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# ASSESSMENT OF SURFACE WATER QUALITY OF CHANNARAYAPATNA IN HASSAN DISTRICT, KARNATAKA WITH RESPECT TO TROPHIC STATUS

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## ABSTRACT

Due to rapid changes in the population and jump in the community life style including development have led to the degradation of natural water system. Lentic water tanks are most important and traditional natural water tanks in our surrounds. They have been widely utilized by mankind over the centuries. Channarayapatna water body was chosen for a water quality analysis since currently this water tank is receiving sewage from the around the area and altering status of the water body due to anthropogenic and agricultural activity. We have found a general relationship between trophic status of a water body and the aquatic plants present there. In the present study indicates, the quality is altering due to presence of various aquatic plants and also these are indicating as indicator. The present study was carried out to estimate the parameter like physical and chemical characteristics in water in Channarayapatna water body, Hassan District, Karnataka of India from January to December 2014. The trophic status was assessed by using multi variate indices and also results are correlated with seasonal changes in the water quality. The contents of temperature, pH, salinity and dissolved oxygen were recorded maximum and minimum in the present study were: 26.0-35.0; 25.0-33.5; 8.0-35.0; 7.2-8.2 and 2.8-5.5 respectively. The ranges of nitrate, nitrite, phosphate and silicate were: 5.2-14.3; 0.8-3.2; 0.3-2.20 and 0.2-0.8 respectively. The present investigation indicates that the two water bodies are in moderate Eutrophic condition during the study period (January, 2011 to December, 2014).

## KEYWORDS

Parameters, Water body, Karnataka and Trophic status.

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## INTRODUCTION

Limnology is a part of the science which consists a great deal of detailed field as well as laboratory studies to understand the fundamental and practical aspects and problems associated with the freshwater environment, from a holistic point of view (Adoni *et al*, 1985)[1]. Lakes can be defined as bodies of standing water occupying a basin. It may vary from stagnant water pools of less than 0.4 hectares to big water bodies of an area of thousands of kilometres. In geological definition lakes are ephemeral. The stagnant water body originate as a product of geological processes and terminate as a result of the loss of the ponding calculation, due to high temperature may cause by changes in the hydrological balance, or by in filling caused by accumulation of dead plants and animals and also human activities like interfering/violation. Most of the ponds are getting polluted due to domestic waste, manure, engineering and agronomic waste from surrounding (Shiddamallayya and Pratima, 2008; Shekhar *et al.,* 2008)[2,3]. The requirement of water in for all biotic organism, from microscopic species to man, is a serious problem today because all water resources have reached to emergency due to unplanned urbanization and industrialization. Fresh water habitats are located in different parts of the region especially in rural parts and are mainly used as a source of drinking water, irrigation and for fish production by the local people. Water quality is explained in terms of the chemical physical and biological contents of water. The water quality of surface water bodies may changes with the seasons and geographic areas, even when there is no contamination existing. Scientific administration of surface water bodies will assist to enhance the concept of sustainable utilization. Further, the investigation of ecological status, fishery activity status and potential for fish production will help in implementation of developmental activities and improvement of fish production in water habitats. The quality of water is now the concern of specialists in all countries of the ecosphere. The quality of water is depends on the location of the source and the state environmental protection in a given region. Hence, the quality of water and the nature of water may be determined by physical and chemical analysis (Abdo, 2005)[4]. Channarayapatna water body is having an longitude: 76.25, latitude: 12.55 an Area of 217 hectare, capacity of the water body 170.41 mcft, total population around the water body is 33253, distance from the village is 1 km. The water from this body is used for Agriculture, fishery, washing animals, clothes, vessels etc. The water body is polluting may be due to human activity like drainage water was connected earlier but now it is diverted, human and animal excreta and refusal disposal, detergents, fertilizers etc. The aim of the present study is to determine the distribution of physical variables in Channarayapatna water body (air and water temperatures, chemical variables (DO, pH, Electrical Conductivity, $NO_2^-$, $NO_3^-$, $PO_4^{3-}$ and $SiO_2$ in water of Channarayapatna lentic ecosystem for a period of one year.

