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Assessment of water quality (physicochemical) of Kanekal tank, Anantapuramu, Andhra Pradesh, India

V. N. Jayaram Naik, K. V. Ramanaiah, G. H. Philip

Department of Zoology, S K University, Anantapuramu, Andhra Pradesh, India

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Address for correspondence:
Prof. G. H. Philip, Department of Zoology, Sri Krishnadevaraya University, Anantapuramu - 515 003, Andhra Pradesh, India. E-mail: gundalahphilip@gmail.com

ABSTRACT

Different physicochemical parameters of Kanekal tank water, Kanekal, were estimated from October 2012 to September 2014 to assess its quality. The different parameters such as temperature, pH, total dissolved solids, conductivity, salinity, dissolved oxygen, turbidity, alkalinity, free carbon dioxide, chloride, total hardness, calcium, magnesium, phosphates, sulfates, silicates, nitrites, nitrates, biological oxygen demand, and chemical oxygen demand were carried out by standard methods. These parameters showed either positive or negative correlation between each other. The analysis reveals these parameters are interrelated with each other. From the data, it can be said that water of this tank is partially contaminated with human feces, domestic sewage, etc. Hence, it is not good quality for culture of fish as well as drinking for animals.

KEY WORDS: Biological oxygen demand, chemical oxygen demand, Kanekal tank, physicochemical parameters, water quality

INTRODUCTION

One of the most vital parts of ecosystems is lakes. It provides important habitat and food resources to the diverse aquatic life (Kini *et al.*, 2016). Kanekal tank is located at 4° 53'11" N, 77° 1'54" E. Kanekal is a small town situated in the Anantapuramu district, 100 km from district headquarters. This is an important freshwater tank in Anantapuramu district. It is a perennial tank into which water flow from Tungabhadra dam. This tank is used for culture of fish and this water is used for irrigation of different crops of this area. However, unfortunately, this tank is regularly used for fishing is done by the local people regularly besides water is used for washing animals, tractors, and clothes. Natural calamities are completed beside the tank and dumping of domestic solid water and wastewater due to this the tank has become polluted. This is a major concerned as it has been affected because of anthropogenic activities. The deterioration of water quality has affected aquatic life including fish cultures.

Andhra Pradesh has good number of lakes, tanks, and water bodies. Qualitative and quantitative hydrological investigations had been carried out in few water bodies lower manair reservoir of Karimnagar district (Thirupathaiah *et al.*, 2012), some selected freshwater fish ponds in Warangal area (Sandhya and Benarjee, 2016) investigation from our laboratory have shown that Singanamala tank and Dharmavaram tank in district of Anantapuramu have been affected and to the extent that water quality has deteriorated for human beings (Venkataramanaiah *et al.*, 2017). In India, much research has been carried out with regard to assessment of water quality of different tanks some of them are fish pond in Thanjavur (Kumar *et al.*, 2017), Kolong river (Sharma *et al.*, 2017), Bolinj Ram mandir talao (Kini *et al.*, 2016), Kadamba Tank (Karthick *et al.*, 2016), Urban Pond in Thiruvananthapuram district (Mol and Shaji, 2016), Water quality index at Athiyannoor panchayat (Sajitha and Vijayamma, 2016), Fish pond of Shahdol (Patel, 2016), Eutrophication costal lake (Abhijna, 2016), Lalpur pond (Patel, 2015), Two temple ponds of Karnataka (Shivalli and Giriyappanavar, 2015), and different pond water of Bilaspur district (Dixit *et al.*, 2015).

Due to uncontrolled increase in human population and urbanization at large, these freshwater bodies are under tremendous pressure owing to their overuse on the one hand and enrichment due to nutrients and organic matter on the other, leading to the cultural eutrophication (Yadav *et al.*, 2013). In view of the above, the present study revels with the assessment of physicochemical characteristics of freshwater tank situated at Kanekal, Anantapuramu district.

