mi). The reservoir water is used mainly for irrigation as well as drinking purpose.

Chankapur reservoir: Chankapur reservoir is earthen reservoir, constructed in 1911 on Girna river at Kalwan in Nashik district of Maharashtra state, India. Geographically, reservoir is located at 73°53′00″E and 20.4988632°N. The surface area of reservoir is 10320 Km^2 (3980 sq mi). The height of reservoir is 41m and length is 3705m. The total capacity of reservoir is 76850 Km^3 (18440 cu mi). The volume content of reservoir is 509 cu mi and gross storage capacity is 19118.65 cu mi. The reservoir water is used mainly for irrigation, industry as well as for drinking purpose.

Gangapur reservoir: Gangapur reservoir, 10 km away from Nasik city is an earthen dam, constructed in 1954 on Godavari river. Geographically, Gangapur reservoir is located at 20.0261° N and 73.6672° E. The total catchment area of the dam is 357.4 Sq.km. The height of reservoir is 36.57m and length is 3810m. The surface area of reservoir is 22,860 Km^2 (8830 sq mi). The volume content of reservoir is 4612 Km^3 (1106 cu mi) and total gross storage capacity is 215.88 MCM. The reservoir water is used mainly for irrigation as well as drinking water purpose. The reservoir has two canals, the left bank canal is 64 Km long and right bank canal is 30 Km long. The water of reservoir is used for irrigation and for drinking purpose.The total irrigable area of this reservoir is 15960 hectares.

Materials and Method

For physicochemical analysis, water samples were collected seasonally (summer, monsoon and winter seasons) from different places of four reservoirs of Nasik district during November 2010 to October 2011 at 8.30 am, in triplicates and mixed together for each location so as to portray the average condition in the respective area. The water samples were collected from depth of 5-10 cm below the surface water in acid washed plastic bottles. Temperature was measured directly on field by thermometer; pH measurement was carried out by a pH meter (Elico LI 120). Separate samples were collected for dissolved oxygen (DO) in 250 ml bottles and dissolved oxygen was fixed in the field by adding alkali reagent. The samples analyses were carried out immediately after return to the laboratory. Physico-chemical parameters like total alkalinity, O_2, total hardness, salinity, chloride, electric conductivity were determined seasonally in summer, monsoon and winter seasons by standard method (APHA *et. al.*, 1998).

Results and Discussion

The physico-chemical parameters like temperature, pH, total alkalinity, dissolved oxygen, total hardness, chlorides, salinity and electrical conductivity were determined seasonally in water samples collected from Girna, Ozarkhed, Chankapur and Gangapur reservoirs of Nasik district and obtained data are summarized in table.no. 1 and figure No. 1 (a to h).

Temperature: In summer season the mean temperature values were 27.12^{0}C, 27.08^{0}C, 26.92^{0}C and 27.21^{0}C, in monsoon season values were 24.08^{0}C, 23.94^{0}C, 24.05^{0}C and 24.61^{0}C, while in winter season values were 20.48^{0}C, 20.52^{0}C, 20.73^{0}C and 21.42^{0}C at Girna, Ozarkhed, Chankapur and Gangapur reservoirs respectively. Temperature is important parameter which affects dissolve oxygen, rate of photosynthesis and distribution of biota. In the present study variation in mean values of temperature was observed at four reservoirs during three seasons. Jha and Bharat (2003) reported a significant fluctuation in temperature between summer and rainy seasons.

pH: In summer season the mean pH values at Girna, Ozarkhed,Chankapur and Gangapur reservoirs were 8.31, 8.03, 7.68 and 7.53 respectively. In monsoon season values were 8.01, 7.61, 7.43 and 7.21 respectively, while in winter season values were 7.60, 7.19, 7.03 and 6.92 respectively. In the present investigation high pH values were recorded, might be due to heavy input of textile, printing, dyeing and other industrial waste and municipal waste, which contain higher amount of carbonate and bicarbonates in water (Kalff and Knoechel, 1998). Richardson (1988) reported that heavy contamination of water alter the physico-chemical properties of water. Dehadri (1990) reported that the direct discharge of industrial effluents and runoff comprising versatile chemicals deplete the dissolved oxygen, altering pH, increase the CO_2 level in the water. Srilakshmi (1995) reported that pollutants alter the pH of the water.