**Literature review**

Lakes are categorized inversely on the basis of origin: tectonic lakes, glacial lakes, and shoreline lakes (E. P. Odum and Barrett, 1996)[5]; explained on Temperature and Intercourse: Dimictic lakes, Cold monomictic lakes, Warm monomictic, Polymictic lakes, Oligomictic pond, Amictic lakes (Odum and G. W. Barrett, 1996)[5]; based on Trophic status: Oligotrophic lakes, middle trophic pond, Eutrophic lakes (R. Thomas *et al.*, 1996)[6]. Primary production in lake ecosystems depends on accumulation of dead plants and animals and abiotic component as essential properties. Phytoplankton take up nutrients dissolved in lake water whereas rooted plants from the sediments. Prime producers are potentially limited by carbon, nitrogen or phosphorus. Nitrogen (nitrate, ammonia, and free nitrogen) and Phosphate are much less available, suggesting that phosphorus, along with nitrogen, is are likely to limit algal production in lakes (Pushpa Tuppad *et al.,* 2013)[7].

## MATERIAL AND METHODS

Water quality sampling for abiotic factors like physico-chemical constraints were done on two stations for three Seasonal variations. The water samples were collected in flexible container and some of the parameters were tested in the field, as well as in the laboratories. Temperature was measured using calibrated glass thermometer precise to 0.10C. pH was measured using portable pH meter instrument model number is Elico 256. Dissolved oxygen was analyzed using modified Winkler azide method. Biochemical oxygen demand (with duration of 5 days of incubation at $20^0$C) and salinity (by titrometric method) were also estimated. Nitrate, Nitrite, Phosphate and Silica were measured using UV-spectrophotometer model Shimadzu UV 1800. The digestion and titration method was carried out as per the procedures given in APHA, AWWA and WEA (1998)[8].

## RESULTS AND DISCUSSION

The physico-chemical constituents and arithmetical data are given in the Table No.1 and Table No.2 respectively. Map showing the sampling stations in channarayapatna water body in Hassan District, Karnataka state

### Water and Air Temperature

Temperature is one of the basic abiotic and important for its affects on confident chemical and biological activities in the organisms attributing in lentic fresh water system. In the Indian subcontinent the temperature in most of lentic water bodies ranges between 27.8 to 38.5$^0$C (Singhal *et al*., 1986)[9]. There were dissimilarities in air and water temperatures across the two stations, however these variations were not significantly dissimilar (P>0.05) across the stations. In the present study, air temperature varied between 26.0-35.0 (31.2±2.64)°C and water temperature ranged from 27.0-35.0 (31.6±2.63)°C (Table No.1 and Table No.2). These values were within the suitable levels for existence, metabolism and physiology of aquatic organisms. Water temperature has some positive and negative effects on plant growth. The most suitable water temperature for plant growth is 20.0-35.0°C, Temperature over 30°C can cause regression in growth and decay in plants Kara Y *et al*., (2004)[10]. The variation is mainly related with the temperature of atmosphere and weather conditions.

### pH

pH is influenced by acidity of the bottom sediment and biological activities. High pH may result from high rate of photosynthesis by dense phytoplankton blooms. pH higher than 7 but lower than 8.5 according to Abowei J F N, (2010)[11] is ideal for biological productivity, but pH at <4 is detrimental to water life. The pH values of fresh aquatic system was found in alkaline side (pH>7) (Goldman and Horne, 1983)[12]. In general the pH contents are higher in winter than other seasons. The variation can be due to the exposure of dam water to atmosphere, biological activities and temperature changes (Adebowale, *et al.*, 2008)[13]. In the present study the hydrogen ion concentration of pH was both alkaline. The pH ranged between 7.2 and 8.2 in station 1 and 7.9 to 8.2 in station 2, respectively with overall mean value of 7.9±0.21. pH varied with seasons and variations were statistically different at 5% level (P<0.05) across the stations.

