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Studies On Water Quality Evaluation Of Nidige Tank (Chunchadri Water Sports), Shivamogga, Karnataka, India

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Abstract:*Present work was designed to study the water quality of Nidige tank (Chunchadri water sports) of Shivamogga based on physico-chemical aspect. Sampling was done from June 2014 to May 2015.Physco-chemcial parameters like Water temperature, pH, Turbidity, Dissolved Oxygen, Biological Oxygen Demand, TDS (Total Dissolved Solids), Total alkalinity, Carbon dioxide, Total hardness and Chloride were analyzed. Mean with standard deviation and correlation matrix were taken. In this study, the air temperature ranges from 23.3^{0}C to 30.3^{0}C whereas water temperature ranges from 10.1^{0}C to 26.8^{0}C. pH ranges from 7.32(January) to 7.76 (May).Lowest value of turbidity observed in December(14.4 NTU) and highest value was observed in August (55.3 NTU). Dissolved oxygen fluctuated between 5.14 to 8.21 mg/l. The values of Biological oxygen demand ranged from 0.78 to 1.85 mg/l. Total hardness values observed are 25.1 to 33.9 mg/l. Free carbon dioxide varies from 1.3 to 4.1 mg/l. Lowest value of TDS observed in July (19.5) and highest value was observed in June (29.32). Total alkalinity level ranges from 31.15 mg/l/ (July) to 62.78 mg/l. Chloride content ranges from 24.32 to 16.14 mg/l. According to above result, the selected tank water is used for human consumption after proper treatment.*

Key words: *Nidige tank, physico-chemical parameters, Correlation co-efficient, Shivamogga, Karnataka*

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I. Introduction

Water resources are of critical importance to both natural ecosystem and human development (Medudhula Thirupathaiah et al., 2012).. It is essential for agriculture, industry and human existence. The healthy aquatic ecosystem is dependent on the physico-chemical and biological characteristics (Venkatesharaju et al., 2010). Water is one on the most important and abundant compounds of the ecosystem. All living organisms on the earth need water for their survival and growth (Yogitha and Ramachandra, 2018). Physico-chemical parameters play an important role in the quality of any type of water body. The normal ranges of physico-chemical characteristics indicate the good water quality (Swaminathan and Manonmani, 1997). The quality and quantity of surface water bodies like lakes and tanks depend upon on the climate, catchments, geography of the area and inputs and outputs both natural and manmade (Gray, 1994). The water quality of lakes and tanks can be degraded due to microbiological and chemical contaminants. Lentic water bodies play a very important role in maintaining the biodiversity and over all ecological balance in nature. Environmental pollution is a modern day evil affecting all ecosystems (Mahapatra and Rangarajan, 1995). Unplanned urban development has posed gigantic problems of environmental pollution. Due to this, water of natural bodies is getting polluted at an alarming rate (Shastri et al., 2008). Due to anthropogenic activities, rapid industrial growth, domestic and agricultural activities of the region, the water body is being polluted, which is the case with almost all major water bodies of the country (Manjappa et al., 2008). The physico-chemical study could help in understanding the structure and function of particular water body in relation to its habitats. The proper balance of physical, chemical and biological properties of water in ponds, lakes and reservoirs is essential for Limnological studies. Abundance of particular element might suggest the type of organism that may be found as well as indication of ecologically unfavorable ecosystem which can have negative or positive impact on the population i.e. high concentration of nitrate or phosphate is indicative of eutrphication (Patil Shilpa et al., 2012).

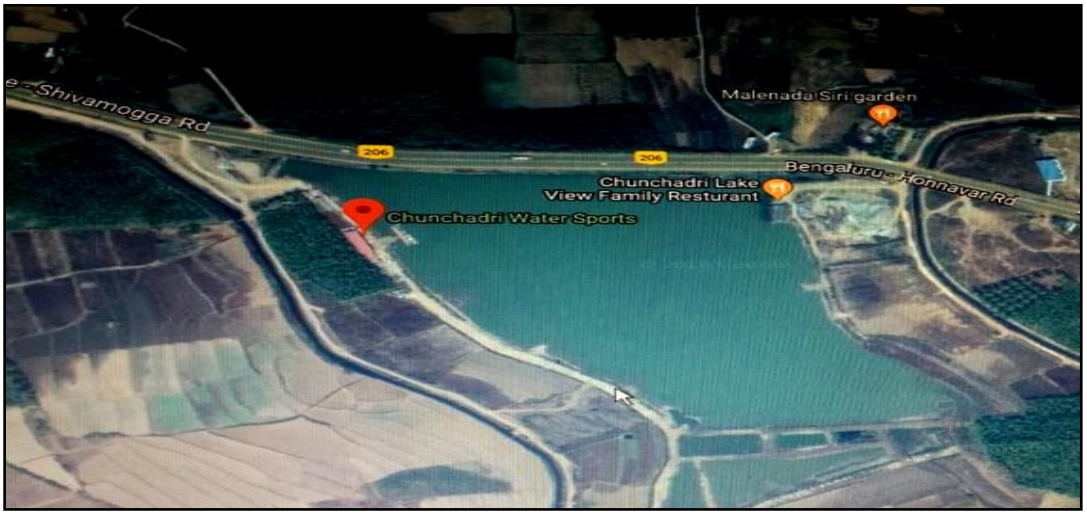
Now-a-days, increasing effects of pollution have become a serious threat. Thus, periodic monitoring of water bodies is necessary to access its suitability for drinking and other purposes. Studies on physico-chemical dynamics of lentic water bodies were reported by several researchers (Sayeswara et al., 2011; Mahesh and Sayeswara, 2011; Sayeswara et al., 2012; Mahesh et al., 2012; Nafeesa Begum et al., 2012; Neelam and Monkodi, 2013; Bhatnagar and Devi, 2103; Mahesh et al., 2014; Qureshimatva and Solanki, 2015; Dhananji et al., 2016; Balbeen and Dayananda, 2016; Karthika et al., 2016; Sajitha and Vijayamma, 2017; Dinesh et al.,