MATERIALS AND METHODS

Sample Collection and Analysis

Water samples were collected during the 1st week at monthly interval for 2 consecutive years from October 2012 to September 2014 for the assessment of physicochemical parameters. Water samples were collected in acid-washed 10 l polythene containers below the depth of 5–10 centimeters and collection was usually completed during morning hours between 08 am and 10 am. Color and odor of water was noticed and recorded. For each sample temperature, pH was monitored at the sampling site using mercury thermometer and digital pH meter. Immediately after arrival into the laboratory, the conductivity of the water was measured using the help of conductivity meter. All parameters were assessed by following standard methods. The chemicals used in the present investigations were procured from Merck India. All glassware used was of corning grade manufactured by Borosil India Ltd., spectrophotometer used for our research work was ELICO double beam, SL210, ultraviolet visual spectrophotometer. Systronics water analyzer 371 used with a microcontroller was used for measuring pH, dissolved oxygen (DO), conductivity, total dissolved solids (TDS), salinity, and turbidity in water sample. Six replicates of each sample were assessed for each parameter. Mean of the six replicates was taken for data analysis.

RESULTS AND DISCUSSION

Temperature

Temperature of water varied between 23.83 ± 0.40°C (December 2012) and 29.83 ± 0.25°C (May 2013) [Figure 1a]. Temperature showed significant positive correlation with turbidity, TDS, carbon dioxide, chlorides, silicates, and sulfates and negative correlation with conductivity, total hardness, DO, biological oxygen demand (BOD), chemical oxygen demand (COD), salinity, alkalinity, calcium, magnesium, phosphates, nitrates, and nitrites [Tables 1 and 2]. The temperature of water bodies varies with seasons. The water temperature varies with radiation of season as lowest in winter (December) and highest in summer (May) (Timade and Shinde, 2012; Mishra *et al.*, 2013).

pH

pH of water recorded was minimum in September 2014 (7.90 ± 0.08) and maximum in May 2013 (9.19 ± 0.24) [Figure 1b]. pH showed positive significant relation with conductivity, turbidity, TDS, total hardness, DO, alkalinity, chlorides, magnesium, silicates, phosphates, nitrates, and sulfates and pH showed negatively correlated with BOD, COD, carbon dioxide, salinity, calcium, and nitrites [Tables 1 and 2]. High values of pH during summer (May) might be low water levels and concentrations of nutrients in water and decrease pH values were due to dilution caused by rainwater during monsoon (September) (Shinde *et al.*, 2011; Verma *et al.*, 2011).

Conductivity

The monthly variability in conductivity of water has fluctuated between 1.29 ± 0.173 mS (January, 2013) and 8.72 ± 0.36 mS (May 2013) [Figure 1c]. Conductivity showed positive significant relation with DO, COD, carbon dioxide, alkalinity, chlorides, silicates, phosphates, nitrates, and sulfates and showed negative significant correlation with turbidity, TDS, total hardness, BOD, salinity, calcium, magnesium, and nitrites [Tables 1 and 2]. The high value of conductivity was recorded in the month of May due to higher temperature and stabilization of water to sedimentation and increased the concentration of salts, whereas low value was recorded in January month (Harney *et al.*, 2013; Mishra *et al.*, 2013).

Turbidity

The monthly fluctuation of turbidity of water varied between 3.49 ± 0.354 NTU (November 2013) and 4.9 ± 0.346 NTU (October 2013) [Figure 1d]. Turbidity showed positive significant correlation with total hardness, DO, carbon dioxide, salinity, alkalinity, chlorides, calcium, silicates, phosphates, and sulfates and showed negative significant correlation with TDS, BOD, COD, magnesium, nitrates, and nitrites [Tables 1 and 2]. High values of turbidity in monsoon (October) may be due to influx of rainwater from catchment area, cloudiness, less penetration of light, washes, silts, sand, high organic matter, and low transparency due to suspended inert particulate matter and during winter season (November) settlement of slit, clay resulting low turbidity (Shinde *et al.*, 2011).