### Electrical Conductivity (EC)

EC is a good indicator parameter on the total dissolved ions in aquatic ecosystem. The electrical conductivities of the water samples generally varied significantly (P < 0.05) and ranged between 345.5 μmohs/cm to 742.8 μmohs/cm throughout the study period (Table No.1). Higher conductivities were observed station 1 in winter and spring seasons, suggesting that there could be other non point sources pollution entering into the receiving water body that resulted in the high values. The maximum values 392.0, 742.0 and 369.0 μmohs/cm were recorded at Station 1, which may be receiving the sewage and other waste of surrounding villaes. These results agree with that finding El-Sayed, (2008)[14] studied in the same region and nearby River Keiskamma (Fatoki *et al.*, 2003)[15].

### Dissolved Oxygen (DO)

DO is one of the essential parameter in water quality assessment. DO reflects the physical and biological processes predominant in all the surface water. Not polluted lotic and lentic surface water is normally inundated with DO. The DO varies from 2.8 to 5.5 mg/L during the study. These results are indicate moderately large due to biological pollution. The high temperature and low DO during summer create favorable conditions for increasing in the number of blue-green algae (Jayaraju *et al.*, 1994)[16]. The dissolved oxygen profile throughout the seasons diverse significantly (P < 0.05) and results showed between 3.3 and 3.5 mg/L during winter; 3.9 and 4.0 mg/L during rainy season 3.2 and 3.5 mg/L during summer season (Figure No.1). The DO content in water body which was observed to deplete faster than DO in the receiving water body could be accredited to the presence of degradable organic matter which resulted in affinity to be more oxygen difficult. The DO values obtained from this study are similar to those reported elsewhere's (Fatoki *et al.*, 2003[15]; Jaji *et al.*, 2007; Obire *et al.*, 2003)[17,18].

**Nitrates, Nitrite, Phosphates and Silica**

$NO_2^-$ and $NO_3^-$concentrations were found slightly variations at two locations and during twelve collection months, Table No.1. $NO_2^-$ and $NO_3^-$ were ranged between 0.8 - 3.2 mg/L and 5.2-14.3 mg/L respectively. The maximum value of $NO_3^-$ 14.3 mg/L in station 1 during the month of April and in station 2 during the month of October. The results indicates that the anthropogenic activities of surrounding villages discharge at this station (Figure No.2 and Figure No.3). This may be attributed to the oxidation of ammonia by nitrifying bacteria and biological nitrification (Seike *et al.*, 1990)[19]. The lowest values of DO is attributed during winter 5.2 to 6.4 mg/L may be related to the denitrifying bacteria (Merck, 1980). The nitrate content during rainy and summer could be due to leaching and surface run-off of agricultural waste from nearby farmers land into the lentic water system.

The Phosphate content of dam water bodies were found in the range of 1.1 mg/L to 1.3 mg/L before rainy 1.1 - 1.2 mg/L after rainy season is 0.8 to 0.9 mg/L (Figure No.3). Phosphates increases the entroplication process, which could also main to disagreeable taste and odour of the aquatic system, when algae die decompose thus deteriorating the quality of the water (Kolo, 1996)[20]. The high concentration of Phosphate before rainy season is due to leaching of Phosphate fertilizer from the agricultural land.

