*Available online at* www.pelagiaresearchlibrary.com

Pelagia Research Library

**Pelagia Research Library**

**Advances in Applied Science Research, 2014, 5(1):97-102**

Pelagia Research Library

**ISSN: 0976-8610**
**CODEN (USA): AASRFC**

# Use of water quality index to validate lentic ecosystem pollution and seasonal dissimilarity at Channarayapatna taluk, Hassan district, Karnataka, India

**Bharathi H. R.[1], Manjappa S.[2], Suresh B.[3] and E. T. Puttaih[3]**

[1]*Department of Environmental Science Kuvempu University, Shankaraghatta, Shimoga, Karnataka, India*
[2]*Department of Chemistry, UBDT College of Engineering, Davangere, Karnataka, India*
[3]*Department of Civil Engineering, Bapuji Institute of Engineering & Technology, Davangere, Karnataka, India*
[4]*Gulbarga University, Gulbarga, Karnataka, India*

---

**ABSTRACT**

*To evaluate spatial and temporal contamination of selected water bodies using Water Quality Index (WQI) has been calculated for Channarayapatna ($SC_1$ and $SC_2$), Bagur ($SB_1$ and $SB_2$), Janivara ($SJ_1$ and $SJ_2$) and Anekere ($SA_1$ and $SA_2$) at Channarayapatna taluk during pre-monsoon season and monsoon season. Water quality parameters were selected as per the WHO guidelines. Fourteen water quality physico-chemical parameters were estimated as per the standard methods and procedures. Drinking water at almost all the sites was found to be highly contaminated, except a few sites, where it was found moderately contaminated for both the seasons during the year 2011. In general, to some extent water quality showed deterioration after the onset of monsoon. The rural village activity produces a serious and negative effect on the water quality, this is due sewage discharge from the villages. It was found that some effective measures are urgently required for water quality management in this region.*

**Keywords**: Water Quality Index, physico-chemical parameters, lentic ecosystem, quality rating, water body

---

## INTRODUCTION

It is well known fact that potable safe water is absolutely essential for healthy living. Adequate supply of fresh and safe drinking water is a basic need for all human beings on the earth. The problem of drinking water contamination, water conservation and water quality management has assumed a very complex shape. Attention on water contamination and its management has become a need of our because of far reaching impact on human health.

The use of water quality indices (WQI) is a simple practice that overcomes many of the previous mentioned problems and allows the public and decision makers to receive water quality information (AOAC, 1995). The major tool of pollution profile studies is the water quality index (WQI). Horton proposed the first formal WQI in the literature in 1965 (Ott, 1978).Water Quality Index (WQI) is regarded as one of the most effective way to communicate water quality (Kannan, K, 1991 and Pradhan, S. K *et al.*, 2001). In a number of nationwide studies, water quality of different natural resources was assessed on the basis of calculated water quality indices (Sinha, D. K *et al.*, 2001 and Rajmohan, N, 2003). The data obtained through quantitative analysis and WHO water quality standards8 were used for calculating water quality indices. The purpose of calculating WQI and comparing it with the standards is to assess drinking water contamination at selected water body at Channarayapatna taluka and seasonal variation of water quality after the onset of monsoon on the basis of calculated values of water quality indices.

## MATERIALS AND METHODS

### Study area

The study was carried out at selected water body in Channarayapatna taluk, which are a balancing and maintained to serve water requirement for irrigation and other human activity. The water samples from the identified water bodies were collected at an interval of 30 days and analyzed for 14 physico-chemical parameters as per the standard method (APHA, 1995). The study area is shown on a satellite image with 4 sampling stations. The present study was conducted along the priority road which is of 18 Kms in length, touching 4 villages (water body) namely Channarayapatna, Janivara, Bagura and Anekere. The Latitude and longitude ranges given in Table 1.

