International Journal of Engineering Research and Development
e-ISSN: 2278-067X, p-ISSN: 2278-800X, www.ijerd.com
Volume 11, Issue 10 (October 2015), PP.49-54

Seasonal Variation and Bacteriological Analysis of an Industrial City of Western India

Jain Nupur[1], Mehta Anurika[2], Duggal Rakesh[3]
Department of Chemistry, Poornima University, Jaipur, India

Abstract:- In the present study efforts have been made to assess seasonal variations and bacteriological analysis in ground water quality. The impact of industrialization on quality of drinking water of different locations of industrial city of Kota, Rajasthan, India was investigated. Parameters like pH, Temperature, TDS, Conductivity, Dissolved oxygen, Hardness, Chlorides and Total Coli form were determined. The present study reveals that water quality of most of the selected sampling stations is a cause of concern as parameters like TDS, Conductivity, and Hardness & Coli-form are not in limits prescribed by WHO. Overall study also indicates variance in the concentrations of these parameters in all seasons was in Pre-monsoon > Post-monsoon > Monsoon sequence.

Keywords:- Seasonal variations, bacteriological analysis, Industrialization, groundwater.

I. INTRODUCTION

The quality of water is direct impact on health issues of living beings. Indian population is largely dependent on ground water as it is clean and free from pollution than surface water [1]. But prolonged discharge of industrial effluents and domestic waste clubbed with extensive use of fertilizers and pesticides causes groundwater pollution and causes health hazards [2].The problems of groundwater quality has got multiplied in densely populated areas, industrial pockets and in rural areas due to excess use of pesticides and fertilizers. Rapid urbanization has further deteriorated groundwater quality due to overexploitation of resources and improper waste disposal practices. Thus, there is always a need for proper protection and management of groundwater quality [3].

Kota is famous as educational hub. It also has industries of varying nature like plastics, cement, metals, food production, textile and metallurgical processes. Ironically surface and groundwater of Kota and particularly Kota DCM industrial area has been degraded [4]. The present study therefore has relevance to analyze the groundwater chemistry of the area. In order to have a close look pre-monsoon, monsoon and post-monsoon seasons of year 2014 were chosen [5]. Out of the various parameters studied, concentration of Electrical Conductivity (EC), Total Dissolved Solids (TDS), Total Hardness (TH) and Total Coli were expected to be a cause of concern in study area.

II. MATERIALS AND METHODS

Study Area

Kota is located along eastern bank of the Chambal River in the southern part of Rajasthan. The cartographic coordinates are 25°11′N 75°50′E/ 25.18°N 75.83°E. It covers an area of 318 km^2 (3.63 per cent of the Rajasthan State). It has an average elevation of 271 meters (889 ft). The district is bound by Sawai Madhopur, Tonk and Bundi districts. The Chambal River separates these districts from Kota district. Out of Kota district, DCM industrial area and its adjoining areas have been chosen as area of study. Total covered area under study is 10 sq. Kms. The details of various spots selected for study are given in figure 1.

III. MATERIALS AND REAGENTS

A total of 15 samples of groundwater used for drinking purpose were collected from different sources like hand pumps or open wells at different spots spread over DCM Industrial area during Pre-monsoon, Monsoon & Post-monsoon season in 2014.These spots were specifically identified on the basis of frequent use and probability of contamination and were mapped. (Fig. 1) The season was selected because contamination often increases due to rain and tends to accumulation of ions. All requisite precautions were taken during sample collection and analysis.

The samples were analyzed using standard methods of analyses to assess various physicochemical parameters according to APHA & WHO norms [6]. Some parameters like temperature, color, and pH were measured on site. Water samples were analyzed by standard methods [7] for physicochemical parameters like water temperature(^{0}C), TDS, conductivity, turbidity, odor, nitrate, sulphate, phosphate, Dissolved Oxygen,

hardness, chlorides, fluorides, nitrate, sodium, potassium and Chemical Oxygen Demand(COD),Biological Oxygen Demand(BOD), alkalinity, free NH_4, Coli form Organism. Microbiological quality of water was determined using most probable number (MPN) method. The test was performed within 24 h of sample collection. The MPN method was used to determine the presence of gas producing lactose fermenter and most probable number of coli forms present in 100 ml of water. The standard MPN method (nine multiple tube dilution technique) was used for detection of total coli forms by inoculation of samples into tubes of lactose broth (LB) and incubation at 37°C for 48 h. The positive tubes were sub cultured into Brilliant Green Lactose Broth (BGLB) and were incubated at 44.2°C for 48 h and checked for total count.