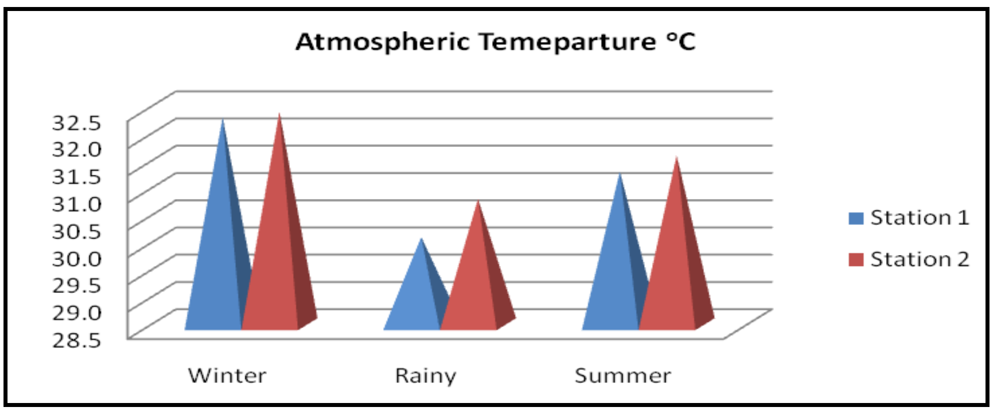
The silicate content was higher than that of the other nutrients like nitrite and phosphate and the recorded high monsoon values (Figure No.3) could be due to large influx of freshwater derived from land drainage carrying silicate leached out from rocks and also from the bottom sediment (Govindasamy *et al.*, 2000; Rajasegar, 2003)[21,22]. The recorded results area very low in summer and winter could be attributed to uptake of silicates by microscopic organisms for their biological action (Ashok Prabu *et al.*, 2008; Saravanakumar *et al.*, 2008)[23,24].

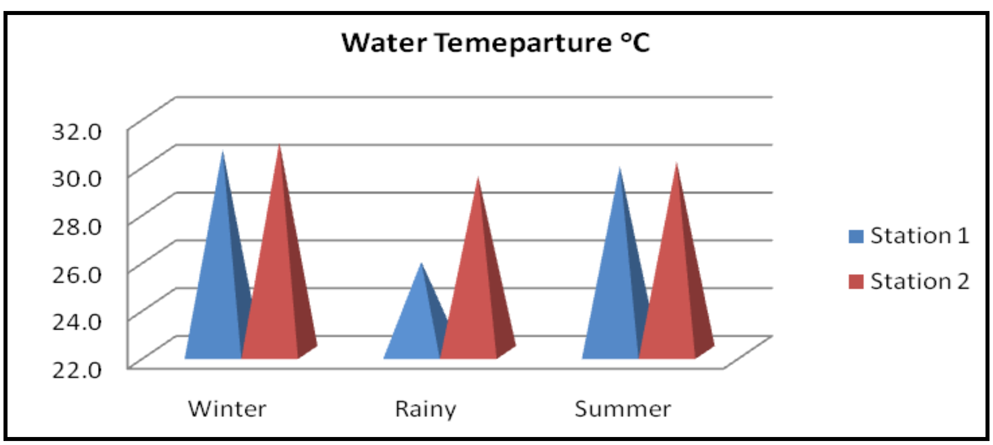
**Table No.1: Physico-Chemical Parameters of Channarayapatna Water Body during Jan to Dec 2014**