Total Alkalinity: During summer season the mean total alkalinity values were 151.29, 141.23,

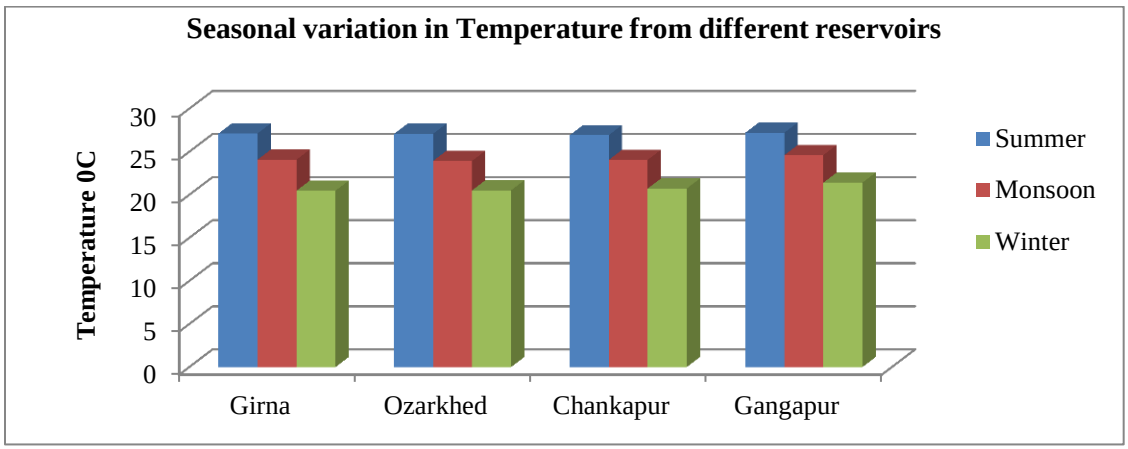
135.37and 132.13 (mg/l) respectively at Girna, Ozarkhed, Chankapur and Gangapur reservoirs. In monsoon season values were 114.08, 102.39, 101.24 and 98.62 (mg/l) respectively. In winter season values were 81.56, 73.52, 71.08 and 68.67 (mg/l) respectively. In the present investigation higher values of alkalinity were observed in surface water sampled from Girna reservoir than other studied reservoirs was attributable to inflow of huge amount of municipal waste, textile and other industrial effluents and run-off from agricultural field. Kataria et al., (1996) stated that higher alkalinity values are due to confluence of industrial and domestic waste.

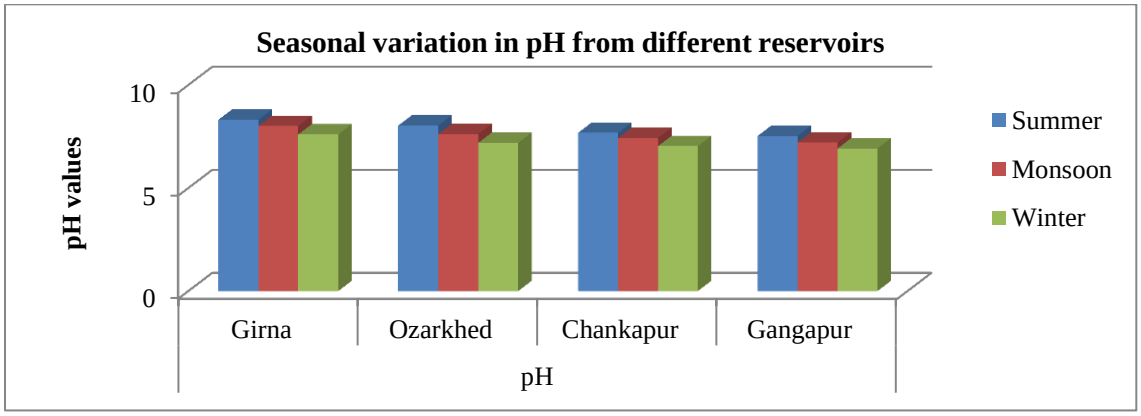
Table 1 : Seasonal variations of Physico-chemical parameters from different reservoirs of Nasik district and highest permitted value for drinking water (WHO standard, 1993 mg/l)