TDS

TDS of water varied between 1527 ± 23.78 ppm (August 2013) and 2545 ± 174.44 ppm (May 2014) [Figure 1e]. TDS showed positive correlation with total hardness,

Table 1: Average correlation values Kanekal tank during 2012–13

2012-13	Temp	pH	Cond	Turb	TDS	TH	DO	BOD	COD	Free C(	Sali	Alka	Cl	Ca	Mg	Si	PO_4	NO_2	NO_3	SO_4
Temp	1																			
pH	0.061	1																		
Cond	−0.491	0.078	1																	
Turb	0.139	0.137	−0.021	1																
TDS	0.005	0.169	−0.008	−0.177	1															
TH	−0.04	0.11	−0.163	0.054	0.074	1														
DO	−0.018	0.009	0.098	0.023	−0.139	−0.119	1													
BOD	−0.157	−0.235	−0.155	−0.224	−0.228	0.123	−0.045	1												
COD	−0.078	−0.104	0.027	−0.407	−0.148	−0.015	−0.28	0.232	1											
Free CO	0.024	−0.125	0.232	0.261	−0.248	0.063	0.19	0.085	−0.11	1										
Sali	−0.074	−0.219	−0.222	0.043	−0.019	0.152	−0.288	0.095	−0.085	0.063	1									
Alka	−0.012	0.009	0.236	0.213	0.28	−0.025	0.044	−0.048	−0.106	−0.104	−0.051	1								
Cl	0.076	0.329	0.089	0.195	0.039	0.337	−0.031	0.088	−0.111	−0.101	−0.116	0.117	1							
Ca	−0.06	−0.12	−0.259	0.104	0.052	0.194	−0.018	0.104	0.097	0.104	0.012	−0.17	−0.134	1						
Mg	−0.141	0.07	−0.045	−0.013	0.223	−0.021	0.076	−0.019	−0.179	−0.077	−0.156	0.103	0.079	−0.048	1					
Si	0.151	0.138	0.011	0.021	0.137	0.155	0.045	0.068	−0.063	−0.039	−0.261	0.199	0.204	−0.188	0.14	1				
PO4	−0.036	0.05	0.043	0.23	0.173	0.059	0.036	−0.165	−0.08	0.192	−0.039	0.166	−0.02	−0.015	0.17	0.258	1			
NO2	−0.083	0.014	0.06	−0.09	−0.097	0.114	0.039	−0.021	−0.115	−0.068	0.096	−0.002	0.05	0.065	0.213	0.087	0.068	1		
NO3	−0.008	−0.142	−0.137	−0.055	0.091	−0.093	0.197	−0.095	−0.115	−0.194	−0.095	0.217	−0.137	0.005	0.1	−0.074	−0.143	0.165	1	
SO4	0.03	0.227	0.114	0.068	0.04	−0.025	0.224	−0.116	−0.104	0.096	−0.329	0.279	0.334	−0.12	−0.104	0.247	0.234	0.256	0.194	1

TDS: Total dissolved solids, DO: Dissolved oxygen, BOD: Biological oxygen demand, COD: Chemical oxygen demand

