*International Research Journal of Environment Sciences*_____ ISSN 2319–1414
Vol. **1(4),** 43-49, November **(2012)** *Int. Res. J. Environment Sci.*

Seasonal Variations of Physico Chemical Characteristics of Ground Water Samples of Mysore City, Karanataka, India

Nirmala B.[1], Suresh Kumar B.V.[2], Suchetan P.A.[1] and Shet Prakash M.[2]
[1]Department of Chemistry, University College of Science, Tumkur University, B.H. Road, Tumkur, Karnataka, INDIA
[2]Department of Geology, Manasa Gangotri, University of Mysore, Mysore, Karnataka, INDIA

Available online at: www.isca.in
Received 19th June 2012, revised 26th June 2012, accepted 13th July 2012

Abstract

Quality of water is an important criterion for evaluating the suitability of water for drinking and irrigation. The influence of seasonal changes on the physico-chemical characteristics of water resources quality in the four zones of Mysore city has been investigated for a period of pre monsoon and post monsoon season during 2010-2011 with an objective to assess the water quality status in the study area and its potability. The water quality parameters considered in the present study were temperature, pH, electrical conductivity, total dissolved solids, acidity, alkalinity, total hardness, chloride, dissolved oxygen, biological oxygen demand, chemical oxygen demand, calcium, magnesium. The results are tabulated along with discussion. On comparing the results against drinking quality standards laid by World Health Organization (WHO), it was found that some of the water quality parameters were above the permissible limit and some were not.

Keywords: Water quality parameters, physico chemical study, drinking water standards, DO, COD, BOD.

Introduction

Approximately 71% of the earth's surface is covered with water. Fresh water is found as underground water in large reservoirs surrounded by rock called aquifers. This ground water has long been considered as one of the purest forms of water available in nature to meet the overall demand of rural and semi urban people. Majority of people in India depends upon fresh water supplies from dug wells, ponds, bore wells, springs and the like. Apart from domestic use, these sources provide the water essential for irrigation and small scale industries.

The addition of various kinds of pollutants and nutrients through the agency sewage, industrial effluents, agricultural runoff etc. in to the water bodies brings about a series of changes in the physicochemical and characteristics of water, which have been the subject of several investigations[1]. The availability of ground water depends upon the rate at which it is recycled by hydrological cycle than on the amount that is available for use at any moment in time.

Water plugs a vital role in human life. The consequences of urbanization and industrialization leads to spoil the water for agricultural purposes ground water is explored in rural especially in those areas where other sources of water like dam and river or a canal is not considerable. During last decade, this is observed that ground water get polluted drastically because of increased human activities[2-5]. Consequently number of cases of water borne diseases has been seen which a cause of health hazards[6-9]. An understanding of water chemistry is the bases of the knowledge of the multidimensional aspect of aquatic environmental chemistry which involves the source, composition, reactions and transportation of water. The quality of water is of vital concern for the mankind since it is directly linked with human welfare. Therefore, monitoring the quality of water is one of the essential issues of drinking water management[10].

Considering the above aspects of groundwater contamination, the present study was undertaken to investigate the impact of the groundwater quality water samples of four zones (East, West, North and South) of Mysore district, Karnataka, India. Thus, in this research work an attempt has been made to assess the physical and chemical parameters of groundwater like, temperature (T), pH, electrical conductivity (EC), total dissolved solids (TDS), turbidity, dissolved oxygen (DO), total alkalinity (TA), total hardness (TH), calcium (Ca^{2+}) magnesium (Mg^{2+}), chloride (Cl^-), fluoride (F^-) and phosphate (PO_3^{4-}). The analyzed data were compared with standard values recommended by WHO[11]

Material and Methods

Mysore district is located between latitude 11°45' to 12°40' N and longitude 75°57' to 77°15' E. It is bounded by Mandya district to the northeast, Chamarajanagar district to the southeast, Kerala state to the south, Kodagu district to the west and Hassan district to the north. The study area is around 32 Sq Km and is situated on undulating surface. The physico-chemical analysis depends to a large extent on the sampling programme. Three hundred ground water samples were collected from four zones (North, South, East and West) of Mysore city during (50 samples per season) pre-monsoon and post-monsoon seasons.