2017; Bidisha and Gosh, 2018).The literature revealed that there is no scientific study carried out with respect to physico-chemical characteristics of this tank. In the present investigation, an attempt has been made to assess the quality and suitability for human consumption and domestic purposes.

II. Materials and Methods

Study area

Nidige tank (Chunchadri water sports), located adjacent to the National Highway 206 on the outskirts of the Shivamogga city. The Nidige tank spreads across 5 acres of land. The water fed into the tank from Bhadra canal. Shivamogga city (13°55' 18" NL, 75°34' 12" EL) is heartland of Karnataka state, located in the banks of river Tunga.



Satellite view of Nidige tank (Source-Google)

Nidige tank of Shivamogga

Collection of the sample

Samples of Nidige tank water were collected regularly during the period from June 2014 to May 2015. During the study period, a water sample measuring 2 liters was collected for the analysis of physico-chemical parameters in a clean plastic can between 9 am to 10 am once a month. The plastic containers were properly washed with diluted hydrochloric acid and then rinsed with normal water followed by distilled water followed by sample water.

Analysis of the sample

The water temperature was recorded on the spot. The samples for dissolved oxygen fixed immediately on the field itself. The physico-chemical parameters were analyzed as per the standard methods (APHA, 1998). Some of the results were recorded at the sampling site where as the others were recorded in the laboratory. The parameters observed were temperature, pH, turbidity, dissolved oxygen, biological oxygen demand, total dissolved solids, total alkalinity, carbon dioxide, total hardness and chloride. The water temperature was recorded at the sampling spot itself. Hydrogen ion concentration was determined with the help of BDH narrow range pH strips. Later on, to confirm the results the pH was also measured in the laboratory by the Phillip's digital pH meter. Total dissolved solids were measured by 100 ml water sample (filtered) dried on a hot plate in a pre-weighed China dish. The China dish was then again weighed to calculate the total dissolved solids per liter of sample. Total hardness was measured by ammonia buffer and EDTA method. The water samples for dissolved oxygen and biological oxygen demand fixed immediately on the field itself.

III. Results and Discussion

The results of physico-chemical parameters are depicted in Tables 1 & 2 and Graphs 1-22. Correlation coefficient of different of physico-chemical parameters are shown in the Table 3.

Air temperature

Temperature is primary environmental factor that affects and governs the biological activities and solubility of gases in water (John Mohammad et al., 2015). The temperature mainly depends on the season, solar radiations, depth of water and other climatic conditions. Values of temperature ranged from 23.3 to 30.3 ^{0}C. The minimum value recorded in February and maximum in April. The seasonal variability of air temperature has fluctuated between 23.6±0.39 ^{0}C (Post-monsoon) and 28.8±2.64 ^{0}C (Pre-monsoon).

Water temperature

One of the most important physical parameters is temperature. In case of Limnological studies, it very much essential to study as the growth and distribution of plants and animals is influenced by this factor (Abir, 2014). The values ranged from 19.1 to 26.8 ^{0}C. The highest and the lowest values were recorded in April and December. The seasonal variability of water temperature has fluctuated between 20.57±1.35 ^{0}C (Post-monsoon) and 25.85±2.33^{0}C (Pre-monsoon). Due to the smaller size of the tank, quick reaction to atmospheric temperature changes was noticed. Similar works with similar findings were found in the study of Saha et al., 1971, Mishra et al., 2008 and Bidisha and Gosh, 2018.

pH

Measurement of hydrogen ion concentration which is represented as pH. Alkaline water bodies are generally more common than acid water bodies. The pH of water body is very important in determination of water quality since it affects other chemical reactions such as solubility and metal toxicity (Fakayode, 2005). Leaching of soil, decomposition of organic matter and discharge of industrial effluents cause the acidity in water bodies (Dhrub et al., 1994). The pH of water is slightly acidic to slightly alkaline and found within permissible limit 7.32 to 7.76 and per the Bureau of Indian Standards (BIS). The minimum value was recorded in January and maximum value recorded in May. The pH is important since aquatic organisms ware well adapted to a specific pH range and do not withstand abrupt changes in it (George, 1997).