Table 2: Average correlation values Kanekal tank during 2013–14

2013-14	Temp	pH	Cond	Turb	TDS	TH	DO	BOD	COD	Free C<	Sali	Alka	Cl	Ca	Mg	Si	PO_4	NO_2	NO_3	SO_4
Temp	1																			
pH	−0.085	1																		
Cond	0.164	−0.024	1																	
Turb	−0.054	−0.165	0.143	1																
TDS	0.26	0.1	0.031	−0.054	1															
TH	0.061	0.104	0.045	0.02	−0.071	1														
DO	−0.091	0.123	0.152	0.299	−0.028	−0.02	1													
BOD	−0.156	−0.06	−0.024	−0.214	−0.014	−0.047	0.026	1												
COD	0.086	0.114	−0.021	−0.163	0.168	0.114	0.003	−0.066	1											
Free Cl	2−0.184	−0.046	0.002	0.05	−0.202	−0.122	−0.152	−0.166	−0.083	1										
Sali	−0.046	0.153	−0.044	−0.095	−0.283	−0.085	0.024	0.181	−0.066	0.268	1									
Alka	0.137	−0.138	−0.003	0.311	−0.047	0.004	0.011	−0.097	0.119	−0.005	−0.093	1								
Cl	−0.058	0.025	−0.149	−0.144	−0.053	0.113	−0.188	0.053	−0.133	0.074	0.129	−0.058	1							
Ca	0.05	0.308	0.024	−0.013	0.015	0.11	−0.488	−0.189	0.16	−0.082	0.072	0.105	−0.095	1						
Mg	0.006	0.193	−0.046	−0.062	0.309	−0.035	0.128	0.011	−0.029	−0.07	−0.039	−0.275	0.103	−0.015	1					
Si	−0.038	0.105	0.007	0.025	0.057	−0.133	−0.168	−0.034	0.231	0.221	0.149	−0.034	0.101	−0.04	−0.113	1				
PO4	−0.139	0.031	0.093	−0.101	0.003	−0.075	−0.255	0.149	0.05	−0.035	0.123	−0.654	0.183	0.23	−0.067	0.149	1			
NO2	0.111	−0.322	0.163		0.16	−0.018	−0.009	0.105	0.285	0.195	−0.003	0.025	0.232	−0.049	−0.134	0.11	0.136	1		
NO3	−0.232	−0.039	−0.063	0.071	−0.407	0.232	0.117	0.019	0.154	−0.138	0.063	0.12	−0.009	0.405	−0.135	−0.117	0.061	−0.081	1	
SO4	−0.244	−0.003	−0.04	−0.246	−0.024	−0.017	−0.04	0.162	0.068	0.206	−0.036	−0.182	−0.123	0.085	0.008	−0.045	0.064	−0.032	−0.083	1

TDS: Total dissolved solids, DO: Dissolved oxygen, BOD: Biological oxygen demand, COD: Chemical oxygen demand alkalinity, chlorides, calcium, magnesium, silicates, phosphates, nitrites, and sulfates and TDS showed negative significant correlation with DO, BOD, COD, CO2, salinity, and nitrates (Tables 1 and 2). Seasonal variations showed maximum values in summer (May) due to high temperature, high turbidity, and minimum during the in the month of August (Pradeep *et al.*, 2012 and Bhat *et al.*, 2012).

Total Hardness (TH)

Total hardness of water was minimum in October (181.066 ± 0.602 mg/L) and maximum in May 2014 (626.3 ± 5.0003 mg/L) [Figure 1f]. Total hardness showed positive significant correlation with BOD, carbon dioxide, salinity, chlorides, calcium, silicates, phosphates, and nitrates and total hardness showed negative significant correlation with DO, COD, alkalinity, magnesium, nitrites, and sulfates [Tables 1 and 2]. Total hardness of water bodies may be high during the summer season may be became higher temperature causes evaporation of water. Decrease in volume of water increase the concentration of salts, and also due to regular addition of large quantities of sewage and detergents into water bodies from the nearby residential localities (Harney *et al.*, 2013; Thirupathaiah *et al.*, 2012).

DO

The monthly variation of DO of water was as low as 3.7 ± 0.11 ppm in July 2013 and as high as 6.61 ± 0.18 ppm in March 2013 [Figure 1g]. DO showed positive significant correlation with carbon dioxide, alkalinity, magnesium, silicates, phosphates, nitrates, nitrites, and sulfates and DO showed negative significant correlation with BOD, COD, salinity, chlorides, and calcium [Tables 1 and 2). When photoperiod was long, water temperature increases this may be due to high temperature and high metabolic rate of aquatic organisms in the month of March. DO has low when photoperiod is short in the month of July (Pathak and Mankodi, 2013).

