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Research Article

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STUDIES ON THE PHYSICO-CHEMICAL CHARACTERISTIC AND NUTRIENTS IN JANIVARA WATER BODY OF CHANNARAYAPATNA TALUK, HASSAN DISTRICT, KARNATAKA, INDIA

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Abstract

This paper is envisioned to be a study concerning with surface water quality in Janivara water body, Hassan District, Karnataka (India) based on physicochemical and nutrient status and water quality according to water quality guidelines. Water bodies are sometimes subjected to sewage and wastewater discharges originating from different sources. Some of the chemical and nutrients such as nitrogen, phosphorus and carbon in certain concentrations might twist and disorder the characteristics of lentic aquatic ecosystems. This study, purposing to determine water quality characteristics of Janivara water body, located in Channarayapatanme taluka, Hassan district, began in April 2013 and was carried out for 12 months by taking bimonthly intervals water samples from four different locations. Water quality parameters of temperature, pH, dissolved oxygen, chemical oxygen demand (COD), total alkalinity and hardness, ammonia, nitrite, nitrate, phosphate, sulphate, chloride, potassium and sodium analyses were done. Changes in water quality parameters of Janivara water body indicates that not yet Janivar water body reached the eutrophic stage and degradation stage. The study also reveals that all physico-chemical water parameters of the Janivara water body are well within the permissible limit of ICMR, BIS and WHO.

Keywords: Water body, WHO, COD and Nutrients

Introduction

Surface water pollution is an acute problem in India. Water is known to contain a large numbers of chemical elements. The interactions of both the physical and chemical properties of water play a significant role in composition, distribution and abundance of aquatic organisms (Mustapha and Omotosho, 2005). Due to increasing urbanization and industrialization, the pollution potential the surface water bodies are deteriorating and giving momentum day by day.

Water pollution means contamination of water by foreign pollutants such as micro-organism, chemicals industrial or other wastes, or sewage. Such pollutants deteriorate the quality of water and render it unfit for its intended uses (Shukla and Dubey, 1996). Water pollution is the introduction into fresh and ocean waters of chemical, physical and biological material that degrades the quality of the water and affects the organisms living in it. Although some kinds of water pollution get occur through natural processes, it is mostly a result of human activities (Kulshrestha, et al., 2004).

The term water quality was developed to give an indication of how suitable the water is for human consumption (Vaux, 2001). Surface water quality in an aquatic ecosystem is determined by many physical, chemical and biological factors (Sargaonkar and Deshpande. 2003). Therefore, particular problem in the case of water quality monitoring is the complexity associated with analyzing the large number of measured variables and high variability due to anthropogenic and natural influences (Abdul Hameed, *et al.*, 2010).

In the present investigation envisioned to be a study concerning with surface water quality in Janivara water body, Hassan District, Karnataka (India) based on physicochemical and nutrient status and water quality according to both ICMR, BIS and WHO guidelines.

MATERIAL AND METHODS:-

Study area

It is a manmade perennial water body. This water body lies at 13^0.07` to $13^0$.09` N latitude and 76^0.22` to $76^0$.25`E longitude. The water spread area is 400 acres and the depth of the water body is 9 feet. Janivara water body tank is situated 5 Kms away from Channarayapatan town to northern region. The water body is rectangular in shape and it receives water from rainfall, wastewater from KMF milk powder factory and agricultural run-off. The water is used for drinking and irrigation. The colour of the water body is pale greyish. Anthropogenic activities are practiced in the vicinity of the water body. The water is used to grow paddy, sugarcane, cotton, coconut, black gram, red gram, wheat and vegetables. The catchment area received an average rainfall of 656.70 mm (Irrigation Department, 2010-11). The location of this water body is represented in study area Figure 1. Sampling Locations of the study area is given in Table 1. Topography of the Janivara water body is given in Figure 1.