Table 1: Physico-chemical parameters of surface water of Nidige tank.

Parameters	2014 to 2015											
	June	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May
AT	27.1	28.2	29.1	27.6	26.1	24.1	23.4	23.7	23.2	26.1	30.3	31.7
WT	24.7	26.1	26.3	25.8	23.6	22.3	19.1	20.1	20.8	23.3	26.8	28.6
pH	7.53	7.57	7.58	7.48	7.44	7.45	7.50	7.32	7.61	7.55	7.35	7.76
TUR.	43.4	51.6	55.3	26.1	19.2	18.1	14.4	16.3	20.2	18.1	21.4	22.3
DO	5.92	5.31	6.81	5.14	6.41	7.14	8.21	8.12	6.24	5.62	6.34	6.34
BOD	1.23	0.92	1.14	1.63	1.02	1.21	0.94	1.34	0.91	1.34	1.85	0.78
TDS	29.3	19.1	24.2	26.3	26.2	26.3	26.3	24.1	21.3	23.1	20.4	24.1
TH	25.1	32.1	30.1	26.2	24.2	30.1	33.9	31.4	25.8	32.3	25.4	27.2
CO2	4.1	3.9	2.9	2.1	3.1	1.9	1.3	2.1	2.6	1.8	2.3	2.2
TA	53.9	31.1	40.1	36.2	43.2	51.9	56.2	59.6	62.7	54.9	59.3	60.3
Cl^-	23.3	17.03	18.27	21.27	20.16	16.14	22.16	23.22	18.23	26.32	25.13	24.63

AT-Air temperature, WT-Water temperature, TUR-Turbidity, EC-Electrical conductivity,
DO-Dissolved oxygen, BOD-Biological oxygen demand, TDS-Total dissolved solids, TH-Total hardness,
TH-Total hardness, CO_2-Corbon dioxide, TA-Total alkalinity, Cl^-–Chloride

Table 2: Seasonal variation in Physico-chemical characteristics of Nidige tank water

Parameters	June 2014-May 2015		
	Pre-monsoon Mean±SD (Min.- Max.)	Monsoon Mean±SD (Min.- Max.)	Post-monsoon Mean±SD (Min.- Max.)
Air temperature	28.8±2.64 (26.1-31.7)	27.75±1.26 (26.1-29.1)	23.6±0.39 (23.2-24.1)
Water temperature	25.85±2.33 (24.7-28.6)	25.45±1.25 (23.6-26.3)	20.57±1.35 (19.1-22.3)
pH	7.5475±0.17 (7.35-7.76)	7.51±0.07 (7.44-7.58)	7.47±0.12 (7.32-7.61)
Turbidity	26.3±11.54 (18.1-43.4)	38.05±18.07 (19.2-55.3)	17.25±2.43 (14.4-20.2)
Dissolved Oxygen	6.055±0.35 (5.62-6.34)	5.91±0.82 (5.14-6.81)	7.42±0.93 (6.24-8.21)
Biological OD	1.3±0.44 (0.78-1.85)	1.71±0.31 (0.92-1.63)	1.1±0.21 (0.91-1.34)
Total Dissolved Solids	24.26±3.72 (20.45-29.32)	23.98±3.36 (19.15-26.30)	24.52±2.35 (21.34-26.30)
Total Hardness	27.5±3.33 (25.1-32.3)	28.15±3.60 (24.2-32.1)	30.3±3.39 (25.8-33.9)
Carbon dioxide	2.6±1.02 (1.8-4.1)	3±0.74 (2.1-3.9)	1.97±0.54 (1.3-2.6)
Total Alkalinity	57.13±3.18 (53.92-60.36)	37.70±5.23 (31.15-43.28)	57.65±4.65 (51.94-62.78)
Chloride	24.86±1.23 (23.36-26.32)	19.18±1.90 (17.03-21.27)	19.93±3.32 (16.14-23.22)

Turbidity

Turbidity measures suspended and inorganic matter in the water. The values fluctuated between 14.4 to 55.3 NTU, the minimum being in December and maximum in August. The seasonal fluctuation of turbidity of water varied between 17.25±2.43 NTU (Post-monsoon) and 38.05±18.07 NTU (Monsoon). The variations of turbidity depend on the inflow of rain water carrying suspended particles (Nafeesa Begum et al., 2006). In natural water bodies, turbidity may import a brown colour to water (George, 1997).