### Laboratory Analysis

In order to determine the water quality index, surface water samples were collected at selected water body from two sampling sites at each water body during June 2010 to January 2011. The samples were collected in sterilized bottles using the standard procedure for grab samples in accordance with standard methods of (Ramakrishniah, C.R., *et al.*, 2009). The samples were analyzed as per standard methods for thirteen Physico-Chemical parameters namely; pH (Hydrogen ion concentration), Turbidity, EC (Electrical conductivity), TDS (Total Dissolved Solids), TS (Total Solids), DO (Dissolved oxygen), BOD (Biochemical Oxygen Demand) and COD (Chemical Oxygen Demand), , TH (Total hardness), Total Alkalinity (TA) ions of $Ca^{2+}$(Calcium), $Mg^{2+}$ (Magnesium) and $Cl^{-}$ (chloride), and Free $CO_2$ (Free $CO_2$). In situ measurement was adopted to determine unstable parameters including; pH, EC and DO by portable meters. The analysis of the parameters total hardness and ions of each calcium, magnesium, chloride and Free $CO_2$ were carried out by volumetric analysis in accordance with standard methods of (Ramakrishniah, C.R., *et al.*, 2009).

### Calculation of WQI

The Water Quality Index (WQI) was calculated using the Weighted Arithmetic Index method. The quality rating scale for each parameter qi was calculated by using this expression (Sinha, D. K., *et al.*, 2004).

Quality rating, Qi = 100 [(Vn -Vi) / (Vs -Vi)]

Where,
Vn: actual amount of nth parameter
Vi: the ideal value of this parameter
Vi = 0, except for pH and DO. Vi = 7.0 for pH; Vi = 14.6mg/L for DO.
Vs: recommended WHO standard of corresponding parameter

Relative weight (Wi) was calculated by a value inversely proportional to the recommended standard (Si) of the corresponding parameter.

Wi = 1/ Si, WQI are discussed for a specific and intended use of water. In this study the WQI for human consumption is considered and permissible WQI for the drinking water is taken as 100. The overall WQI was calculated by using Equation:

Water Quality Index (WQI) =Σ(Qi)Wi /ΣWi (WQI)

## RESULTS AND DISCUSSION

The physico-chemical parameters with their WHO standards and unit weights (Wn) assigned with the help of equation No. 2 presented in the text are listed in Table 2. Location wise and parameter-wise estimated values (Vn), and calculated quality rating (Qn) for the pre-monsoon period are presented in Table 3.

Location-wise and parameter-wise values of Vn and Qn after the onset of monsoon are given in Table 4. Site-wise calculated values of WQI for the pre-monsoon period as well as after the onset of monsoon are presented in Table 5. Critical analysis of the data of the WQI presented in Table 5 and its comparison with the standard assumptions reveals the following facts regarding the level of drinking water contamination and effect of monsoon over the quality of selected water body at Channarayapatna taluk during the study. The observed range of Water Quality

Index ranged 103.88 – 203.5. Whereas water quality index 103.88 – 205.91 during monsoon and in pre-monsoon raged from144.0 - 203.5 (Figure 2).

From the comparative analysis of WQI values at selected locations in both pre-monsoon and monsoon season, it was observed that WQI values for Channarayapatna water body varied from 175.12 in pre-monsoon to 205.91in monsoon season and 180.65 in monsoon to 203.51 in Pre monsoon respectively.

In Bagura water body, WQI varied from 146.25 in monsoon to 163.09 in pre monsoon season and 135.55 in monsoon to 158.71 in pre monsoon. Janivara water body, it varied from 112.34 to 172.84. Anekere water body, it varied from 103.88 – 158.51 in monsoon to 156.63 and 189.67 pre monsoon season respectively. Hence, it can be seen that water quality of water body around Channarayapatna deteriorates slightly from pre monsoon to monsoon season. This could be due to the fact that the microbial activity get reduced due to low temperature, thereby keeping DO level at a very satisfactory range during entire monsoon season. Also during pre-monsoon, the water quality deteriorates on account of the increase in microbial activity as well as increase in pollutants concentration due water evaporation.