Table 1: Description of water quality sampling locations

Sl No	Code & Name of the site	Activities in and around the water body

1	JS_1 Janivara	Agricultural seepage point
2	JS_2 Janivara	Water entering into the water body
3	JS_3 Janivara	Human activity, weeds are present
4	JS_4 Janivara	Vehicle washings and weeds are present

Analytical Method

In order to determine the physic-chemical characteristics and nutrient status of Janivara water body, surface water samples were collected at selected water body from four sampling locations during April 2013 to March 2014. The samples were collected in sterilized bottles using the standard procedure for grab samples in accordance with standard methods of (Ramakrishniah, *et al.*, 2009). The temperature of the water in all the locations was recorded using a standard mercury centigrade thermometer. The samples were analyzed as per standard methods for fifteen Physico-Chemical parameters namely; Water quality parameters of temperature, pH, dissolved oxygen, chemical oxygen demand (COD), total alkalinity and hardness, ammonia, nitrite, nitrate, phosphate, sulphate, chloride, potassium and sodium. In situ measurement was adopted to determine unstable parameters including; pH and DO by portable meters. The analysis of the parameters total hardness, total alkalinity were carried out by volumetric analysis in accordance with standard methods of (Ramakrishniah, *et al.,* 2009) and Nutrients like ammonia, nitrite, nitrate, phosphate, sulphate were estimated by adopting the methods described by Boyd and Tucker (1992).

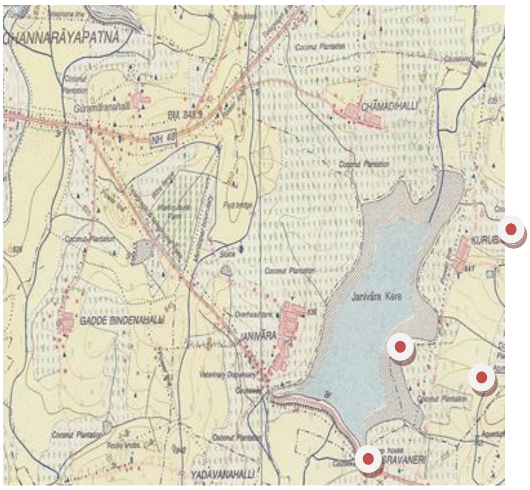

Figure 1. Janivara water body showing sampling locations.

Result and Discussions

Averages values of physico-chemical parameters are represented from Figure 2 to 16. The physico-chemical examination of the water samples carried out for 15 various water quality parameters. The sampling locations of Janivara water body have been shown in Figure 1. In the present study the data revealed that there were considerable variations in the quality with respect to their physicochemical characteristics.

Water temperature is basically important for its affects on certain chemical and biological activities in the organisms attributing in aquatic media. Singhal, et *al.,* (1986) indicated in their work, most of the water bodies in Indian subcontinent ranges from 7.8 and 38.5^{0}C. In the present study water temperature ranged from a low of 20.8ºC in January to a high of 31.9ºC in August over the year. In contrast with seasons, water temperature did not change as much by locations (Boyd, 1990). The average water temperature was 28.7ºC, 27.7ºC, 27.6ºC, and 28.3ºC for JS_1, JS_2, JS_3 and JS_4, respectively (Figure 2). The water temperature varies between locations and water bodies is depends upon the weather and temperature of atmospheric conditions (Sangpal, *et al.*, 2011).