BOD

The monthly variation of BOD of water was low in May and July 2013 (4.3 ± 0.516 mg/L) and high in November 2012 (12.3 ± 1.861 mg/L) [Figure 1h]. BOD showed positive significant correlation with COD, carbon dioxide, salinity, chlorides, calcium, and silicates and BOD showed negative significant with alkalinity, magnesium, phosphates, nitrates, nitrites, and sulfates [Tables 1 and 2]. Minimum BOD values are noticed in summer (May). Whereas, maximum was observed during winter season (November) because of input organic wastes and enhanced bacterial activity (Pradeep *et al.*, 2012; Namrata, 2010).

COD

The COD value is ranged between 123.20 ± 8.01 mg/L (June 2013) and 216.24 ± 4.49 mg/L (October 2012) [Figure 1i]. COD showed positive significant correlation with calcium and COD showed negative significant with carbon dioxide, salinity, alkalinity, chlorides, magnesium, silicates, phosphates, nitrates, nitrites, and sulfates [Tables 1 and 2]. The COD value was found maximum in monsoon season (October) and minimum in the month of June. The factors responsible for increased COD concentration are the establishment of human colonies at the bank of water bodies who are responsible for adding domestic sewage, thus resulting in higher COD (Sharma *et al.*, 2010).

Free Carbon Dioxide

The concentration of free carbon dioxide of water ranged between 4.40 ± 1.391 mg/L (March 2014) and 11.0 ± 3.11 mg/L (May 2013) [Figure 1j]. Free carbon dioxide showed positive significant correlation with salinity, calcium, phosphates, and sulfates and showed negative significant correlation with alkalinity, chlorides, magnesium, silicates, nitrates, and nitrites [Tables 1 and 2]. High carbon dioxide is due to increase in the decomposition of organic matter, low temperature, and photosynthetic activities of phytoplankton. The absence of free carbon dioxide is due to its utilization by algae during photosynthesis or carbonates present (Manjare *et al.*, 2010).

Salinity

The seasonal fluctuation in the salinity values ranged from 1515.8 ± 14.4 ppm (July 2012) and 3468.33 ± 13.291 ppm (February 2014) [Figure 1k]. Salinity showed positive significant correlation with calcium and nitrates and salinity showed negative correlation with alkalinity, chlorides, magnesium, silicates, phosphates, nitrites, and sulfates [Tables 1 and 2]. The maximum value for salinity was observed in the month of February and minimum in the month of July (Kumar *et al.*, 2017; Dixit *et al.*, 2015).

Alkalinity

Alkalinity of water fluctuated between 318.9 ± 6.83 mg/L (October 2012) and 508.9 ± 17.7 mg/L (August 2013) [Figure 1l]. Alkalinity showed positive significant correlation with chlorides, magnesium, silicates, phosphates, nitrites, and sulfates and alkalinity showed negative significant correlation with calcium and nitrates [Tables 1 and 2]. The increased alkalinity in the month of August due to concentration of nutrients in water, water level in many number of water bodies decreases resulting the death of decay of plants and living organisms. This may be attributed to increase in the rate of organic decomposition during which CO2 is liberated, which reacts with water to form HCO3, thereby increasing the total alkalinity (Shinde *et al.*, 2011; Pathak and Mankodi, 2013).

Chlorides

The seasonal variation in the chloride content of the water had a low level of 307.70 ± 3.90 mg/L in October 2013 and high level of 655.23 ± 8.717 mg/L in September 2014 [Figure 1m]. Chlorides showed positive significant with magnesium, silicates, nitrates, and sulfates and chlorides showed negative significant correlation with calcium, phosphates, and nitrites [Tables 1 and 2]. In freshwater, manifold increase in chlorides may be largely due to anthropogenic activities, municipal wastewaters etc. (Hulyal and Kaliwal, 2011).