The selected water body in the Channarayapatna taluk is severely contaminated at almost all the locations, except at location SJ2 and SA2 during monsoon period as the observed values of WQI are more than 100. Drinking water is observed to be excessively contaminated with WQI values more than 200 at location SC1, SC2 and more than 150 at location SA1, SB1 and SJ1 and it is highly contaminated with WQI values less than 200 at location SC1 after the onset of monsoon. A comparison of the values of WQI for two seasons reveals that in general, drinking water quality is deteriorated due to contamination is more in after the onset of monsoon which is quite alarming. A comparison of values of WQI of selected water body SJ1 and SA2 shows that the water quality of SA2 is better.

**Table 1: Description of water quality sampling locations**

| Sl No | Code & Name of the site | Location of site | Longitude | Latitude |
|---|---|---|---|---|
| 1 | $SC_1$ Channarayapatna | North side of the water body | 76°24'30.58"E | 12°54'56.97"N |
| 2 | $SC_2$ Channarayapatna | South side of the water body | $76^0$24’38.58”E | 12°54'46.97"N |
| 3 | $SB_1$ Bagur | North side of the water body | 76°23'35.12"E | 13°01'23.25"N |
| 4 | $SB_2$ Bagur | South side of the water body | $76^0$23’28.12”E | 13°01'16.25"N |
| 5 | $SJ_1$ Janivara | North side of the water body | 76°25'37.66"E | 12°53'33.76"N |
| 6 | $SJ_2$ Janivara | South side of the water body | $76^0$25’29.66”E | 13°53'26.76"N |
| 7 | $SA_1$ Anekere | North side of the water body | 76°20'52.12"E | 12°54'30.47"N |
| 8 | $SA_2$ Anekere | South side of the water body | $76^0$20’42.12”E | 13°54'22.47"N |

**Table 2:Parameter-wise WHO standards and their assigned unit weights**

| Sl No | Parameters | Units | WHO Standard | Assigned unit Wt. (Wn) |
|---|---|---|---|---|
| 1 | pH | - | 8.5 | 0.1176 |
| 2 | Turbidity | NTU | 5 | 0.2000 |
| 3 | Conductivity | mS/cm | 0.3 | 3.3333 |
| 4 | Total Alkalinity | mg/L | 100 | 0.0100 |
| 5 | Total Solids | mg/L | 500 | 0.0020 |
| 6 | TDS | mg/L | 500 | 0.0020 |
| 7 | DO | mg/L | 5 | 0.2000 |
| 8 | BOD | mg/L | 6 | 0.1667 |
| 9 | COD | mg/L | 10 | 0.1000 |
| 10 | Total hardness | mg/L | 100 | 0.0100 |
| 11 | Calcium | mg/L | 100 | 0.0100 |
| 12 | Magnesium | mg/L | 30 | 0.0333 |
| 13 | Free $CO_2$ | mg/L | 10 | 0.1000 |
| 14 | Chloride | mg/l | 200 | 0.0050 |