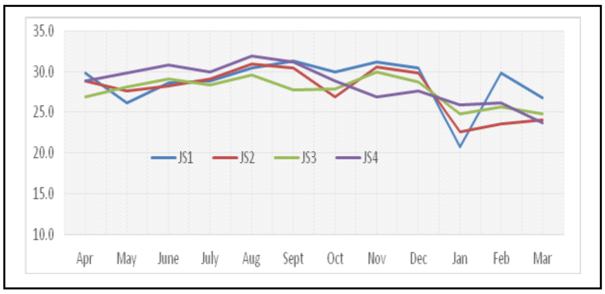

Figure 2 Sequential changes in the Water Temperature of Janivara Water Body

Goldman and Horns, (1983) noticed in their work, in most of the water bodies the pH values found in alkaline side (pH>7). Present study also reveals the same trend, pH values were ranged from 7.2 to 8.8. In general the pH values are higher in winter than other seasons (Adebowale, *et al.*, 2008). Throughout the study period, no statistical difference was found in pH values between the locations. pH values increased month by month starting from December to March. Annual mean pH values were 7.7, 7.8, 7.8 and 7.7 for the JS_1, JS_2, JS_3 and JS_4, respectively (Figure 3). The variation can be due to the exposure of water body to atmosphere, biological activities and temperature changes. Present study also supported by Yalcin Tepe, *et al.,* (2005).

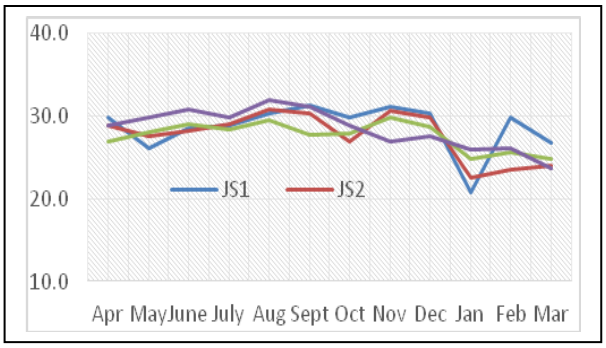

Figure 3 Sequential changes in the pH of Janivara Water Body

Tepe and Mutlu, (2004) worked on Hatay Harbiye Spring Water, noticed in their study dissolved oxygen concentrations were above 5 mg/L, which was adequate enough to support aquatic life. The increase in dissolved oxygen levels might be the result of runoffs accounted for by winter rains. DO reproduces the physical and biological processes prevailing in the water. Present investigation demonstrates DO varies from 4.7 to 8.2 mg/L during the study. The mean 6.0 mg/L, 6.3 mg/L, 6.1 mg/L and 6.3 mg/L for JS_1, JS_2, JS_3 and JS_4, respectively. In the current study maximum (8.2 mg/L) DO values indicated during winter season. These values indicate relatively large organic pollution. The same trend of DO was observed by other researchers (Jayaraju, *et al.*, 1994).

The increased water body temperature could be attributed to increased suspended matter in the water body. Wetzel (1983) opined that, increased temperature in the water body, due to increase increased stability of stratified water column and hence reducing mixing depth. Dissolved oxygen levels, however, increased up to 8.2 mg/L in January (the 10 month) and averaged 8.0, 7.6 mg/L, 6.0 and 7.1 mg/L during the last three months

(January to March) for JS_1, JS_2, JS_3 and JS_4, respectively (Figure 3).

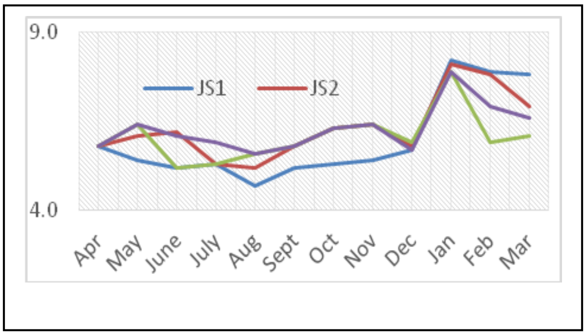

Figure 4 Sequential changes in the DO of Janivara Water Body

COD is the amount of oxygen consumed during the chemical oxidation of organic matter using strong oxidizing agent like acidified potassium dichromate (Selvanayagam and Joseph Thatyas, 1999). In the present study, Chemical oxygen demand (COD) at the beginning of the study in April to until October varies from was 18 mg/L to 32 mg/L at all the locations. After October, COD levels decreased in last four months down to 24 mg/L (Figure 5). Water without adequate DO may be considered waste water. The DO values obtained in the present study are less compared to ICMR standards.