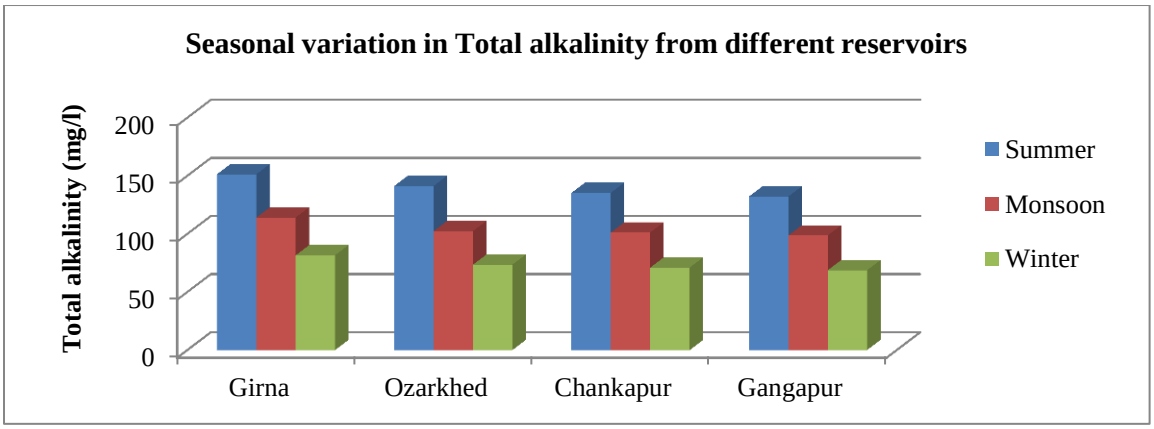
Parameters	Name of reservoir	Seasons			
		Summer	Monsoon	Winter	Highest Permitted value for drinking water (WHO standared, 1993 mg/L)
Temperature ^{0}C	Girna reservoir	27.12 ± 1.35	24.08 ± 1.26	20.48 ± 0.94	
	Ozarkhed reservoir	27.08 ± 1.23	23.94 ± 1.32	20.52 ± 1.03	
	Chankapur reservoir	26.92 ± 1.21	24.05 ± 1.22	20.73 ± 1.05	
	Gangapur reservoir	27.21 ± 1.12	24.61 ± 1.27	21.42 ± 1.07	
pH	Girna reservoir	8.31 ± 0.85	8.01 ± 0.82	7.60 ± 0.52	
	Ozarkhed reservoir	8.03 ± 0.81	7.61 ± 0.77	7.19 ± 0.72	
	Chankapur reservoir	7.68 ± 0.76	7.43 ± 0.74	7.03 ± 0.78	
	Gangapur reservoir	7.53 ± 0.79	7.21 ± 0.72	6.92 ± 0.82	6.5 - 8.5
Total alkalinity (mg/l)	Girna reservoir	151.29 ± 2.04	114.08 ± 1.64	81.56 ± 1.18	
	Ozarkhed reservoir	141.23 ± 2.35	102.39 ± 1.82	73.52 ± 1.27	
	Chankapur reservoir	135.37 ± 2.61	101.24 ± 1.92	71.08 ± 1.43	
	Gangapur reservoir	132.13 ± 2.34	98.62 ± 1.74	68.67 ± 1.82	200 mg/L
Dissolved oxygen (mg/l)	Girna reservoir	6.78 ± 0.43	7.38 ± 0.62	9.31 ± 0.82	
	Ozarkhed reservoir	6.93 ± 0.52	7.87 ± 0.72	9.58 ± 0.74	No guidelines
	Chankapur reservoir	7.15 ± 0.47	7.96 ± 0.78	9.76 ± 0.69	
	Gangapur reservoir	7.21 ± 0.44	8.03 ± 0.79	9.92 ± 0.71	
Total hardness (mg/l)	Girna reservoir	163.27 ± 5.12	108.41 ± 3.47	134.78 ± 3.69	
	Ozarkhed reservoir	152.94 ± 4.65	99.62 ± 3.46	125.42 ± 3.82	
	Chankapur reservoir	141.67 ± 4.24	96.28 ± 3.12	119.46 ± 3.80	
	Gangapur reservoir	138.99 ± 3.91	94.81 ± 3.04	115.62 ± 3.76	300 mg/L
Salinity (mg/l)	Girna reservoir	112.51 ± 2.27	72.46 ± 1.73	107.93 ± 2.16	
	Ozarkhed reservoir	107.25 ± 2.08	66.68 ± 1.47	96.13 ± 1.79	
	Chankapur reservoir	101.69 ± 2.38	62.25 ± 1.54	92.28 ± 1.64	
	Gangapur reservoir	96.49 ± 2.71	56.53 ± 1.62	90.37 ± 1.52	No guidelines
Chlorides (mg/l)	Girna reservoir	62.28 ± 1.42	40.11 ± 1.05	59.74 ± 1.32	
	Ozarkhed reservoir	59.37 ± 1.59	36.91 ± 1.23	53.21 ± 1.29	
	Chankapur reservoir	56.29 ± 1.37	34.46 ± 1.32	51.08 ± 1.15	
	Gangapur reservoir	53.41 ± 1.42	31.29 ± 1.42	50.02 ± 1.18	250 mg/L
Electrical conductivity (µmho/cm)	Girna reservoir	358.09 ± 8.39	213.41 ± 4.28	241.29 ± 5.43	
	Ozarkhed reservoir	329.67 ± 6.32	201.54 ± 5.42	215.81 ± 6.81	
	Chankapur reservoir	316.72 ± 7.48	193.72 ± 5.68	212.05 ± 5.34	
	Gangapur reservoir	312.09 ± 6.82	187.86 ± 5.71	207.88 ± 6.13	250-750 (µmho/cm)