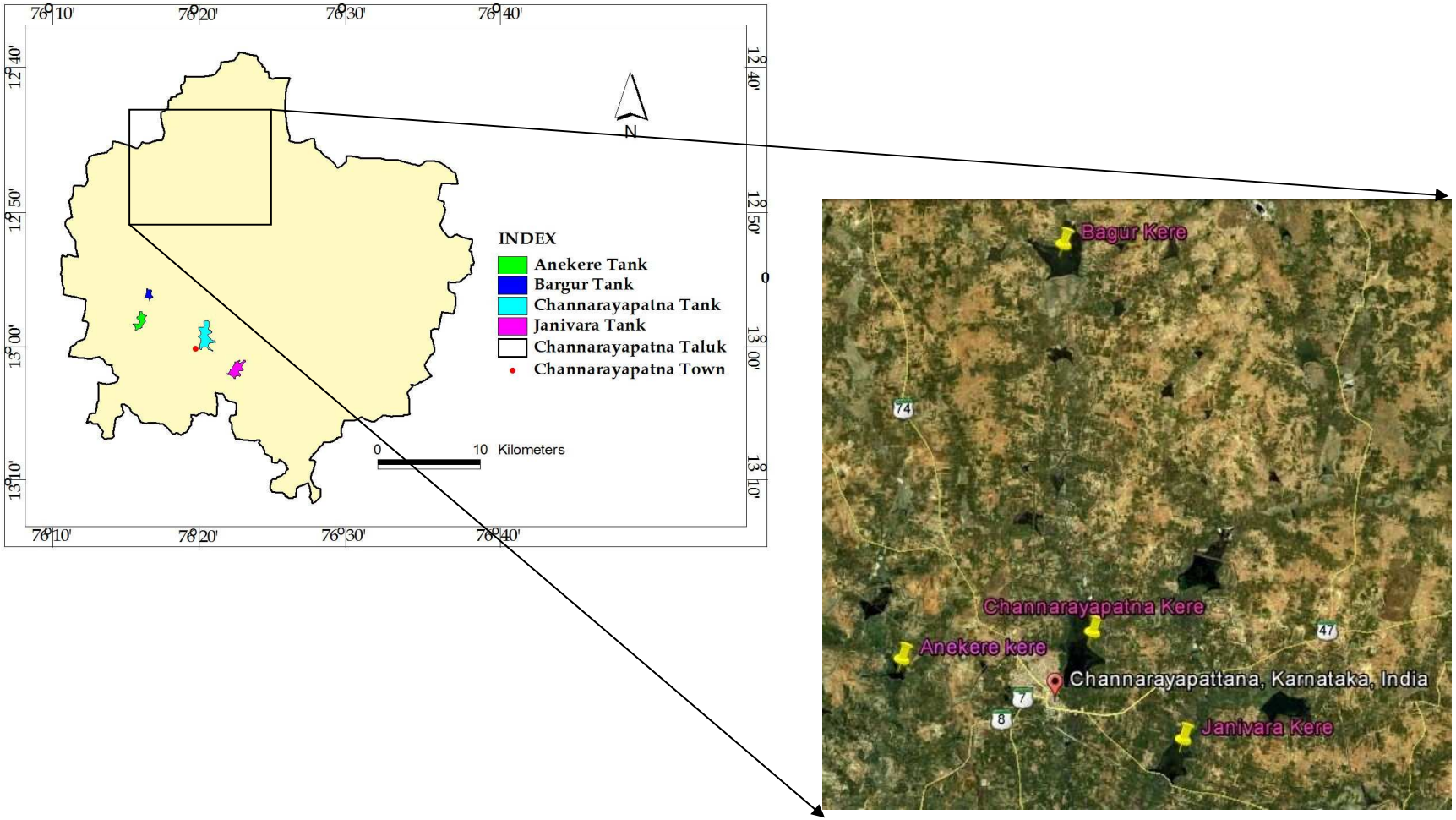


**Figure – 1 Index of Sampling location in Channarayapatna Taluk**

**Table 3:Parameter-wise and site-wise estimated actual values (Vn) and calculated quality rating (Qn) for pre-monsoon period**