The highest values of COD indicated that most of the pollution caused by agricultural runoff at station SJ_1. Similar results were also reported by Pande and Sharma (1998) and Sangpal, *et al.*, (2011). Annual mean COD levels were 25.3 mg/L, 24.8 mg/L, 25.14 mg/L and 27.17 mg/L for JS_1 and JS_4, respectively (Figure 5).

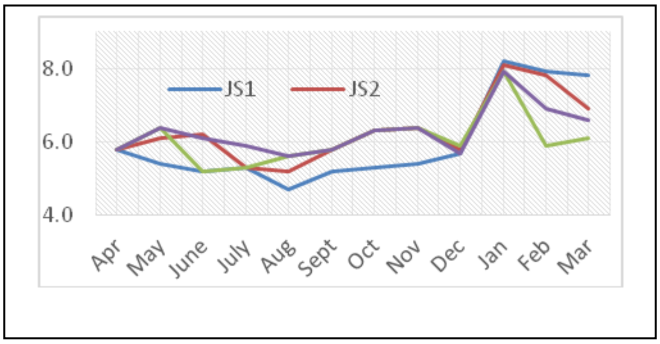

Figure 5 Sequential changes in the COD of Janivara Water Body

Chaterjee and Razuddin, (2002) noticed in their study, nitrate is the most important nutrient in an ecosystem. Generally water bodies polluted by organic matter exhibit higher values of nitrate. Results are used to calculate the WQI. In the present study nitrate, and nitrite levels indicated similar patterns and max levels were recorded in January as especially during winter season. Nitrogen derivatives did not show seasonal change by locations. Although the average measurements of all nitrogen derivatives from JS_1 were higher than those from JS_2, JS_3 and JS_4 there was no statistical difference found. The average nitrate, nitrite levels measured from JS_1 were 10.6 mg/L and 0.038 mg/L. These values were 11.6 mg/L and 0.028 mg/L, values were 11.5 mg/L and 0.032 and values were 11.2 mg/L and 0.046 respectively, for JS_2, JS_3 and JS_4 (Figure 6 and 7). In the present study water samples in all the locations of Janivara water body showed low concentration of nitrate well below permissible limits (BIS, 1993 and ICMR, 1975).

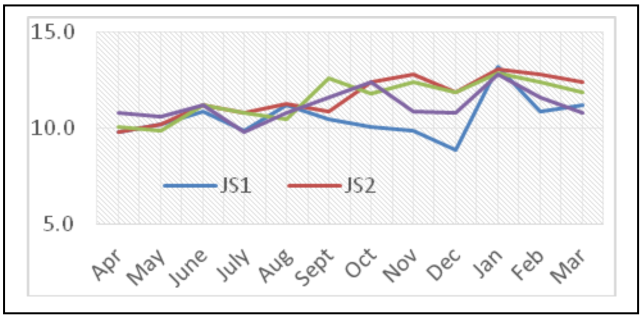

Figure 6 Sequential changes in the Nitrate (NO_3) of Janivara Water Body

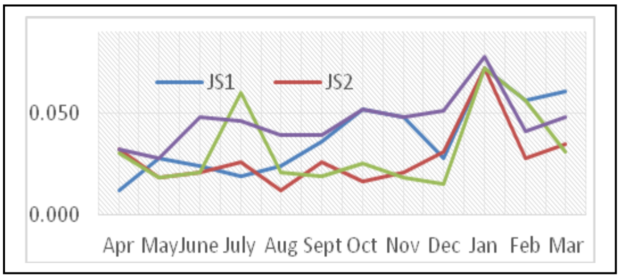

Figure 7 Sequential changes in the Nitrite (NO_2) of Janivara Water Body

The value of Total hardness in water provides an idea of natural salts present in water. The maximum permissible level of alkalinity is 600 mg/L and hardness of drinking water. In the present study the maximum alkalinity of water was 271.0 mg/L and 372.0 mg/L recorded in the month of January in all the locations respectively, indicates that the water of Janiavara water body is slightly hard. In the freshwater, hardness is imparted by the calcium and magnesium ions which are in combination with bicarbonates and carbonates apart from sulphates, chlorides and nitrates.