| Parameter | Stations | Oct. | Nov. | Dec. | Jan. | June | July | Aug. | Sept. | Feb. | March | April | May |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Atmospheric temperature (ºC)** | Station 1 | 30.0 | 29.0 | 32.0 | 34.0 | 32.0 | 34.0 | 26.0 | 28.5 | 35.0 | 33.0 | 30.0 | 31.0 |
| | Station 2 | 30.0 | 29.5 | 32.0 | 35.0 | 33.0 | 34.5 | 27.0 | 28.5 | 35.0 | 33.0 | 30.0 | 31.5 |
| **Surface water (temperature (ºC)** | Station 1 | 29.0 | 28.0 | 29.0 | 33.0 | 30.0 | 33.0 | 25.0 | 27.0 | 33.5 | 31.5 | 28.5 | 28.5 |
| | Station 2 | 29.0 | 28.0 | 30.0 | 33.0 | 31.0 | 33.0 | 26.0 | 27.5 | 33.0 | 32.0 | 29.0 | 29.0 |
| **Electrical Conductivity µmohs/cm** | Station 1 | 356.0 | 425.0 | 375.3 | 468.5 | 524.6 | 685.0 | 742.8 | 698.5 | 542.3 | 426.3 | 398.6 | 356.8 |
| | Station 2 | 348.9 | 418.6 | 368.9 | 457.3 | 514.2 | 648.9 | 687.9 | 598.6 | 512.4 | 389.6 | 416.3 | 375.6 |
| **pH** | Station 1 | 7.4 | 7.3 | 8.0 | 8.1 | 8.1 | 8.2 | 7.2 | 7.5 | 8.2 | 8.0 | 7.4 | 7.7 |
| | Station 2 | 8.0 | 8.1 | 8.1 | 8.2 | 8.1 | 8.2 | 4 7. | 8.0 | 8.0 | 8.1 | 7.9 | 8 7 |
| **Dissolved Oxygen (mg/L)** | Station 1 | 5.0 | 3.1 | 3.1 | 2.9 | 3.0 | 2.8 | 5.5 | 4.8 | 2.9 | 3.2 | 4.2 | 3.5 |
| | Station 2 | 4.6 | 3.1 | 3.0 | 3.1 | 2.9 | 2.9 | 5.2 | 4.5 | 2.8 | 3.1 | 4.0 | 3.4 |
| **Nitrate (mg/L)** | Station 1 | 13.6 | 6.4 | 10.5 | 9.4 | 11.3 | 9.3 | 14.2 | 11.7 | 8.2 | 11.0 | 14.3 | 12.2 |
| | Station 2 | 14.3 | 5.2 | 9.3 | 9.0 | 10.5 | 8.3 | 8.9 | 9.0 | 7.1 | 10.7 | 6.7 | 10.6 |
| **Nitrite (mg/L)** | Station 1 | 2.3 | 2.0 | 1.2 | 1.0 | 1.2 | 1.0 | 3.2 | 2.9 | 1.0 | 2.1 | 2.7 | 2.2 |
| | Station 2 | 2.1 | 1.8 | 1.2 | 1.0 | 1.1 | 1.0 | 3.0 | 2.4 | 0.8 | 2.0 | 2.6 | 1.9 |
| **Phosphate (mg/L)** | Station 1 | 2.0 | 0.6 | 0.5 | 0.4 | 0.8 | 0.6 | 2.2 | 1.8 | 0.8 | 1.0 | 2.0 | 1.2 |
| | Station 2 | 1.8 | 0.6 | 0.5 | 0.3 | 0.8 | 0.6 | 2.0 | 1.7 | 0.8 | 0.9 | 1.6 | 1.0 |
| **Silica (mg/L)** | Station 1 | 6.0 | 5.0 | 5.0 | 6.0 | 4.0 | 5.0 | 6.0 | 4.0 | 5.0 | 3.0 | 5.0 | 6.0 |
| | Station 2 | 5.0 | 4.0 | 4.0 | 6.0 | 4.0 | 5.0 | 4.0 | 4.0 | 3.0 | 4.0 | 5.0 | 4.0 |