| Sl No | Parameter | $SC_1$ | | $SC_2$ | | $SB_1$ | | $SB_2$ | | $SJ_1$ | | $SJ_2$ | | $SA_1$ | | $SA_2$ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Vn | Qn | Vn | Qn | Vn | Qn | Vn | Qn | Vn | Qn | Vn | Qn | Vn | Qn | Vn | Qn |
| 1 | pH | 7.40 | 26.67 | 7.17 | 11.33 | 7.07 | 4.67 | 7.55 | 36.67 | 7.60 | 40.00 | 7.59 | 39.33 | 7.56 | 37.33 | 7.14 | 9.33 |
| 2 | Turbidity | 2.40 | 48.00 | 3.08 | 61.60 | 5.10 | 102.00 | 2.80 | 56.00 | 2.90 | 58.00 | 3.10 | 62.00 | 3.26 | 65.20 | 4.92 | 98.40 |
| 3 | Conductivity | 0.612 | 204.00 | 0.724 | 241.33 | 0.560 | 186.67 | 0.536 | 178.67 | 0.589 | 196.33 | 0.489 | 163.00 | 0.662 | 220.67 | 0.540 | 180.00 |
| 4 | Total Alkalinity | 185.0 | 185.00 | 205.0 | 205.00 | 240.0 | 240.00 | 190.0 | 190.00 | 170.0 | 170.00 | 185.0 | 185.00 | 175.0 | 175.00 | 240.0 | 240.00 |
| 5 | Total Solids | 300.0 | 60.00 | 410.0 | 82.00 | 450.0 | 90.00 | 328.0 | 65.60 | 420.0 | 84.00 | 360.0 | 72.00 | 391.0 | 78.20 | 896.0 | 179.20 |
| 6 | TDS | 200.0 | 40.00 | 360.0 | 72.00 | 320.0 | 64.00 | 304.0 | 60.80 | 290.0 | 58.00 | 260.0 | 52.00 | 281.0 | 56.20 | 791.0 | 158.20 |
| 7 | DO | 6.22 | 86.59 | 6.36 | 85.05 | 6.00 | 89.01 | 7.40 | 73.63 | 7.20 | 75.82 | 7.32 | 74.51 | 7.50 | 72.53 | 3.98 | 111.21 |
| 8 | BOD | 3.50 | 58.33 | 2.67 | 44.50 | 2.52 | 42.00 | 4.51 | 75.17 | 5.42 | 90.33 | 5.97 | 99.50 | 4.81 | 80.17 | 1.02 | 17.00 |
| 9 | COD | 10.00 | 100.00 | 6.00 | 60.00 | 7.26 | 72.60 | 14.60 | 146.00 | 16.86 | 168.60 | 15.00 | 150.00 | 14.00 | 140.00 | 5.60 | 56.00 |
| 10 | Total hardness | 170.0 | 170.00 | 150.0 | 150.00 | 280.0 | 280.00 | 250.0 | 250.00 | 176.0 | 176.00 | 152.0 | 152.00 | 250.0 | 250.00 | 278.0 | 278.00 |
| 11 | Calcium | 44.13 | 44.13 | 37.41 | 37.41 | 85.09 | 85.09 | 64.47 | 64.47 | 44.09 | 44.09 | 38.48 | 38.48 | 60.92 | 60.92 | 64.13 | 64.13 |
| 12 | Magnesium | 26.81 | 89.37 | 24.34 | 81.13 | 33.12 | 110.40 | 25.19 | 83.97 | 16.08 | 53.60 | 13.65 | 45.50 | 23.88 | 79.60 | 28.76 | 95.87 |
| 13 | Free $CO_2$ | 14.20 | 142.00 | 17.40 | 174.00 | 14.00 | 140.00 | 19.80 | 198.00 | 17.60 | 176.00 | 7.40 | 74.00 | 10.88 | 108.80 | 8.76 | 87.60 |
| 14 | Chloride | 49.70 | 24.85 | 77.53 | 38.77 | 159.7 | 79.85 | 21.87 | 10.94 | 29.82 | 14.91 | 17.89 | 8.95 | 71.57 | 35.79 | 135.18 | 67.59 |