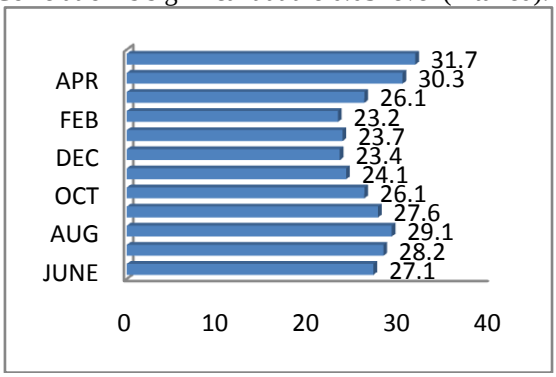
Dissolved oxygen

Dissolved oxygen is an important gaseous factor that determines the quality of water and inturn regulates the distribution of aquatic organisms. The values fluctuated between 5.14 to 8.21 mg/l. The monthly variation of DO of water was low in Monsoon (5.91±0.82 mg/l) and high in Post-monsoon (7.42±0.93 mg/l). The minimum value was recorded in September and August in August. The variations of DO depend on the primary production and respiration of aquatic organisms. Lower levels of DO in summer season is due to higher rate of decomposition of organic matter and limited flow of water in low holding environment due to high temperature (Rani et al., 2004). The permissible standard of DO is above 5 mg/l. (Perk and Park, 1980).

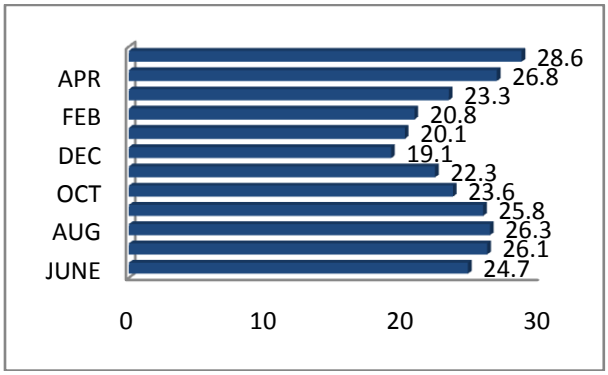
Table 3: Correlation matrix of Physico-chemical parameters of Nidige tank water (June 2014 to May 2015)

	AT	WT	pH	TUR.	DO	BOD	TDS	TH	CO_2	TA	Cl^-
AT	1.000	.966**	.367	.446	-.481	.157	-.224	-.317	.291	-.234	.297
WT		1.000	.397	.514	-.635*	.154	-.196	-.393	.393	-.363	.141
pH			1.000	.307	-.355	-.677**	-.075	-.005	.161	-.023	-.068
TUR.				1.000	-.397	-.127	-.111	.015	.756**	-.631*	-.366
DO					1.000	-.168	.231	.409	-.484	.473	-.011
BOD						1.000	-.016	-.219	-.181	-.006	.370
TDS							1.000	-.180	-.038	.033	.087
TH								1.000	-.386	-.081	-.074
CO_2									1.000	-.438	-.285
TA										1.000	.504
Cl-											1.000

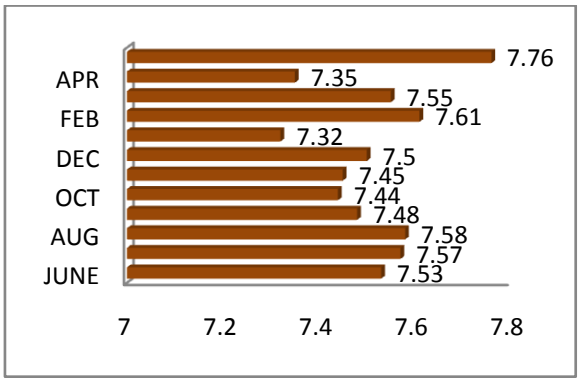
**Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).



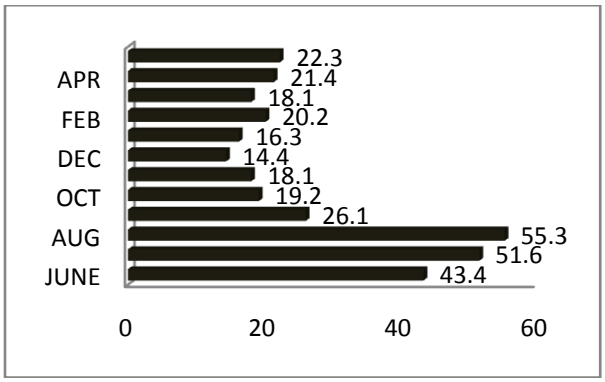
Graph 1: Monthly variations in Atmospheric temp.