The water was pumped out from bore wells a few minutes before sample collection.

Figure-1
Map of study area (from google)

Water samples were collected from bore wells in and around Mysore city. Ground water samples were collected in polythene cans. Date, time of collection and source of water and locality of the area were recorded properly. Standard methods were used for the determination of the chemical and physical characteristics of the water.

From each of the sampling site, water samples were collected for physico-chemical analysis, temperature and pH were determined immediately at the sampling station. The samples were taken to the laboratory as early as possible and kept for further analysis. Usually 2 litres of sample was sufficient for analysis of physico-chemical parameters.

Physico-chemical analysis: 50-60 ground water samples were collected from North Zone of (Bannimantap, N.R.Mohalla and Mandi Mohalla); South Zone of (J.P.Nagar, Vidyaranyapuram and Agrahar), East Zone of (Saraswathipuram, Kuvempunagar and Ramakrishna Nagar) and West Zone of (Siddartha Layout, Nazarbad and Kyathamaranahalli) during pre-monsoon and post monsoon season. Five samples from each area accounting 15 samples from each zone.

Analysis was carried out for various water quality parameters such as temperature, pH, electrical conductivity (EC), total dissolved solids (TDS), dissolved oxygen (DO), total alkalinity (TA), total hardness (TH), calcium (Ca^{2+}) magnesium (Mg^{2+}), chloride (Cl^{-}), fluoride (F^{-}), and phosphate (PO_3^{4-}) using standard method[12-14].

pH and temperature were determined immediately at the place of collection.

Results and Discussion

Hydrogen ion concentration (pH): pH is a measure of the hydrogen ion concentration in water and indicates whether the water is acidic or alkaline. The measurement of alkalinity and acidity of pH is required to determine the corrosiveness of the water.

The standard values of pH for drinking water by BIS is between 6.5-8.5 while, WHO is between 7.0-8.5. pH value for drinking water is limited from 5.5 to 8.5 and for effluent discharge it is between 5.5 and 9 as per IS: 2490 and CPCB [15]. High value of pH may results due to waste discharge, microbial decomposition of organic matter in the water body[16].

All the samples have pH values below the prescribed values and could be classified as suitable for drinking purpose.

Electrical Conductivity: Conductivity is ability of water to carry an electrical current. This ability mainly depends on presence of anion and cations in water and also depends on mobility, valence of ions and temperature.

It signifies the amount of total dissolved salts. Conductivity measurement gives rapid and practical estimate of the variations in the dissolved mineral contents of water. One of the reason of salinity is the high concentration of cations such as sodium, calcium and magnesium whereas chloride, phosphate and nitrate as anions[17].

In the present study, all the water samples nearly have 0-1mho electric conductance except water samples from north zone during post monsoon and pre-monsoon have electrical conductance more than one mhos. Therefore, most of these waters do not have corrosive property and needs no treatment before use.

Total dissolved solids (TDS) and hardness: Water source in its natural form itself might contain a variable quantity of inorganic salts dissolved in it for example Ca^{2+}, Mg^{2+}, Cl^{-}, SO_4^{2-}, CO_3^{2-} and HCO_3^{-}. Hardness of water may be temporary or permanent

Hardness is expressed in terms of equivalent quantity of $CaCO_3$. Water quality association has provided a general scale of hardness demarcating the limits for soft and hard waters.

Hardness although has no health effects it can make water unsuitable for domestic and industrial use.

The concentration of TDS in natural water is usually less than 500mg per litre, while more than 500mg per litre is undesirable for drinking and many industrial uses.

TDS value of 500mg per litre as the desirable limit and 2000mg per litre as the maximum permissible limits[18]. Water containing more than 500mg per litre of TDS causes gastrointestinal irritation. High value of TDS influences the taste, hardness and corrosive property of the water[19-20]. High values of TDS indicate that the well water is unfit for human consumption.