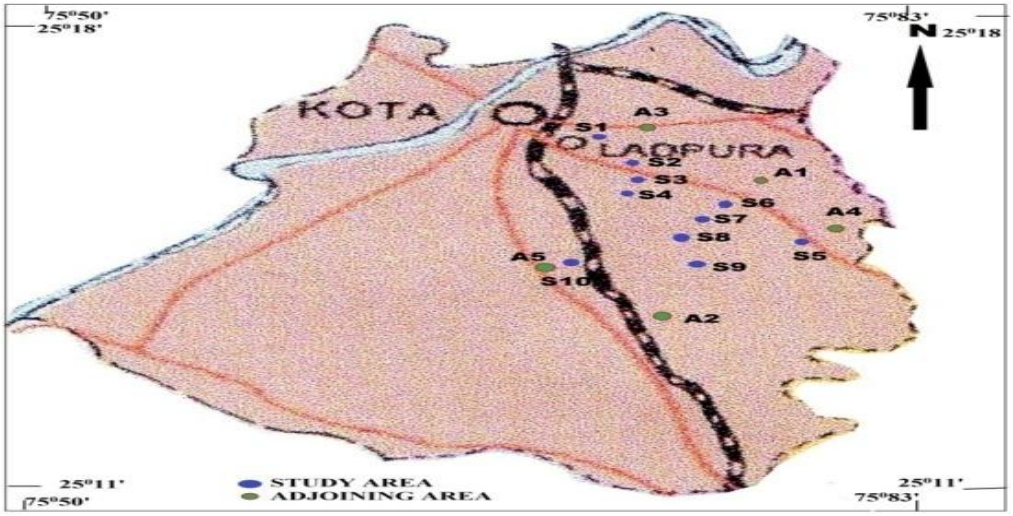

Fig. 1: Map of Kota District and Sample location of DCM industrial area, Kota

IV. RESULT AND DISCUSSION

Comparative analysis of overall average physico-chemical parameters of different ground water samples collected between March to December 2014 are reported in the Figure 2-8. The interpretation of data has been made with the help of Mat lab software.

Temperature is basically important for its effect on chemical and biological reaction in the organisms living in water. A rise in the temperature of water leads to the speeding up of the chemical reactions in water, reduces the solubility of gases and amplifies the taste and odours [8].The average temperature varied within the range of 29.0° to 33.24°.

All chemical and biological reactions are directly dependent upon the pH of water system [9]. In our finding pH varied between 6.78 to 8.49.Maximum pH of 6.78 was recorded in Pre monsoon season whereas 8.47 during Monsoon season were recorded at A4. However, the pH 8.1at A3 & A4 in Post monsoon season is within the permissible limit prescribed by WHO. [6.5-8.5] (Fig. 2)