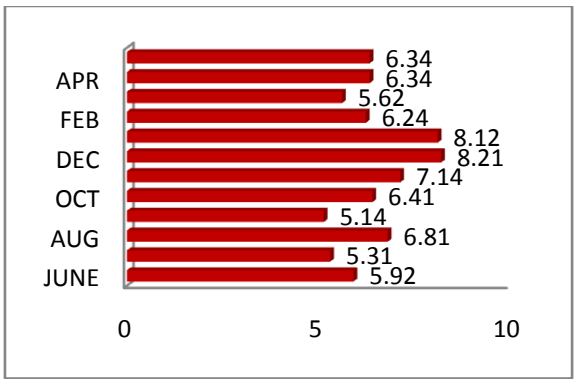
Graph 2: Monthly variations in Water temp.



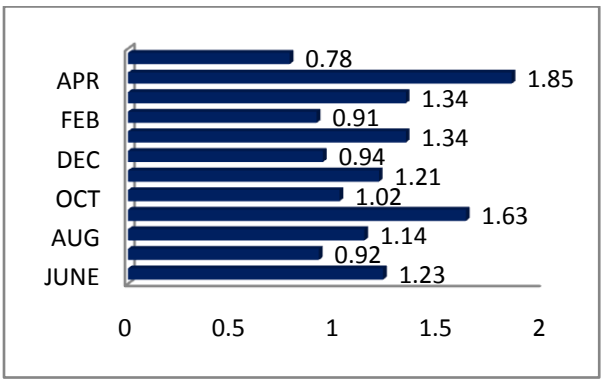
Graph 3: Monthly variations in pH



Graph 4: Monthly variations in Turbidity



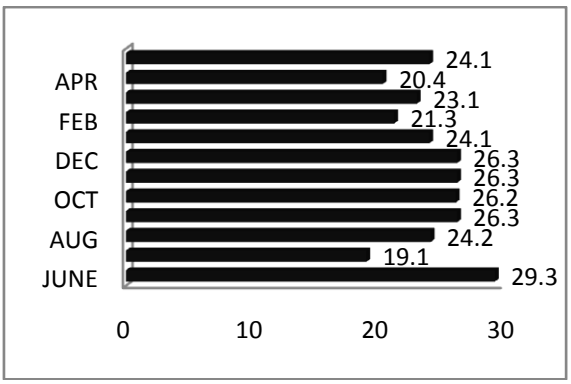
Graph 5: Monthly variations in DO



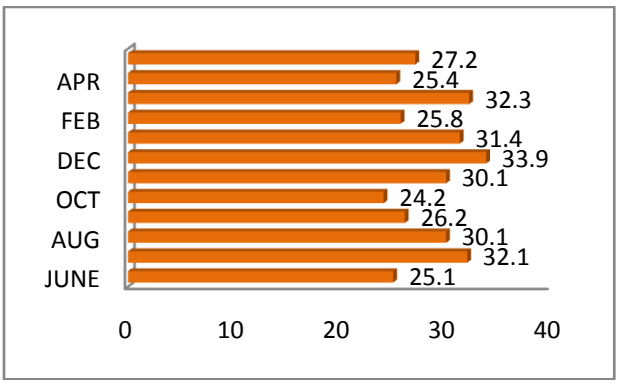
Graph 6: Monthly variations in BOD

Free carbon dioxide

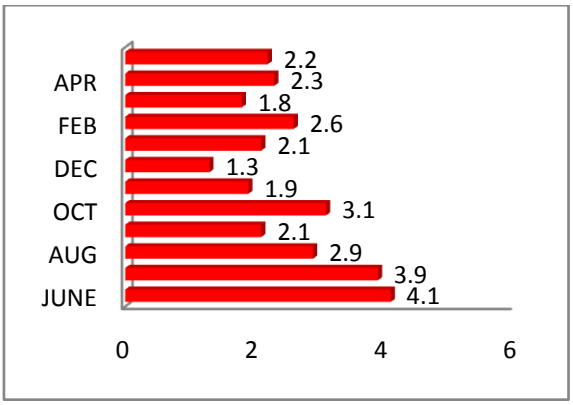
CO_2 values fluctuated between 1.3 to 4.1 mg/l. the highest and the lowest values were recorded in June and December, respectively. The seasonal variability of CO_2 of water has fluctuated between 1.97±0.54 mg/l (Post-monsoon) and 3±0.74 mg/l (Monsoon). The variation of CO_2 was due to its absorption by plants for photosynthesis and activity of other organisms.