In the present study, it is found that almost all samples have TDS values less than the prescribed standards and is fit for drinking purposes.

Total Alkalinity: Alkalinity of water is a measure of its capacity to neutralize acids. Natural alkalinity to water sources is imparted mainly by salts of weak acids such as bicarbonates, carbonates, borates, silicates, phosphates and the salts of humic and fulvic acids. Few industrial effluents such as calcium hydroxide from cement factory, sodium hydroxide from soap manufacturing, textile dyeing, rubber reclaiming and tanneries also contribute to the water alkalinity.

Total alkalinity is the combined activity of the values of carbonates and bicarbonates in water. The observed values of alkalinity ranged between 102 to 360 mg/l during post monsoon and 105 to 325 during pre-monsoon season. The higher values of alkalinity during post-monsoon may be due to the presence of excess free CO_2. Alkalinity of drinking water has not been reported to be harmful but generally 100 mg/l is desirable for drinking water.

In the present study, none of the samples analyzed had alkalinity in the prescribed range and hence require suitable treatments before use.

Temperature: Temperature is one of the most important ecological and physical factors which have profound influence on the abiotic and biotic components of the environment. Temperature helps in controlling the solubility of gases. The water temperature of all the samples analysed did not have much variations and was between 25-28^{0}C.

Chloride: Chloride a major anion in potable and industrial water has no adverse effect on health, but imparts bad taste to drinking water.

The chloride concentration serves as an indicator of pollution by sewage. People accustomed to higher chloride in water are subjected to laxative effects[21]. A high concentration of chlorides affects growth of vegetation and imparts an increase in corrosiveness of metals. Chloride in excess of 100mg per litre imparts a salty taste and may cause physiological damages. Water with high chloride content usually has an unpleasant taste and may be objectionable for some agricultural purposes.

The chloride concentration varies from sample to sample. Chloride imparts a permanent hardness to the water. Although hardness does not have adverse health effect they make water unsuitable for general domestic purposes and for certain industries such as textiles, food industry etc. In the presence of calcium and magnesium even 1g /l; chloride does not impart bad taste due to formation of $MgCl_2$ and $CaCl_2$.

In the present study eastern zone have high amount of chloride during both the seasons. On an overall concentration all the samples have chloride value during both the seasons below the prescribed limits and are potable.

Fluoride: The major natural source of fluoride is amphiboles, apatite, fluorite and mica. Its concentration in natural waters generally should not exceed 10 mg/l.

The factors responsible for ground water contamination with fluoride are geological factors such as weathering of minerals, rock dissolution and decomposition containing fluoride over a long period of time resulting in the leaching it into ground water (2) An anthropogenic factor such as industrial process liberates higher concentration of fluoride into atmosphere. Excess of fluoride results in the destruction of enamel and causes fluorosis leading to dental disorder, retinal disorder, decalcification, mineralization of tendons, digestive and nervous disorders. The excess of fluoride (more than 1.5 mg/litre) is dangerous to health. Hence excess fluoride should be removed from water and this process is called defluoridation.

All the water samples analysed in the present study had fluoride content less than 0.3mg/l and are safe to drinking purpose. The small quantity of fluoride observed was mainly during the post - monsoon period.

Phosphate (PO_4^{3-}): Phosphate may occur in ground water as a result of domestic sewage, detergents, agricultural with fertilizers and industrial waste water. The phosphate content in the study area was found in the range of 0 mg/l to 0.3mg/l.

Calcium and Magnesium: Calcium (Ca^{2+}) and magnesium (Mg^{2+}) ions are both common in natural waters and both are essential elements for all organisms. Calcium and magnesium, when combined with bicarbonate, carbonate, sulphate and other species, contribute to the hardness of natural waters. The effect of this hardness can be seen as deposited scale when such waters are heated. Normally hardness due to calcium predominates although in certain regions, magnesium hardness can be high. In some river catchments, hardness can vary seasonally reaching peak values during low flow conditions. It is possible to analyze waters to determine hardness and then classify them as shown in Table below[22].