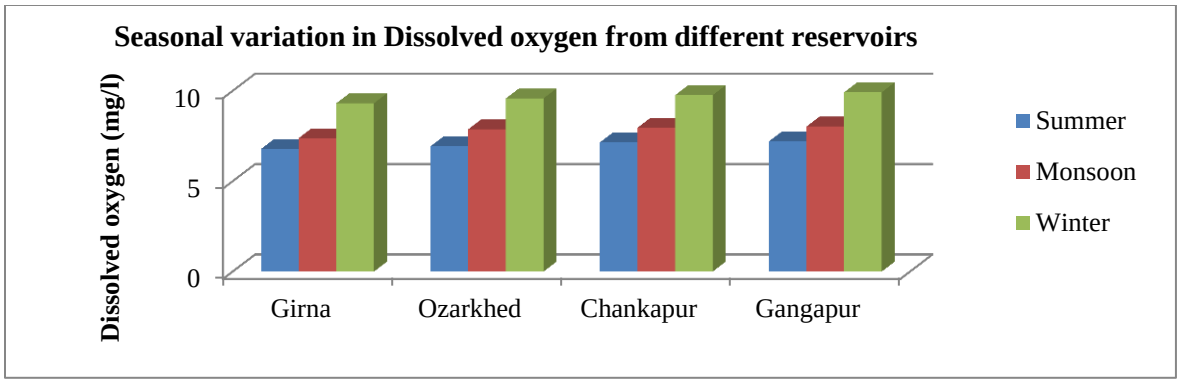
Dissolved Oxygen: In summer season the mean dissolved oxygen values were 6.78, 6.93, 7.15 and 7.21 (mg/l), in monsoon season values were 7.38, 7.87, 7.96 and 8.03 (mg/l), while in winter season values were 9.31, 9.58, 9.76 and 9.92 (mg/l) at Girna, Ozarkhed, Chankapur and Gangapur reservoirs respectively. Dissolved oxygen is a key parameter reflecting the quality of the water.