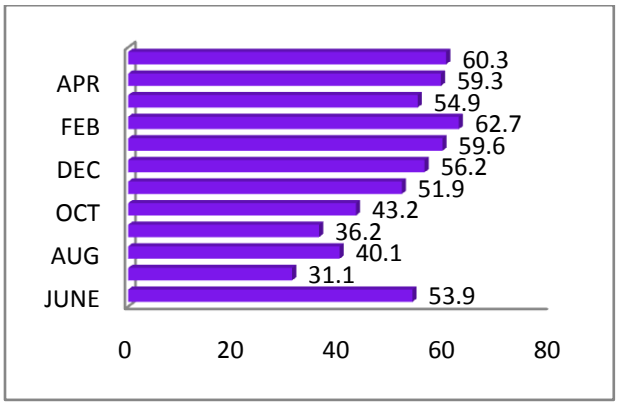
Graph 7: Monthly variations in TDS



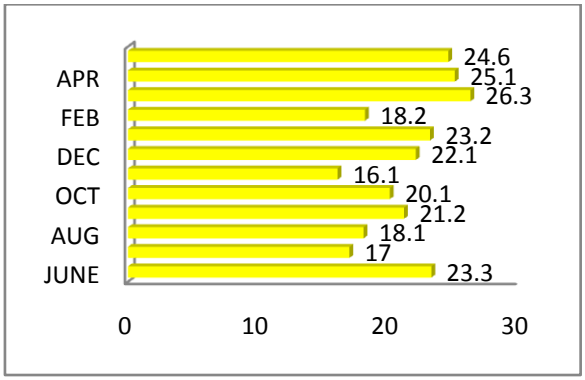
Graph 8: Monthly variations in Total hardness



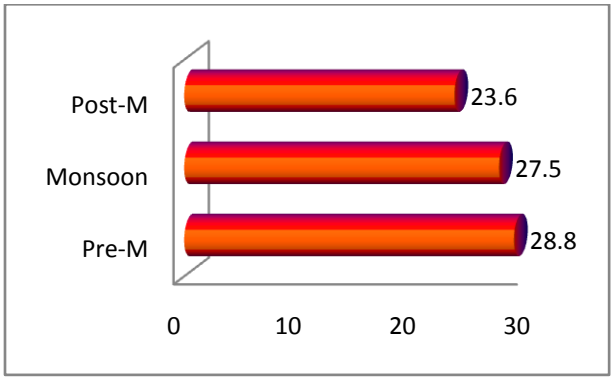
Graph 9: Monthly variations in CO_2



Graph 10: Monthly variations in Total alkalinity



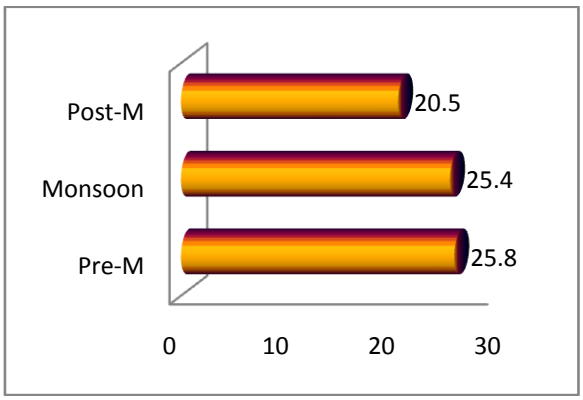
Graph 11: Monthly variations in Chloride



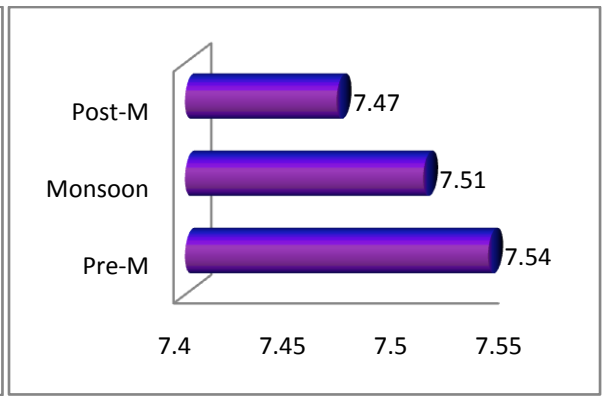
Graph 12: Seasonal variations in Atmospheric temp.

Biological Oxygen Demand

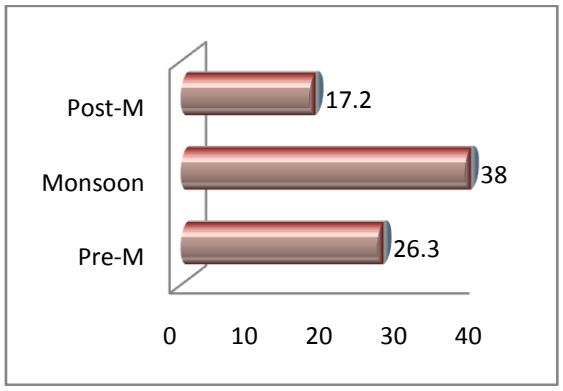
BOD is the measure of degradable organic matter present in water. The BOD and other microbial activities are generally increase by the introduction of sewage (Hynes, 1971). The values ranged from 0.78 to 1.85 mg/l. The highest and the lowest values were recorded in April and May. The seasonal variation of BOD of water was low in Post-monsoon (1.1±0.21mg/l) and high in Monsoon (1.71±0.31mg/l).