Table-1
Hardness Classification

Hardness (mg/l as $CaCO_3$)	Classification
0 – 75	Soft
75 – 150	Moderately hard
150 – 300	Hard
Over 300	Very hard

In natural waters, calcium concentrations are normally below 15 mg/l although this can rise to 100mg/l where waters are associated with carbonate-rich rocks. Magnesium concentrations also vary widely and can be from 1 to over 50 mg/l depending upon the rock types within the catchment. Calcium or Magnesium salts or both cause almost all the hardness of water. Hardness below 300mg per litre is considered as potable but, beyond this limit causes gastrointestinal irritation. Hardness concentration more than 300mg per litre may cause heart and kidney problems[23-24].

In the present study, it is found that almost all the samples of the four zones have hardness greater than 300 mg /l. The trend in hardness of water during post-monsoon is also very similar to that during pre monsoon. Hardness during summer day may be attributed to low water level and high rates of evaporation. Therefore all the water of the present study are rated as hard to very hard during all seasons of the year and required processing before supply.

Dissolved Oxygen (DO): Dissolved oxygen is important parameter in water quality assessment and biological processes prevailing in the water. The DO values indicate the degree of pollution in the water bodies. Dissolved oxygen values varied from 3.6 to 7.5 during pre-monsoon and 4.6 to 8.82 during post-monsoon season.

Biochemical oxygen demand (BOD): Biochemical oxygen demand (BOD) is a chemical procedure for determining the amount of dissolved oxygen needed by aerobic biological organisms in a body of water to break down organic material present in a given water sample at certain temperature over a specific time period. It is not a precise quantitative test, although it is widely used as an indication of the organic quality of water [25]. It is most commonly expressed in milligrams of oxygen consumed per litre of sample during 5 days of incubation at 20°C and is often used as a robust surrogate of the degree of organic pollution of water. BOD can be used as a gauge of the effectiveness of wastewater treatment plants.

All the water samples analyzed in the present study has BOD content within the prescribed limits.

Chemical oxygen demand (COD): In environmental chemistry, the chemical oxygen demand (COD) test is commonly used to indirectly measure the amount of organic compounds in water. Most applications of COD determine the amount of organic pollutants found in surface water making COD a useful measure of water quality. It is expressed in milligrams per litre (mg/l), which indicates the mass of oxygen consumed per litre of solution.

All the water samples analyzed in the present study had COD content within the prescribed limits.

Table-2 and table-3 shows average values of physico chemical parameters of ground water of Mysore City during post-monsoon and pre-monsoon season.

Table-2
Average values of Physico Chemical parameters of ground water of Mysore City, Post-Monsoon season

Directions→ / Parameters↓	North	South	East	West
pH	8.34	8.06	8.00	7.70
EC	1.04	0.84	0.92	0.66
TH	309	382	275	285
Ca^{2+}	176	182	194	142
TA	325	345	242	360
Cl^-	156	113	107	136
DO	6.60	6.90	8.50	7.70
BOD	3.90	3.20	3.80	3.50
COD	0.060	0.029	0.051	0.032

Table-3
Average values of Physico Chemical parameters of ground water of Mysore City, Pre-Monsoon season

Directions→ / Parameters↓	North	South	East	West
pH	7.73	7.92	8.26	7.57
EC	1.10	0.70	0.75	0.59
TH	288	349	236	336
Ca^{2+}	180	186	219	183
TA	296	237	194	307
Cl^-	137	120	151	149
DO	6.50	5.40	6.70	7.00
BOD	4.60	3.30	3.20	3.70
COD	0.049	0.047	0.024	0.036

Conclusion

The present study was undertaken with an aim to analyze certain physico-chemical parameters in the ground water samples in Mysore city. In nutshell, the parameters analyzed have shown that they are all well within the permissible limits for drinking water except TA, Cl^- and TH in certain water samples. Therefore, our study based on scientific methodology clearly shows that the said study sites can be easily used for drinking purpose and however it is suggested to monitor the same regularly for sustainable usage.