**Table No.2: Statistical values of Physico-Chemical Parameters of the Channarayapatna Water Body**

| S.No | Parameter | Stations | Max | Min | Median | Std |
|---|---|---|---|---|---|---|
| 1 | Atmospheric temperature ($^oC$) | Station 1 | 35.0 | 26.0 | 31.2 | ±2.64 |
| | | Station 2 | 35.0 | 27.0 | 31.6 | ±2.63 |
| 2 | Surface water (temperature ($^oC$) | Station 1 | 33.5 | 25.0 | 29.7 | ±2.62 |
| | | Station 2 | 33.0 | 26.0 | 30.0 | ±2.36 |
| 3 | Electrical Conductivity µmohs/cm | Station 1 | 742.8 | 356.0 | 447.4 | ±139.51 |
| | | Station 2 | 687.9 | 348.9 | 438.0 | ±114.79 |
| 4 | pH | Station 1 | 8.2 | 7.2 | 7.8 | ±0.38 |
| | | Station 2 | 8.2 | 7.9 | 8.1 | ±0.09 |
| 5 | Dissolved Oxygen (mg/L) | Station 1 | 5.5 | 2.8 | 3.7 | ±0.95 |
| | | Station 2 | 5.2 | 2.8 | 3.6 | ±0.81 |
| 6 | Nitrate (mg/L) | Station 1 | 14.3 | 6.4 | 11.0 | ±2.44 |
| | | Station 2 | 14.3 | 5.2 | 9.1 | ±2.33 |
| 7 | Nitrite (mg/L) | Station 1 | 3.2 | 1.0 | 1.9 | ±0.79 |
| | | Station 2 | 3.0 | 0.8 | 1.7 | ±0.71 |
| 8 | Phosphate (mg/L) | Station 1 | 2.2 | 0.4 | 1.1 | ±0.66 |
| | | Station 2 | 2.0 | 0.3 | 1.0 | ±0.57 |
| 9 | Silica (mg/L) | Station 1 | 6.0 | 3.0 | 5.0 | ±0.95 |
| | | Station 2 | 6.0 | 3.0 | 4.3 | ±0.78 |



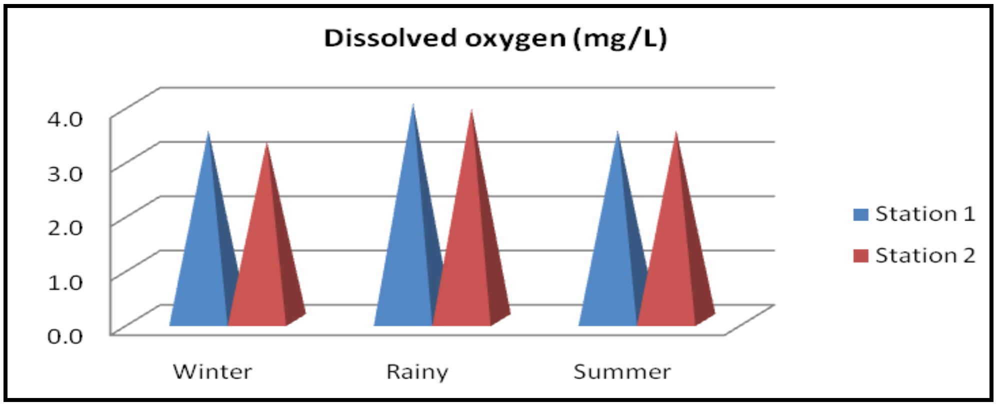
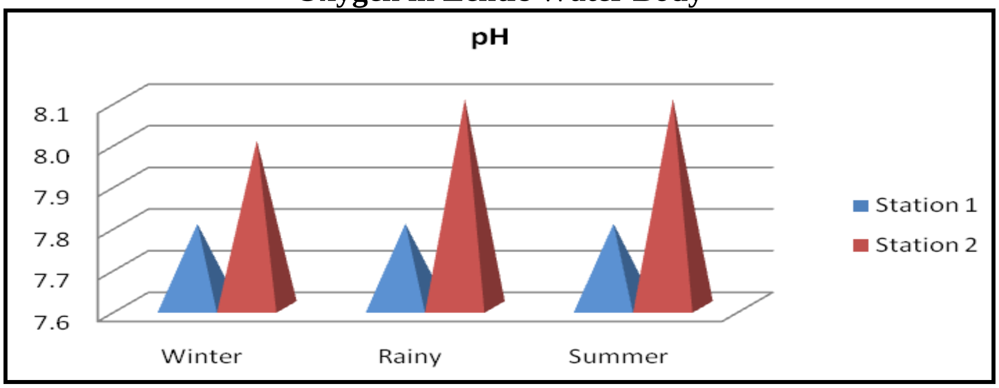
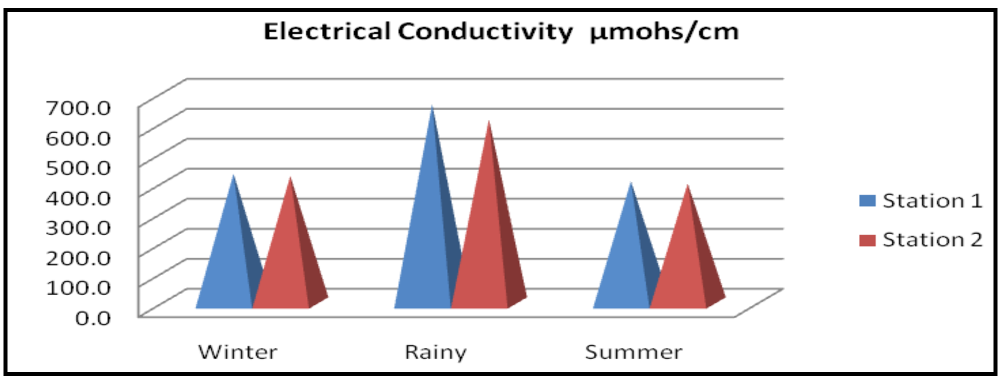