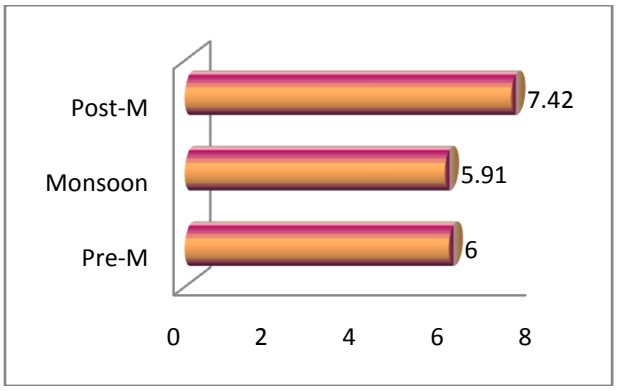
Graph 13: Seasonal variations in Water temp.



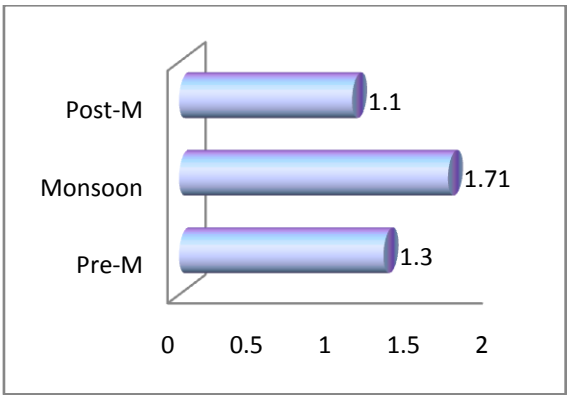
Graph 14: Seasonal variations in pH



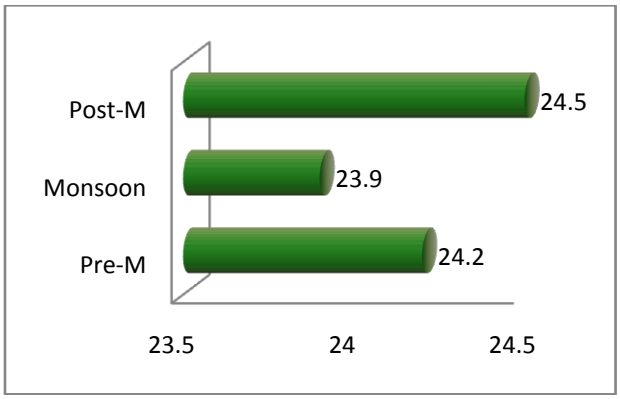
Graph 15: Seasonal variations in Turbidity



Graph 16: Seasonal variations in DO



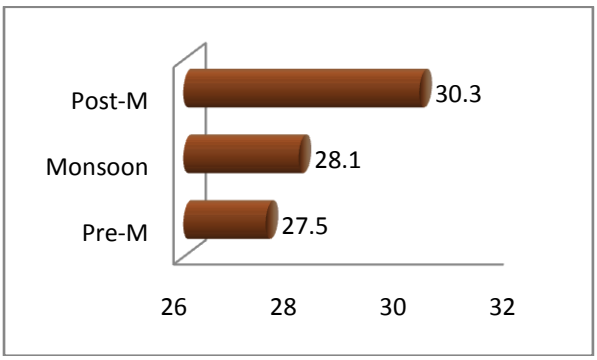
Graph 17: Seasonal variations in BOD



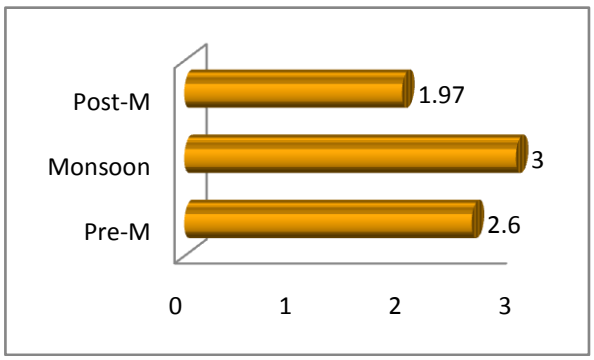
Graph 18: Seasonal variations in TDS

Total alkalinity

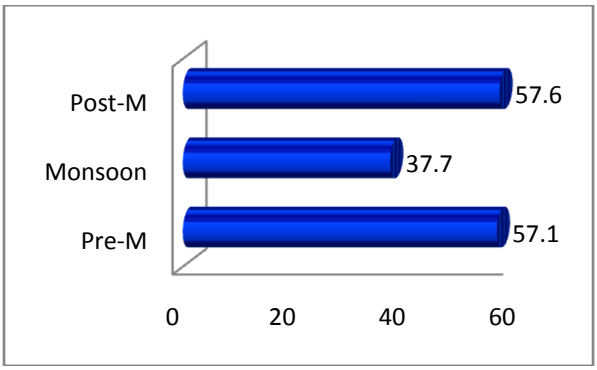
Alkalinity in the water samples primarily a function of carbonate, bicarbonate and hydroxide contents. It ranged from 31.1 mg/l/ (July) to 62.7 mg/l. (February). The seasonal fluctuation of total alkalinity of water varied between 37.70±5.23 mg/l (Monsoon) and 57.65±4.65 mg/l (Post-monsoon). Surface alkalinity may result from the discharge of domestic wastes. Total alkalinity is within permissible limit of 600 mg/l. (BIS, 1993).