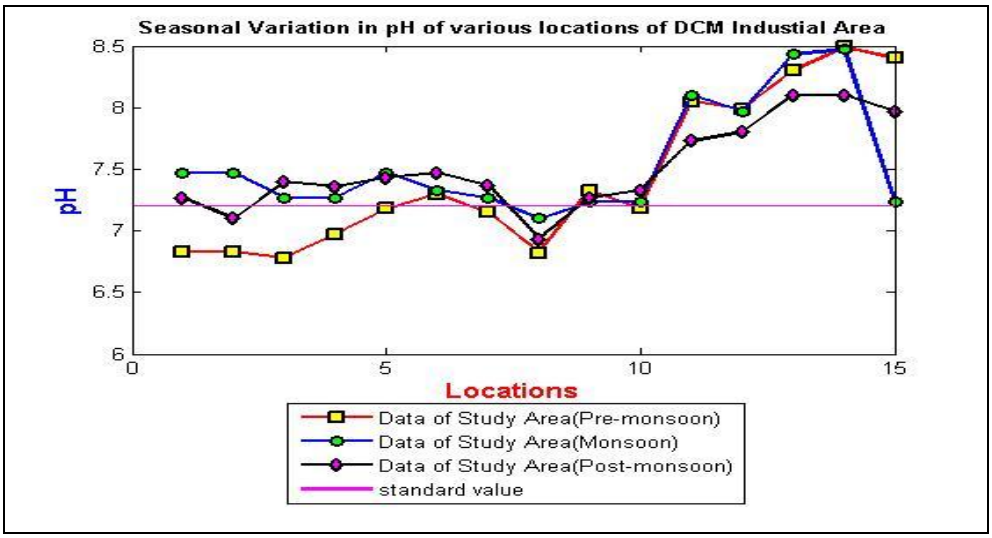

Fig. 2: Seasonal Comparison of pH values in Study area

Based on electrical conductivity values the water quality can be classified as poor, medium or good [10]. In present investigation maximum conductivity was observed at S2 in Post monsoon and minimum at S5 in Monsoon season. The electrical conductivity (EC) of ground water samples in pre-monsoon ranged from 307.47(S1) to 794.62(A3) and monsoon season ranged from 418.70(S1) to 819.33 µS/cm (A3) whereas in post-monsoon it varied from 121.67(S1) to 813.33 µS/cm (A3). The EC in the study area was found on higher side of permissible limits of WHO and BIS (300 µS/cm) except some samples of S1 & S2. (Figure 3) and is indicative of changes occurring in soil of the area.

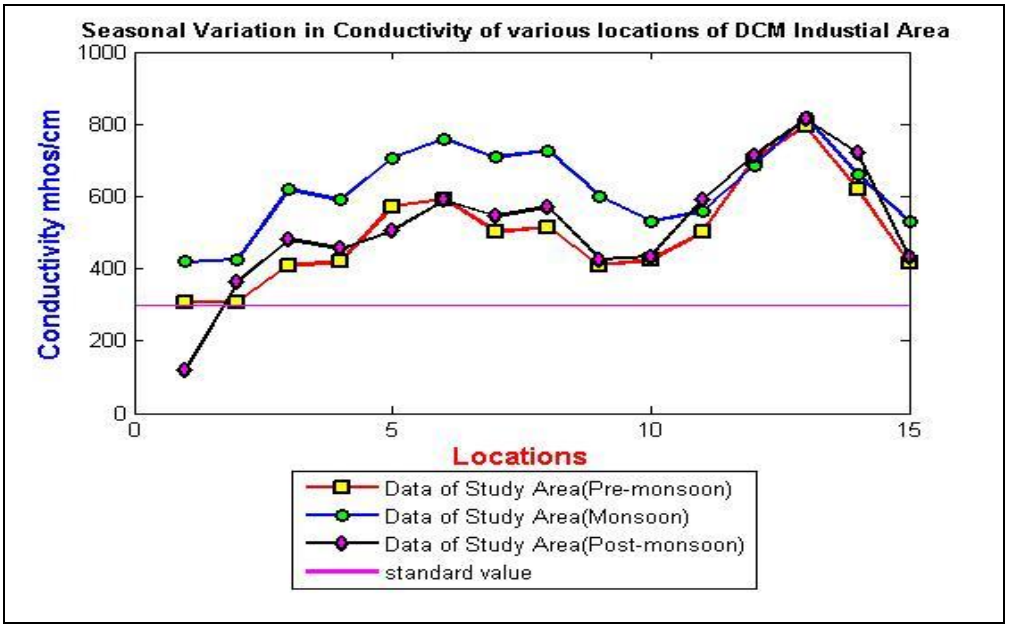

Fig. 3: Seasonal Comparison of Conductivity values in Study area

Total dissolved solids are composed mainly of carbonates, bicarbonates, chlorides, phosphates and Nitrates of Calcium, Magnesium, Sodium, Potassium, Manganese, organic matter salt and other particles [11]. The Total dissolved solids (TDS) in water samples in pre-monsoon ranged from 327.63(A1) to 905.82 (S6) ppm and monsoon ranged from 356 (A4) to 841.70 (S6) ppm whereas in post-monsoon ranged from 390 (A1) to 826.67 ppm (S6). The TDS in the water samples of the study area are above the permissible limit of WHO and BIS (<500 ppm) for sampling stations S3, S4, S5, S6, S7, S8, S9, S10, A4, A5. (Fig. 4)