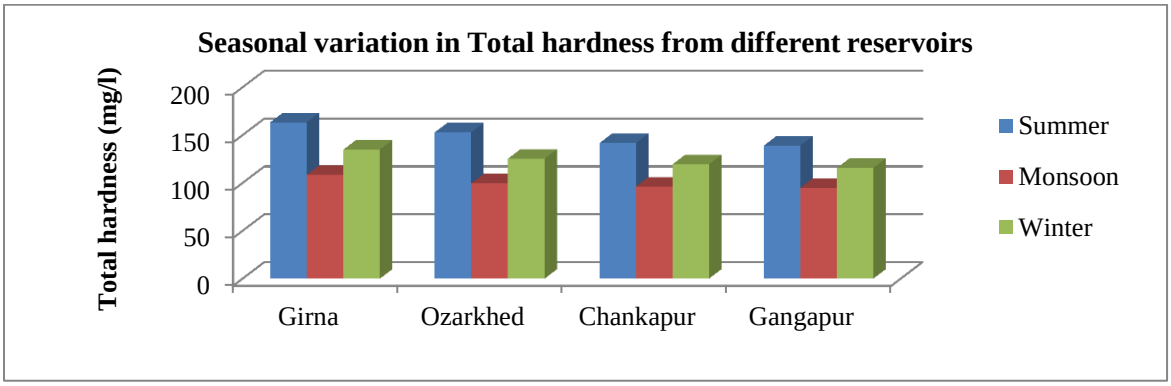
Figure 1 (a) : Physico-chemical parameters from different reservoirs of Nasik district and highest permitted value for drinking water (WHO standard, 1993 mg/l)