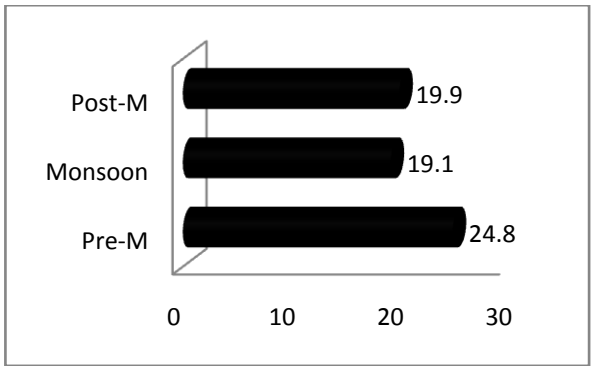
Graph 19: Seasonal variations in TH



Graph 20: Seasonal variations in CO_2



Graph 21: Seasonal variations in TA



Graph 22: Seasonal variations in Chloride

Total hardness

Total hardness of water is not a pollution parameter but indicates water quality mainly n terms of calcium and magnesium contents. Total hardness values observed are 25.1 to 33.9 mg/l. The highest and lowest values were recorded in December and June, respectively. The total hardness was lowest in Pre-monsoon (27.5±3.33 mg/l) and highest in Post-monsoon (30.3±3.39 mg/l). Total hardness of water is not a pollution parameter but indicates water quality mainly in terms of Ca^{2++} and Mg^{2++} contents.

Total dissolved solids

The values ranged in between 19.1 to 29.3 mg/l. being maximum in June and minimum in July. The minimum values may be due to the stagnant condition of the water body. The values are within permissible limits of1500 mg/l. (BIS, 1993). The seasonal variation of total dissolved solids of water was low in Monsoon (23.98±3.36 mg/l) and high in Post monsoon (24.52±2.35 mg/l)**.**The higher values during the monsoon might be due to surface run-off. TDS analysis has great implications in the control of biological and physical water treatment process.

Chloride

Chlorides are important anions found in variable amount in water bodies. The chloride content normally increases as the mineral content increases. Chlorides present in sewage and form drainage, control the salinity of water and osmotic stress on biotic communities (Goel et al., 2003). Chloride values observed are 24.32 to 16.14 mg/l. The highest and lowest values were recorded in March and November, respectively. The seasonal fluctuation of Chloride of water varied between 19.18±1.90 mg/l (Monsoon) and 24.86±1.23 mg/l (Pre-monsoon). High chloride content indicates the deterioration of water quality usually linked with sewage load (Mini et al., 2003). The most important sources of chlorides in the fresh water are discharge of domestic sewage and farm drainage. The concentration of chlorides is thus indicator of pollution (Madhuri Pejavar and Meenakshi Gurav, 2008).

Correlation co-efficient

The relationship between various physico-chemical parameters of water samples of Nidige tank were analyzed statistically following Pearson's correlation coefficient[r]. Correlation analysis is an important part of bivariate analysis which is concerned with the relation between two variables. Correlation co-efficient of physico-chemical parameters of lentic water bodies were reported by several researchers (Shinde et al., 2011; Patil Alaka, 2014;Sivalingam et al., 2016; Kolala Venkatararamanaiah et al., 2017; Sharma et al., 2017;Nasim Ahmad Ansari, 2017) Table 3 showed that Atmospheric temperature has positive and significant correlation with water temperature (r=0.966). Water temperature has negative and insignificant correlation with dissolved oxygen (r=-0.635). pH has negative and insignificant correlation with biological oxygen demand (r=-0.677). Turbidity has negative and insignificant correlation with total alkalinity (-0.631) and positive and significant correlation with carbon dioxide (r=0.756).

IV. Conclusion

The study revealed that there were variations in certain physico-chemical properties of Nidige tank of Shivamogga district of Karnataka due to the surface run-off and other excessive human activities. The results were compared with standard values prescribed by the Bureau of Indian Standard (BIS) and World Health Organization (WHO). Except turbidity, all the other physico-chemical characteristics were found with permissible limits. Therefore, the present investigation based on scientific methodology clearly shows that the said study Nidige tank water can be used for drinking and other cooking purpose after proper treatment.

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