**Table 4:Parameter-wise and site-wise estimated actual values (Vn) and calculated quality rating (Qn) for monsoon period**

| Sl No | Parameter | $SC_1$ | | $SC_2$ | | $SB_1$ | | $SB_2$ | | $SJ_1$ | | $SJ_2$ | | $SA_1$ | | $SA_2$ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Vn | Qn | Vn | Qn | Vn | Qn | Vn | Qn | Vn | Qn | Vn | Qn | Vn | Qn | Vn | Qn |
| 1 | pH | 7.80 | 53.33 | 7.90 | 60.00 | 7.80 | 53.33 | 7.82 | 54.67 | 7.60 | 40.00 | 7.65 | 43.33 | 7.70 | 46.67 | 8.12 | 74.67 |
| 2 | Turbidity | 2.50 | 50.00 | 3.67 | 73.40 | 5.32 | 106.40 | 3.12 | 62.40 | 3.25 | 65.00 | 2.23 | 44.60 | 2.98 | 59.60 | 5.20 | 104.00 |
| 3 | Conductivity | 0.724 | 241.33 | 0.624 | 208.00 | 0.480 | 160.00 | 0.453 | 151.00 | 0.459 | 153.00 | 0.368 | 122.67 | 0.542 | 180.67 | 0.320 | 106.67 |
| 4 | Total Alkalinity | 210.0 | 210.00 | 210.0 | 210.00 | 300.0 | 300.00 | 200.0 | 200.00 | 180.0 | 180.00 | 160.0 | 160.00 | 164.0 | 164.00 | 184.0 | 184.00 |
| 5 | Total Solids | 255.0 | 51.00 | 301.0 | 60.20 | 310.0 | 62.00 | 288.0 | 57.60 | 418.0 | 83.60 | 380.0 | 76.00 | 450.0 | 90.00 | 223.0 | 44.60 |
| 6 | TDS | 275.0 | 55.00 | 290.0 | 58.00 | 250.0 | 50.00 | 204.0 | 40.80 | 290.0 | 58.00 | 310.0 | 62.00 | 390.0 | 78.00 | 592.0 | 118.40 |
| 7 | DO | 6.78 | 80.44 | 6.62 | 82.20 | 6.48 | 83.74 | 7.80 | 69.23 | 7.85 | 68.68 | 6.50 | 83.52 | 5.20 | 97.80 | 5.02 | 99.78 |
| 8 | BOD | 3.00 | 50.00 | 3.80 | 63.33 | 3.80 | 63.33 | 4.50 | 75.00 | 4.80 | 80.00 | 4.56 | 76.00 | 3.08 | 51.33 | 2.21 | 36.83 |
| 9 | COD | 14.0 | 140.00 | 10.0 | 100.00 | 12.0 | 120.00 | 10.0 | 100.00 | 15.0 | 150.00 | 15.0 | 150.00 | 12.0 | 120.00 | 14.0 | 140.00 |
| 10 | Total hardness | 130.0 | 130.00 | 160.0 | 160.00 | 250.0 | 250.00 | 114.0 | 114.00 | 158.0 | 158.00 | 128.0 | 128.00 | 220.0 | 220.00 | 244.0 | 244.00 |
| 11 | Calcium | 55.31 | 55.31 | 86.57 | 86.57 | 68.60 | 68.60 | 34.47 | 34.47 | 37.68 | 37.68 | 30.46 | 30.46 | 52.91 | 52.91 | 58.52 | 58.52 |
| 12 | Magnesium | 22.42 | 74.73 | 35.09 | 116.97 | 48.74 | 162.47 | 14.14 | 47.13 | 15.60 | 52.00 | 12.19 | 40.63 | 21.44 | 71.47 | 23.4 | 78.00 |
| 13 | Free $CO_2$ | 17.40 | 174.00 | 14.00 | 140.00 | 15.00 | 150.00 | 17.60 | 176.00 | 12.00 | 120.00 | 9.80 | 98.00 | 13.00 | 130.00 | 12.60 | 126.00 |
| 14 | Chloride | 55.66 | 27.83 | 79.52 | 39.76 | 161.03 | 80.52 | 19.88 | 9.94 | 29.83 | 14.92 | 15.90 | 7.95 | 59.64 | 29.82 | 12.0 | 6.00 |