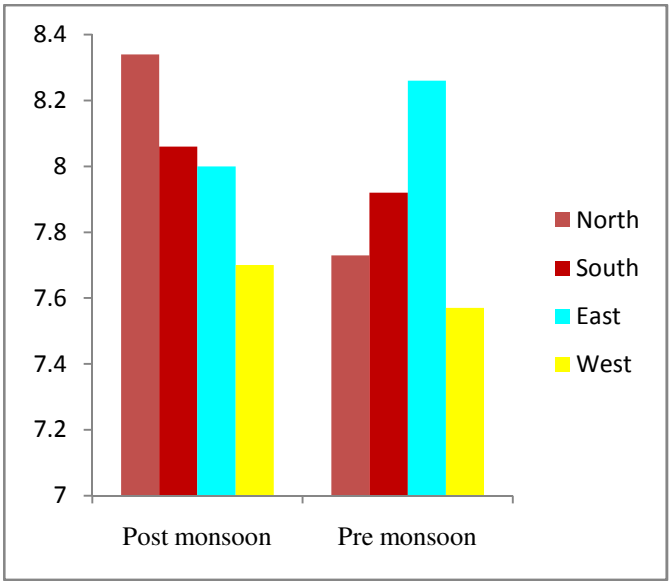

Figure-2
Graph showing variations of pH

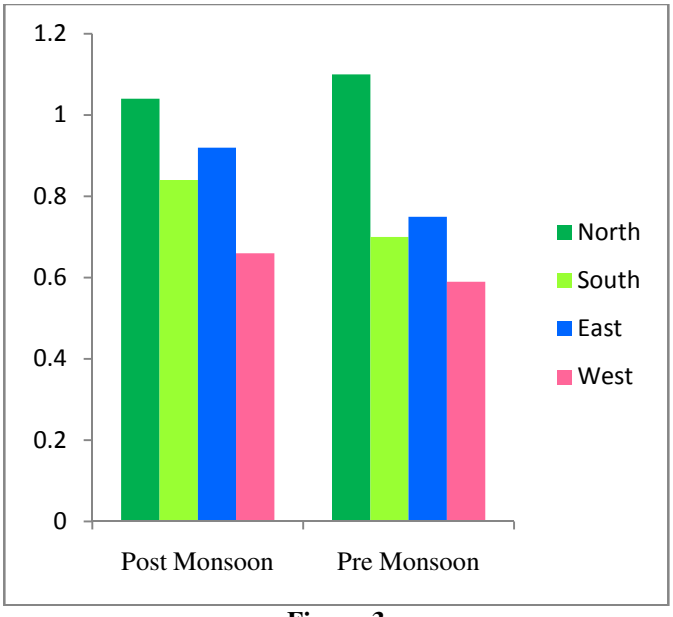

Figure-3
Graph showing variations of EC

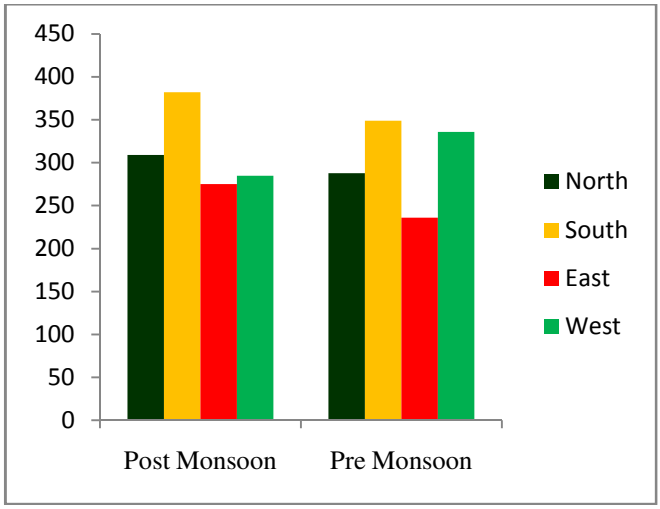

Figure-4
Graph showing variations of TH

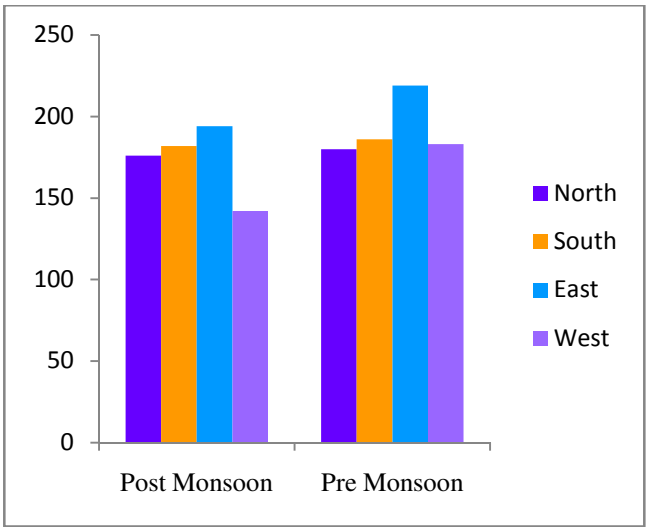

Figure-5
Graph showing variations of Ca^{2+}

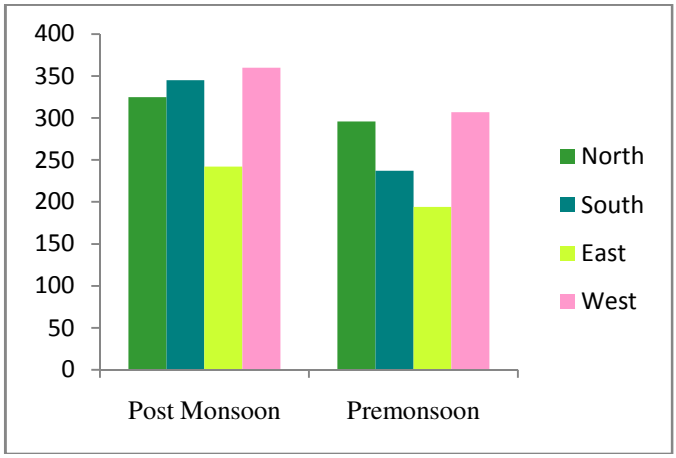

Figure-6
Graph showing variations of TA

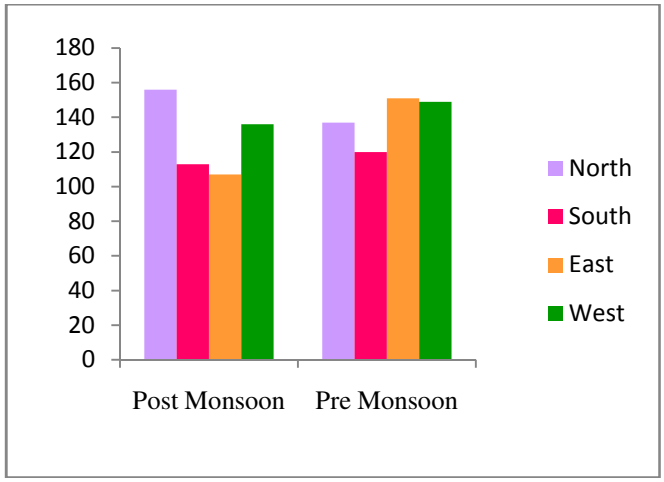

Figure-7
Graph showing variations of Cl^-

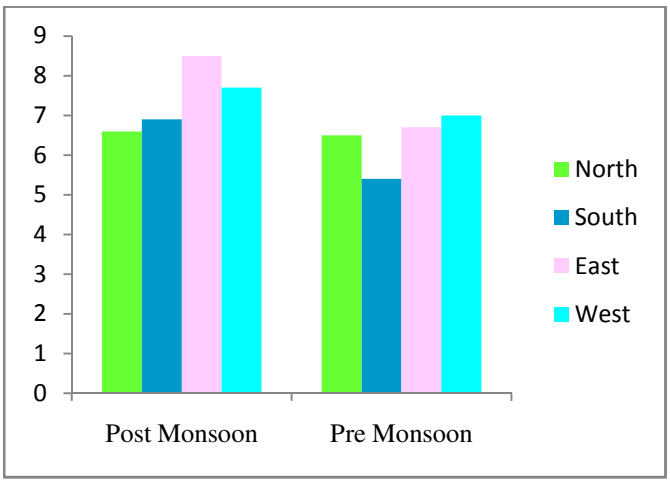

Figure-8
Graph showing variations of DO

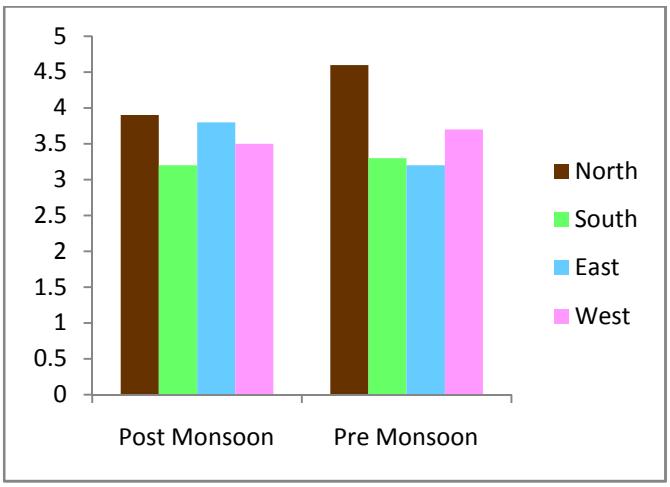

Figure-9
Graph showing variations of BOD

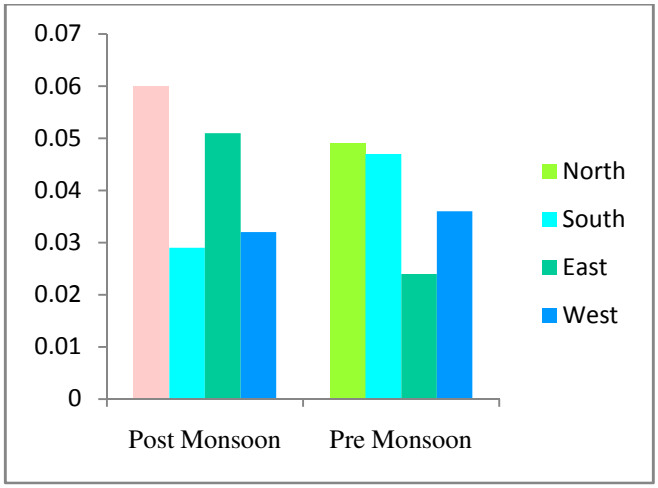

Figure-10
Graph showing variations of COD

Acknowledgements