Fluctuations in total alkalinity and total hardness were similar but the amount of the total hardness was significantly greater than that of the total alkalinity. Over the study period, JS_1 had significantly higher measurements of both total alkalinity and total hardness than JS_2, JS_3 and JS_4 ($p < 0.05$). The average total alkalinity and total hardness values were 274 mg/L and 318 mg/L for JS_1, respectively. These values were 208 mg/L and 275 mg/L for JS_2, 218 mg/L and 267 mg/L for JS_3 and 228 mg/L and 259 mg/L for JS_4 for the total alkalinity and total hardness, respectively (Figure 8 and 9). Present study reveals that the total hardness and total alkalinity are in all the locations the value of hardness is well under the permissible limit of WHO and BIS.

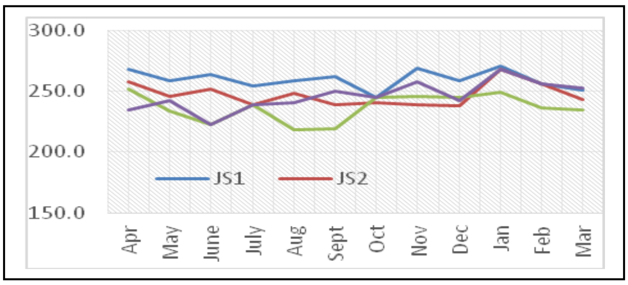

Figure 8 Sequential changes in the Total Alkalinity of Janivara Water Body

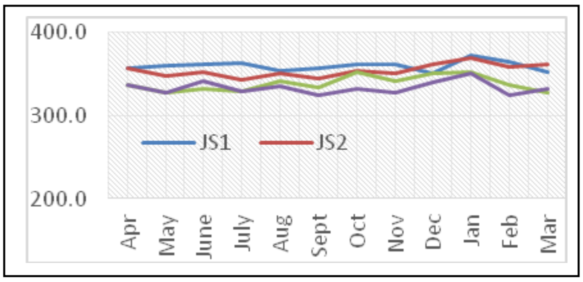

Figure 9 Sequential changes in the Total Hardness of Janivara Water Body

Considering phosphate is the most vital nutrient effecting productivity of natural water resources. Plant absorbs and store phosphorous in water, hence phosphate occurs in surface water is low quality many times their actual immediate needs, present study the average phosphate values ranged between 0.47 mg/L in JS_1. Phosphate measurements in all other locations JS_2 JS_3 and JS_4 were significantly lower than JS_1 and averaged 0.43 mg/L, 0.38 mg/L and 0.37 mg/L. Phosphate levels increased during summer in all the locations. Levels increased until monsoon (August) and gradual decrease was seen during winter (December) season. Phosphate levels reached to 0.6 mg/L, 0.55 mg/L, 0.49 mg/L and 0.51 mg/L in August for JS_1, JS_2 JS_3 and JS_4, respectively. The same trends were also observed by the other researcher (Bandela, *et al.*, 1998). Phosphate levels did not change by locations and by months (Figure 10). Bronmark and Hansson (2002) found that biodiversity of lakes and pond ecosystems are currently threatened by a number of human disturbances. Present study also reveals that the water body is disturbed by the human activity and due to agricultural discharge.