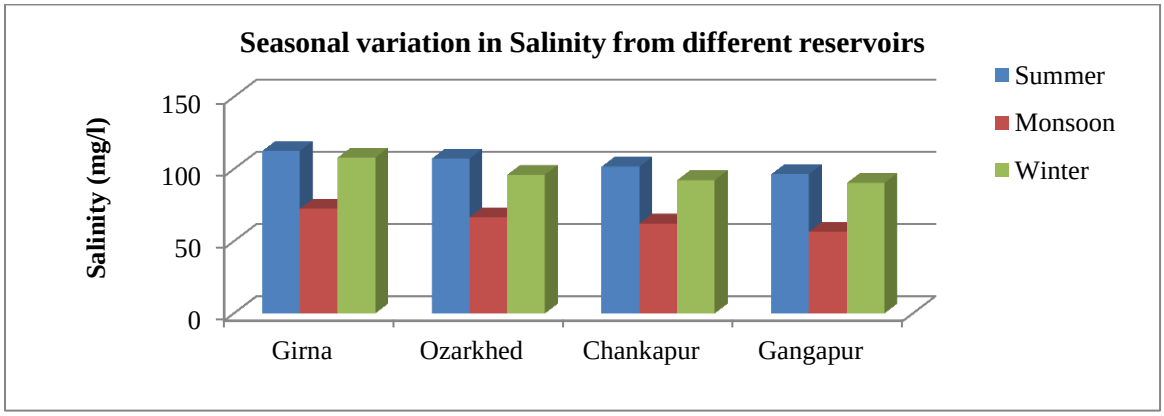


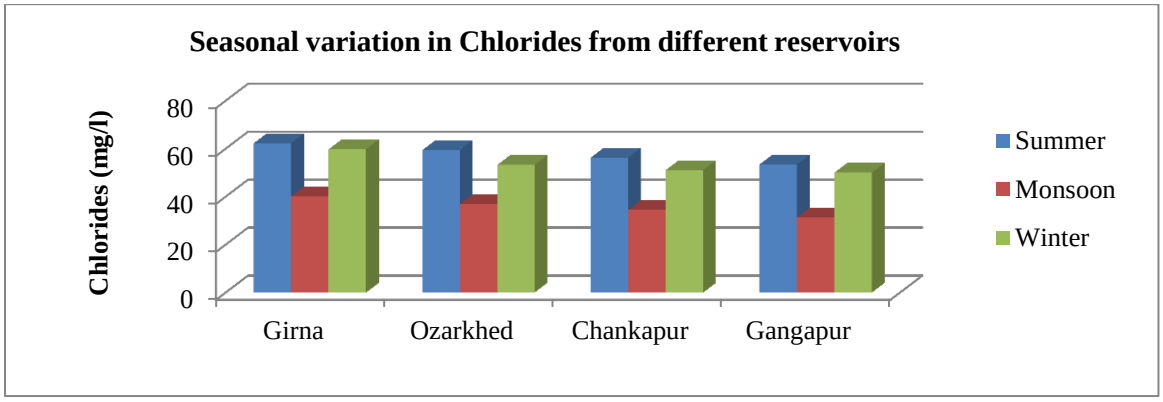


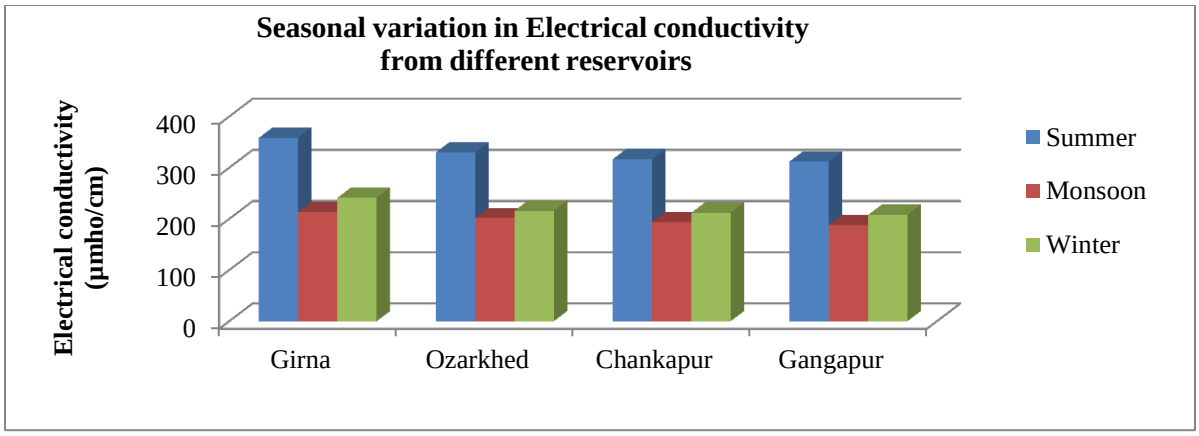



Seasonal variation in Dissolved oxygen from different reservoirs
Dissolved oxygen (mg/l)
10
5
0
Girna
Ozarkhed
Chankapur
Gangapur
Summer
Monsoon
Winter


Seasonal variation in Total hardness from different reservoirs
Total hardness (mg/l)
200
150
100
50
0
Girna
Ozarkhed
Chankapur
Gangapur
Summer
Monsoon
Winter


Seasonal variation in Salinity from different reservoirs
Salinity (mg/l)
150
100
50
0
Girna
Ozarkhed
Chankapur
Gangapur
Summer
Monsoon
Winter


Seasonal variation in Chlorides from different reservoirs
Chlorides (mg/l)
80
60
40
20
0
Girna
Ozarkhed
Chankapur
Gangapur
Summer
Monsoon
Winter



In the present investigation compared to other reservoirs low level of O_2 and higher values of CO_2 were observed at Girna reservoirs, this might be due to decomposition of organic waste. Bhalla et.al, (2012) reported that high values of free CO_2 in water may be due to discharge of domestic waste, inflow of sewage and mostly due to decomposition of organic waste. Deshmukh (2013) reported lower values of O_2 and higher values of CO_2 at higher polluted site than less polluted sites of Jayakwadi reservoir.

Total Hardness: The mean total hardness values in summer season at Girna, Ozarkhed, Chankapur and Gangapur reservoirs were 163.27, 152.94, 141.67 and 138.99 (mg/l) respectively. In monsoon season values were 108.41, 99.62, 96.28 and 94.81 (mg/l) respectively, while in winter season values were 134.78, 125.42, 119.46 and 115.62 (mg/l) respectively. In the present investigation higher values of hardness were observed at Girna reservoir, might be due to input of industrial and domestic waste. Kumar (1995) reported that hardness of water is higher due to domestic waste and human activities.

Salinity: In summer season mean salinity values were 112.51, 107.25, 101.69 and 96.49 (mg/l), in monsoon season values were 72.46, 66.68, 62.25 and 56.53 (mg/l), while in winter season values were 107.93,96.13,92.28 and 90.37 (mg/l) respectively at Girna, Ozarkhed, Chankapur and Gangapur reservoirs respectively. La Fond (1954) reported that the freshwater released from rivers cause a decline in the salinity of the surface water during the monsoon and restoration occurs as the salinity continuously increase from post-monsoon to summer. Varma and Reddy (1959) and Subramanyan and Gupta (1965) reported similar trend of salinity in the coastal waters from southeast coast of India.