Calcium

The seasonal variability in the calcium content of water was lowest in October 2012 (77.75 ± 0.878 mg/L) and highest in May 2013 (146.15 ± 2.356 mg/L) [Figure 1n]. Calcium showed positive significant correlation with nitrates and nitrites and calcium showed negative significant correlation with magnesium, silicates, phosphates, and sulfates [Tables 1 and 2]. High concentration of calcium may be due to inflowing sewage from surrounding area (Pathak and Mankodi, 2013). The high value of calcium may be due to the seepage of effluent and domestic wastes or due to cationic exchange with sodium (Shanthi *et al.*, 2016).

Magnesium

Magnesium of water varied between 21.568 ± 0.545 mg/L (August 2014) and 77.43 ± 0.741 mg/L (June 2013) [Figure 1o]. Magnesium showed positive significant correlation with silicates, phosphates, nitrates and nitrites and showed negative significant correlation with sulfates [Tables 1 and 2]. The permissible limit of magnesium content for drinking water is 50 mg/L, maximum limit is 150 mg/l (Hulyal and Kaliwal, 2011). The highest concentration of magnesium observed in the month of June and a lower concentration observed in the month of March in groundwater quality in and around Thiruvallur district (Shanthi *et al.*, 2016).

Silicates

The seasonal fluctuation in the silicate concentration of water was between 0.466 ± 0.007 ppm (January 2014) and 0.9396 ± 0.025 ppm (November 2013) [Figure 1p]. Silicates showed positive significant correlation with phosphates, nitrates, and sulfates and showed negative significant correlation with nitrites [Tables 1 and 2]. The concentration of silica was in the range of 40.61 to 99.41 mg/L. The higher concentration of silica observed in the month of June and lower concentration observed in the month of February in groundwater quality in and around Thiruvallur district (Shanthi *et al.*, 2016).

Phosphates

Phosphate value obtained in this study ranged between 0.981 ± 0.01 ppm (September 2013) and 1.89 ± 0.04 ppm (November 2012) [Figure 1q]. Phosphates showed positive significant correlation with nitrates and sulfates. Phosphates showed negative significant correlation with nitrites [Tables 1 and 2]. The high values of phosphate are mainly due to rain, surface water runoff, agriculture runoff, washerman activity, and leaching of phosphate fertilizer (Prasath, *et al.*, 2013; Pathak and Mankodi, 2013).

Nitrates

The seasonal variability in the nitrate concentration was as low as 0.242 ± 0.021 ppm in September 2013 and as high as 0.485 ± 0.009 ppm in May 2013 [Figure 1r]. Nitrates showed positive significant correlation with nitrites and sulfates and no negative significant correlation [Tables 1 and 2]. During summer season (May), lesser nitrates are due to algal assimilation and other biochemical mechanisms and nitrate higher values are due to surface runoff and domestic sewage and specially washing activities in the month of September (Pathak and Mankodi, 2013; Shinde *et al.*, 2011).

Nitrites

Monthly variation of nitrites content of ranged between 0.015 ± 0.239 ppm (May 2014) and 0.423 ± 0.015 ppm (April 2013) [Figure 1s]. Nitrites showed positive significant correlation with sulfates and no negative significant correlation [Tables 1 and 2]. The concentration of nitrite was maximum during the pre-monsoon period and minimum during post-monsoon period observed in Kadamba tank, Thoothukudi district of Tamil Nadu (Karthick *et al.*, 2016; Abhijna, 2016).

SULFATES

Sulfate content of water was minimum in November and December 2012 (0.003 ± 0.01 ppm) and maximum