**Figure No.1: Seasonal Variation in Atmospheric Temperature, Water Temperature and Dissolved Oxygen in Lentic Water Body**



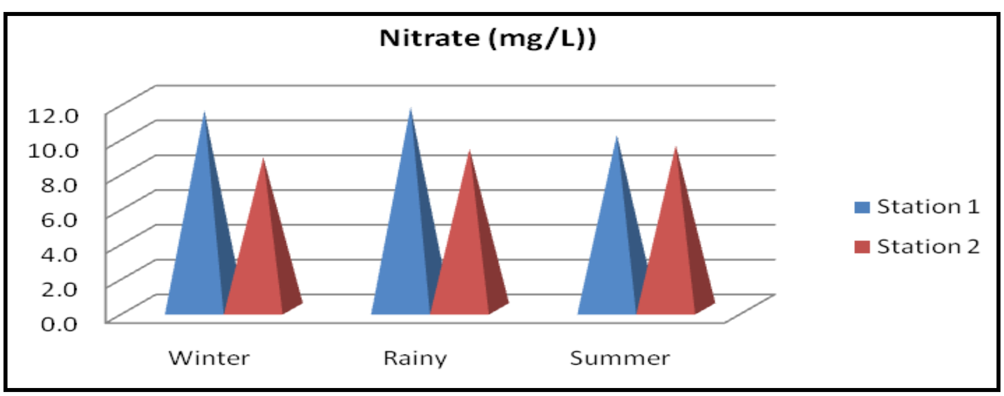




**Figure No.2: Seasonal Variation in pH, Electrical Conductivity and Nitrate in Lentic Water Body**

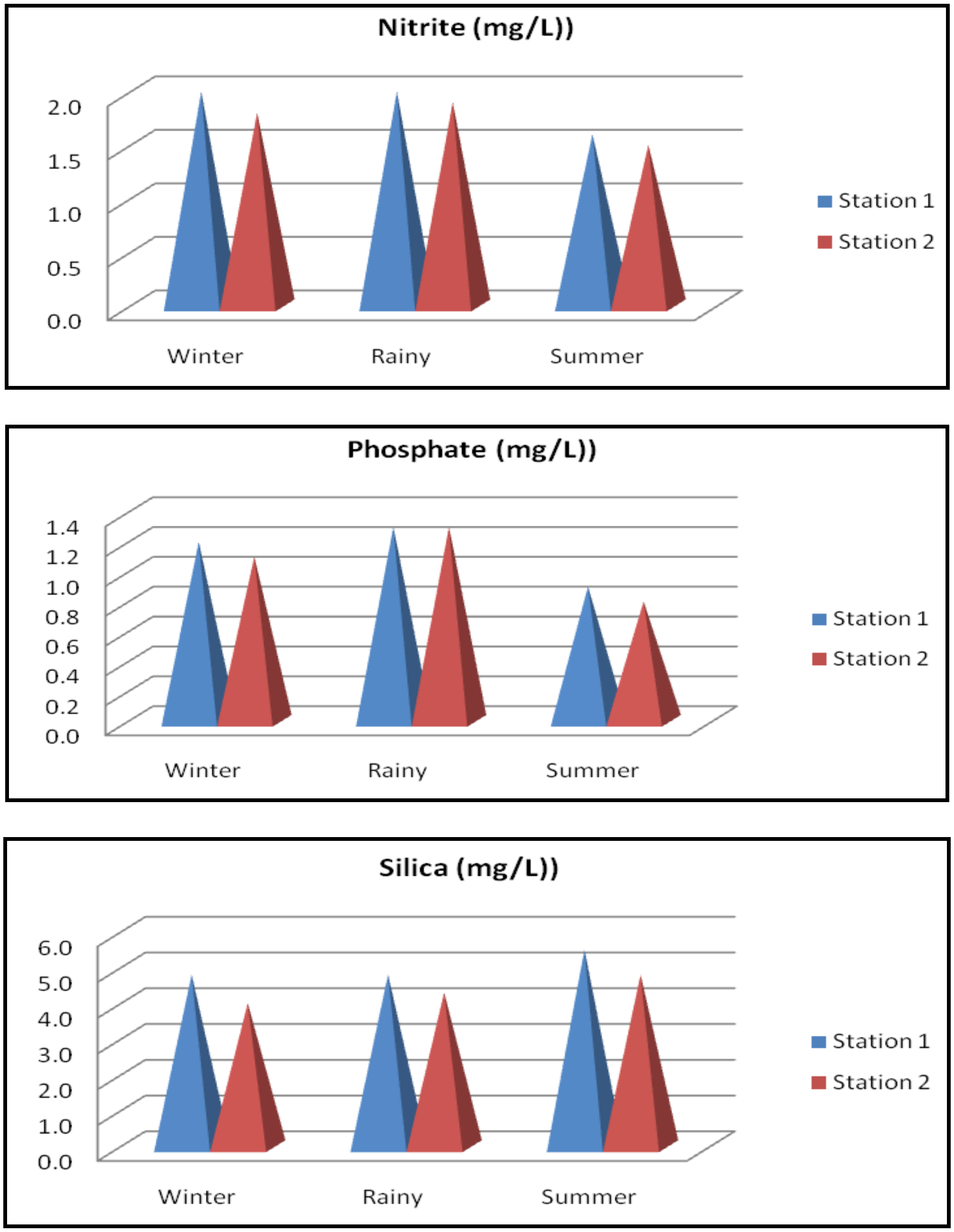



**Figure No.3: Seasonal Variation in Nitrite, Phosphate and Silica in Lentic Water Body**

## CONCLUSION

A conclusion of results can serve as a reference for future studies of chemical, trace metals and biological indicators of pollution in the Channarayapatna water body to assess the impact on the aquatic organisms and assess the ecological condition of the water body. Channarayapatna water body is moderately polluted. The study showed a need for a continuous pollution monitoring programme of the surface waters (lentic ecosystem) in rural setting. Finally, the work has revealed that there was an adverse impact on the physico-chemical characteristics of the receiving watershed as a result of the discharge of inadequately sewage from the surrounding villages and also increased number of macro vegetation indicates that the water quality the lentic ecosystem is going towards eutrophied condition.

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**CONFLICT OF INTEREST**

We declare that we have no conflict of interest.

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