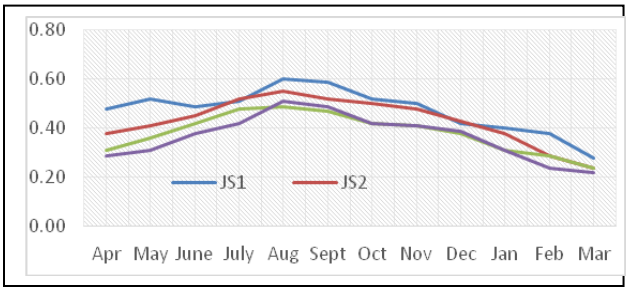

Figure 10 Sequential changes in the Phosphate of Janivara Water Body

Chloride occurs in all aquatic ecosystem. (Trivedi, *et al.*, 2009 and Chandrashekar, *et al.*, 2003) explained in their studies Chloride is one of the pollution indicator and indicates the pollution is due to high organic waste of animal origin. Maximum permissible limit with regard to chloride content in natural surface freshwaters according to WHO (1985) is 200 mg/ L and the same according to ICMR (1975) is 250 mg/L.

In the present study, the average chloride concentration is 198.4 mg/L in JS_1 and in all other location 182.0 mg/L, 187.3 mg/L and 185.3 mg/L in JS_2, JS_3 and JS_4 respectively (Figure 11). Chloride found in the range of 159.0 mg/L to 215.0 mg/L, at all the sampling points within the desirable limit as per ICMR and above the desirable as per limit BIS standard in JS_1 and JS_4. According to Versari, *et al.*, (2002), chloride concentrations higher than 200.0 mg/L are considered to be risk for human health and may cause unpleasant taste of water. In the present except JS_2 and JS_3 locations falls below the 200 mg/L and study reveals that water can be used for human consumption.

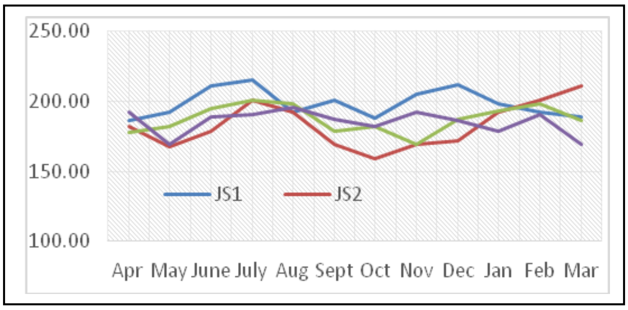

Figure 11 Sequential changes in the Chloride of Janivara Water Body

Water containing more than 200 mg/L of sodium should not be used for drinking by those and moderately restricted (Mahendra, *et al.*, (2010). In the present study sodium concentration started from 31.6 mg/L in Station JS_4 and 49.0 mg/L in Station JS_1 during the month of February and January respectively. The average sodium levels were 40.4 mg/L, 37.9 mg/L, 40.0 mg/L and 38.8 mg/L for JS_1, JS_2, JS_3 and JS_4, respectively (Figure 12).

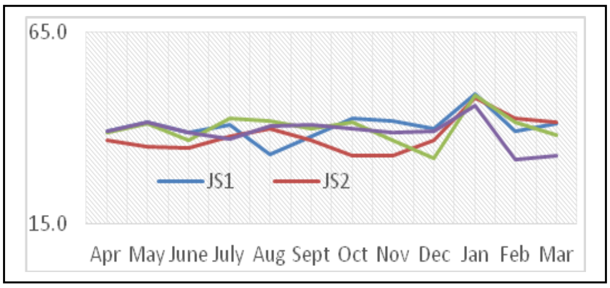

Figure 12 Sequential changes in the Sodium of Janivara Water Body

As potassium and sodium levels also did not change by stations and by months. Potassium concentrations showed between 7.8 mg/L in April and increased gradually each month until January up to 11.0 mg/L, 13.0 mg/L, 12.1 mg/L and 14.2 mg/L and then dropped back to 10.6 mg/L, 11.6 mg/L, 10.2 mg/L and 11.5 mg/L in March for JS_1, JS_2, JS_3 and JS_4, respectively (Figure 13). The average potassium levels in entire study is 10.2 mg/L and did not change by stations and by months. In the present study both sodium and potassium concentration were showing within the desirable limit of ICMR and BIS. Other investigators studies also coincide with the present investigation (Versari, *et al.*, 2002 and Lena, *et al.*, 2012)