The authors are very thankful to the UGC, New Delhi, for financial support and Principal, University College of Science, Tumkur; and JSS College for Women (Autonomous), Mysore for providing necessary research facilities.

References

1. Mahananda M.R., Mohanty B.P. and Behera Mahananda N.R., Physico-Chemical Analysis of Surface and Ground Water of Bargarh District, Orissa, India, *IJRRAS,* **2 (3) (2010)**
2. A. Abdul Jamal, Physico-Chemical studies in Uyyakondan Channel water if river Cavery, *Poll.Res.*, **17(2)**, 111 **(1998)**
3. Murhekar Gopalkrushna H., Determination of physic-chemical parameters of surface water samples in and around Akot city, *International Journal of Research in Chemistry and Environment,* **1(2)**, 183-187 **(2011)**
4. Vijender Singh, Physico-chemical Examination of water, Sewage and Industrial effluents, *Res. J. chem and ENV*, **10(3),** 62-66 **(2006)**
5. Arunabh Mishra and Vasishta Bhatt, Physico-Chemical and Microbiological Analysis of Under Ground Water in V.V Nagar and Nearby Places of Anand District, Gujarat, India, *E-.J.Chem*., **5(3),** 487-492 **(2008)**
6. Desai P.V., Water quality of Dudhsagar river at Dudhasagar(Goa), India, *Poll.Res.,* **4**, 377-382 **(1995)**
7. Elizabeth K.M. and Naik Premnath L., Effect of polluted water on human health, *Poll.Res.,* **24(2)**, 337 **(2005)**
8. Muller E.E., Ethlers M.M. and Grabow, The occurrence of E.Coli 0157:H7 in South African water sources intended for direct and indirect human consumption, *Water Research*, **35**, 3085-3088 **(2001)**