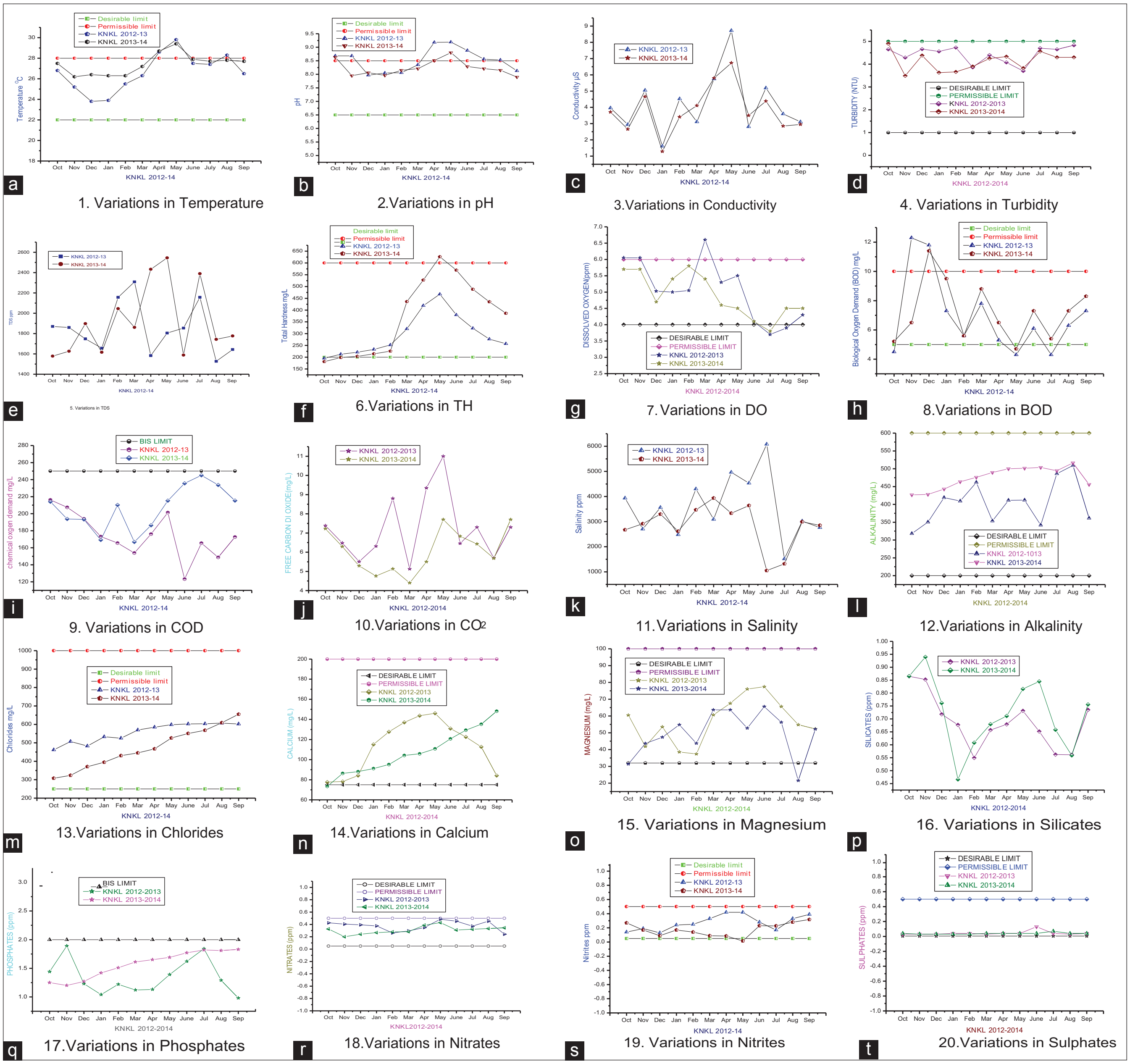

Figure 1: Variation in physicochemical parameters of kanekal tank during 2012–2014

in June 2013 (0.13 ± 0.18 ppm) [Figure 1t]. High concentration of sulfates may be due to biodegradation of organic matter by the microorganisms. Whereas, dilution and utilization of sulfate by the aquatic plant and phytoplankton gradually bring down the sulfate concentration (Hulyal and Kaliwal, 2011).

CONCLUSION

From all the above-mentioned research findings, it is finally concluded that Kanekal tank water is partially contaminated with human feces, domestic sewage, etc., hence, it is not a good quality for culture of fish as well as drinking for animals. Proper measure should be taken to control the contamination of water by anthropogenic activity.

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