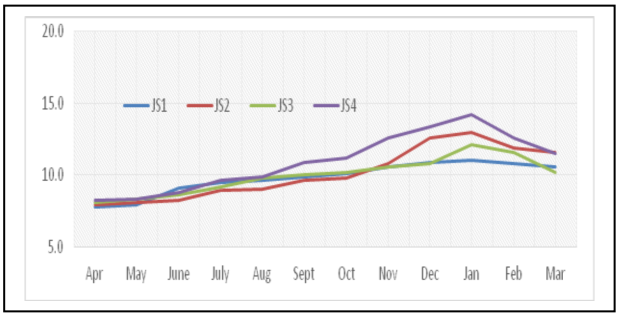

Figure 13 Sequential changes in the Potassium of Janivara Water Body

Seitzniger, (1988) observed in their study, higher concentration of sulphate during monsoon season, is due to surface runoff, drainage, siphon runoff, storm water. In the present study, contradictory result were indicating sulphate concentration is indicated the maximum values in May with 129.0 mg/L, 198.6 mg/L, 118.3 mg/L and 142.6 mg/L for JS_1, JS_2 JS_3 and JS_4 respectively. The average sulphate concentrations were 108.1 mg/L, 121.9 mg/L, 103.1 mg/L and 112.4 mg/L for location JS_1, JS_2 JS_3 and JS_4, respectively (Figure 14). Higher concentration in summer is maybe due to activity of biological reaction. However dilution and utilization by aquatic plants gradually brought down the concentration in monsoon seasons Munawar, (1970). Present study also reveals that biodegradation process occurring probably due to entering of agricultural waste into the water body. Sulphate level found in the range of 92.2 mg/L to 198.6 mg/L, at all the sampling locations within the desirable limit as per ICMR and BIS standard (Lonkar, *et al.*, 2015).

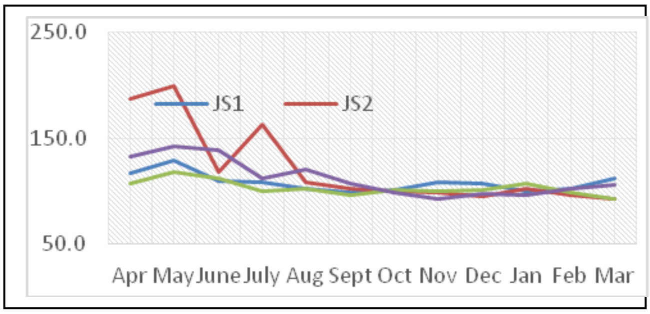

Figure 14 Sequential changes in the Sulphate of Janivara Water Body

Conclusion

On the basis of the present investigation and above discussion, it may be concluded that the selected Janivara water body at almost all the locations at in the Channarayapatna taluk is not yet Janivar water body reached the eutrophic stage and degradation stage. At two locations, it is moderately polluted in the catchment study area. In the entire investigation, the quality of water at SJ_2 and SJ_3 was found better the water quality at SJ_1 and SJ_4. Therefore, the use at SJ_1 and SJ_4 should be unenthusiastic. Some parameters were showing the drinking water quality was found to start deteriorating after the onset of monsoon. People dependent on this water body are frequently and continuously it may leads to health hazards. Therefore, some control measures are to be introduce to enhance the drinking water quality by delineating an effective water quality management plan for the region Channarayapatna taluka a specially in and around the Janivara water body.

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