9. AremuM.O., Gav B.L., Opaluwa O.D., Atolaiye B.O., Madu P.C. and Sangari D.U., Assessment of Physicochemical Contaminants in Waters and Fishes from Selected Rivers in Nasarawa State, Nigeria, *Research Journal of Chemical Sciences,* **1(4),** 6-17 **(2011)**

10. Shama Sehar, Iffat Naz, Mohammad Ishtiaq Ali and Safia Ahmed, Monitoring of Physico-Chemical and Microbiological Analysis of Under Ground Water Samples of District Kallar Syedan, Rawalpindi-Pakistan, *Research Journal of Chemical Sciences*, **1(8),** 24-30 **(2011)**

11. World Health Organization, Guidelines for drinking water quality-I, Recommendations, *2nd Ed. Geneva WHO* **(1993)**

12. Standard methods for the examination of water and waste water, *American Public Health Association, 17th Ed., Washington, DC*, **(1989)**

13. Trivedy R.K. and Goel P.K., Chemical and Biological methods for water pollution studie*s Environmental Publication, Karad*, **(1986)**

14. Manivaskam N. Physicochemical examination of water sewage and industrial effluent, *5th Ed. Pragati Prakashan Meerut.,* **(2005)**

15. IS: 2490 Standards for Industrial and Sewage effluents discharge, *Bureau of Indian standards*, New Delhi **(1982)**

16. Patil S.G., Chonde S.G., Jadhav A.S. and Raut P.D., Impact of Physico-Chemical Characteristics of Shivaji University lakes on Phytoplankton Communities, Kolhapur, India, *Research Journal of Recent Sciences*, **1(2),** 56-60 **(2012)**

17. Chauhan R., Chaudhary R., Singh A. and Singh P.K., Salt Tolerance of Sorghum bicolour Cultivars during Germination and Seedling Growth, *Research Journal of Recent Sciences*, **1(3),** 1-10 **(2012)**

18. Jain C.K, C.P Kumar and M.K.Sharma– Ground water qualities of Ghataprabha command area Karnataka, *Indian Journal Environ and Ecoplan,* **7(2),** 251-262 **(2003)**

19. Hari Haran A.V.L.N.S.H Evaluation of drinking water quality at Jalaripeta village of Visakhapatanam district, Andrapradesh, *National Envt and Poll. Tech*., **1 (4)** 407-410 **(2002)**

20. Subhadra Devi D.G, Barbaddha S.B, Hazel D. and Dolly, Physico-chemical characteristics of drinking water at Velsao Goa, *J. Ecotoxicol Environ. Monit*., **13 (3),** 203-209 **(2003)**

21. Fried J.J. and Combarnous M.A., Dispersion in porous media, *Advances Hydroscience*, **7,** 169-282 (**1971**)

22. Clair N. Sawyer, Perry L. McCarty and Gene F. Parkin. Chemistry for Environmental Engineering and Science (5th ed.). New York: *McGraw-Hill. ISBN* **0-07-248066-1 (2003)**

23. Ponangi R., Asolkar Shyam and Joshi S.G., Trace Pollutants in drinking water, *J.IAEM,* **27,** 16 -24 **(2000)**

24. Dilip B.P., Rajendra V. Tijare and Rewater S.B., Physico Chemical characteristics of ground water of Armori town of Gadchiroli district, Maharashtra, India, *Poll Res.,* **20(2),** 207-209 **(2001)**

25. Suthar K., Sharma R., Mathur R. and Sharma S., Physico-chemical and microbiological studies ofdrinking water of Pali district, Rajasthan, *Journal of Chemical, Biological and Physical Sciences,* **2(2)**, 1061-1088 **(2012)**