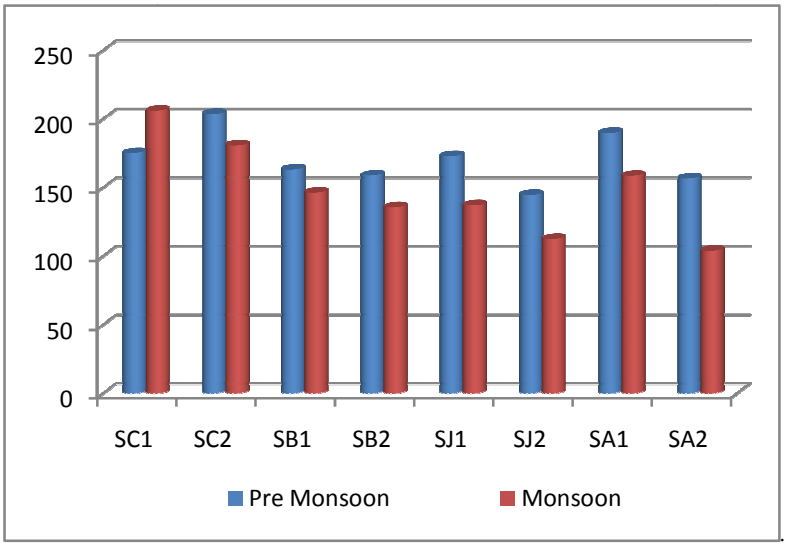


**Figure: 2 Graphical Representation of Water Quality Index**

## CONCLUSION

On the basis of the above discussion, it may be concluded that the selected water body at almost all the sites at in the channarayapatna taluk is highly polluted as indicated by WQI. At two locations sites, it is moderately polluted in the catchment study area. The water body is polluted with reference to almost all the water quality physico-chemical parameters studied. The quality of SA2 water was found better than the water of SJ1. Therefore, the use of SJ1 and SA2 should be unenthusiastic. The drinking water quality was found to start deteriorating after the onset of monsoon. People dependent on this water are often prone to health hazards due to polluted water. Therefore, some effective measures are urgently required to enhance the drinking water quality by delineating an effective water quality management plan for the region Channarayapatna taluk (Karnataka, India).

**Acknowledgment:**
The authors are thankful to Head, Department of P G Studies in Environmental Sciences, and research Centre, Kuvempu University and Principal U B D T College of Engineering, VTU, Davangere abd BIET, Davangere for their constant support and encouragement.

## REFERENCES

[1] Agbaire.P.O. *Journal of Applied Science and Environment Management*, **2009,** Vol. 13(1), 55 – 57.
[2] American Public Health Association (APHA-AWWA-WPCF), Standard methods for the examination of water and wastewater, **1989**.
[3] Association of Official Analytical Chemists (AOAC), AOAC Official Methods of Analysis, 16th ed. AOAC International, Gaithersburg, Maryland, **1995**.
[4] Guidelines for Water Quality Monitoring, Central Pollution Control Board, INDIA, MINAS/27/**2007**-08.
[5] Indian Standard Specifications for Drinking Water, BIS: 10500, **1992**.
[6] Kannan, K., Fundamentals of Environmental Pollution, S. Chand & Company Ltd., New Delhi, **1991**.
[7] Ott, W.R., *Theory and Practice, Ann Arbor, MI (USA):* Science Publishers Inc. **1978**.
[8] Pradhan, S. K., Patnaik, D. and Rout, S. P, *Indian J. Env. Prot.*, 21(4), 355-358, **2001**.
[9] Rajmohan, N., *Indian J. Environ. Hlth.*, 45(1), 1-5, **2003**.
[10] Ramakrishniah, C.R., Sadashivaiah, C. and Ranganna, G. *E-Journal of Chemistry.* 6(2), 523-530, **2009.**
[11] Sinha, D. K., Saxena, Shilpi and Saxena, Ritesh, *Poll. Res.*, 23(3), 527-531, **2004**.
[12] WHO's Drinking Water Standards **1993**