Chloride: In summer season the mean chloride content values were 62.28, 59.37, 56.29 and 53.41 (mg/l) at Girna, Ozarkhed, Chankapur and Gangapur reservoirs respectively. In monsoon season values were 40.11, 36.91, 34.46 and 31.29 (mg/l), while in winter season values were 59.74, 53.21, 51.08 and 50.02 (mg/l) respectively. Higher chloride content might be due to input of textile, printing, dyes and other industrial effluent as well as domestic waste. According to Sawyer and Mccarty (1978) the chloride content normally increases with increase in mineral content. Haslam (1991) reported that the sewage water and industrial effluents are rich in high chloride and therefore the release of these wastes result in high chloride level in fresh water.

Electrical Conductivity: During summer season the mean electrical conductivity value were 358.09, 329.67, 316.72 and 312.09 (µmho/cm), in monsoon season values were 213.41, 201.54, 193.72 and 187.86 (µmho/cm), while in winter season values were 241.29, 215.81, 212.05 and 207.88 (µmho/cm) at Girna, Ozarkhed, Chankapur and Gangapur reservoirs respectively. Conductivity is the measures of ability of water to conduct electric current and is influenced by dissolved salts present in water body. Bawa and Gaikwad (2013) reported that conductivity values were higher at Dasak bridge sampling station because it receives domestic sewage and industrial effluents. Kohle et.al., (2014) reported that high electrical

conductivity of water indicates accumulation of salts in the water.

Conclusion

Results of the present study indicated that the mean values of temperature, pH and total alkalinity were highest in summer season and lowest in winter season, mean values of dissolved oxygen was highest in winter season and lowest in summer season. The mean values of total hardness, salinity, chloride and electrical conductivity were highest during summer season and lowest during monsoon, in surfaces water sampled from four studied reservoirs. Overall results of the present study showed the higher values of pH, total alkalinity, total hardness, chlorides, salinity, electrical conductivity and lowest values of dissolved oxygen in surface water sampled from Girna reservoir than Ozarkhed, Chankapur and Gangapur reservoirs. On other hand results also showed lowest values of pH, total alkalinity, total hardness, chlorides, salinity, electrical conductivity and highest dissolved oxygen in surface water sampled from Gangapur reservoir than Girna, Ozarkhed, Chankapur reservoirs. Compare to Girna reservoir, Ozarkhed reservoir showed lowest values of pH, total alkalinity, total hardness, chlorides, salinity, electrical conductivity and higher values of dissolved oxygen. This indicates Ozarkhed reservoir received less pollutant than Girna reservoir. Compare to Ozarkhed reservoir, Chankapur reservoir showed lowest values of pH, total alkalinity, total hardness, chlorides, salinity, electrical conductivity and higher values of dissolved oxygen. This indicates Chankapur reservoir received less pollutant than Ozarkhed reservoir. Compare to Chankapur reservoir, Gangapur reservoir showed lowest values of pH, total alkalinity, total hardness, chlorides, salinity, electrical conductivity and higher values of dissolved oxygen. This indicates Gangapur reservoir received less pollutant than Chankapur reservoir. Thus result clearly indicated that the surface water of Girna reservoir was more polluted than other three reservoirs, while surface water of Gangapur reservoir was less polluted than other three studied reservoirs.The observed values of physico-chemical parameters was due to anthropogenic input through run-off from agricultural field, domestic waste, brick industry waste, runoff from traffic and high boating activity due to ecotourism and fishing in the reservoir.

The study indicated that physicochemical parameters undertaken to assess the water quality of reservoirs of Nasik district were found to be below the permissible limit set by regulating agency (WHO, 1993). Therefore this study indicates that water of Girna, Ozarkhed, Chankapur and Gangapur reservoirs is suitable for drinking, irrigation and industrial purpose. Hence it is recommended that regular monitoring is needed to maintain water quality.

Acknowledgement

The authors gratefully acknowledge the Department of Zoology, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (M.S.) 431004, India, for providing laboratory facility for this work.

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