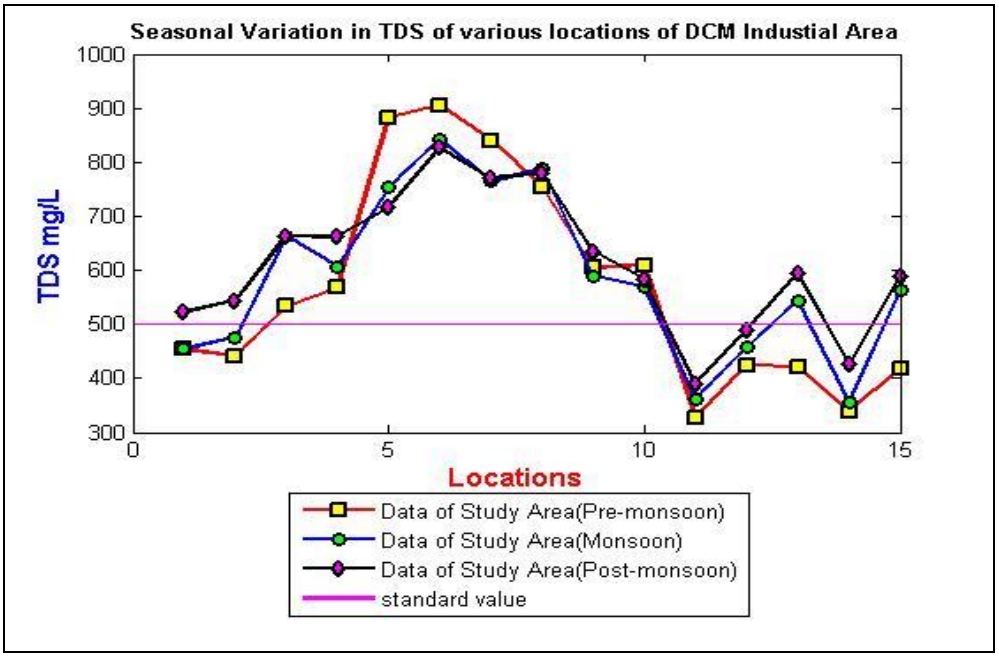

Fig. 4: Seasonal Comparison of TDS values in Study area

Dissolved oxygen is important parameter in water quality assessment and it reflects probable physical and biological changes in ascertaining water quality. The DO values indicate extent of pollution in water bodies [12]. DO values in the present finding varied from 0.71 to 4.83. Maximum value was recorded at S2 in post-monsoon and minimum was recorded at S8 in pre-monsoon season. The DO in the study area was found in the permissible limits of WHO and BIS (6 ppm).As such, water quality can be assumed to be of acceptable one for this parameter.

Alkalinity values were found in pre-monsoon season in the range of 193.42(S1) - 310.13 mg/L (S4); in monsoon from 126.70(S8) - 260(S6) mg/L and in post-monsoon season from 162(S8) - 306.67 mg/L (S6). Maximum values of alkalinity are beyond the permissible limit (in samples S5, S6, S9, S10, A4, A5) as prescribed by WHO (200 mg/L).Alkalinity values may be assumed to be higher due to carbonate and bicarbonate content in soil. (Fig. 5)

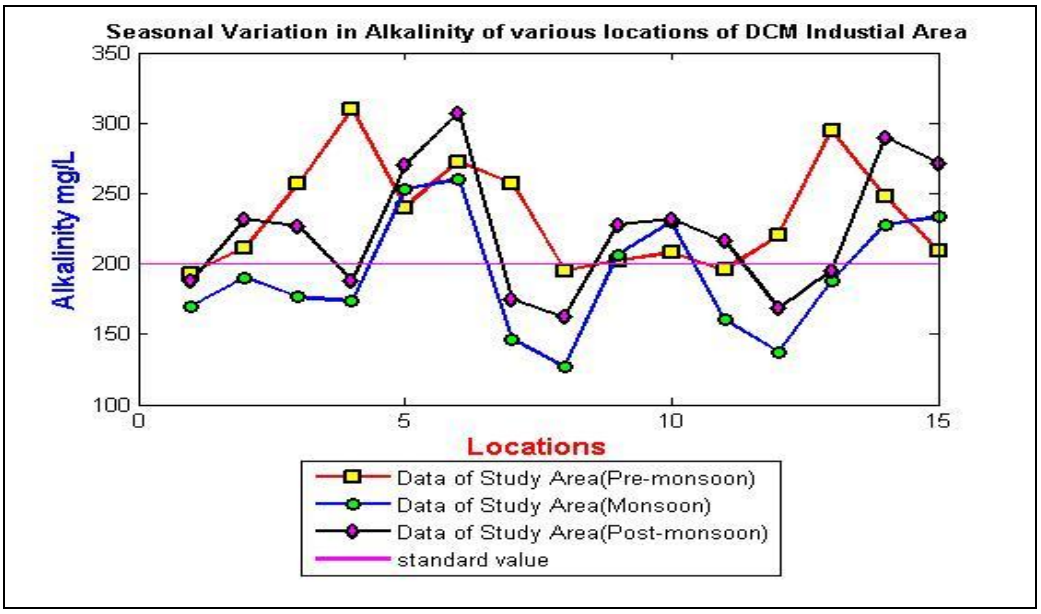

Fig. 5: Seasonal Comparison of Alkalinity values in Study area

Chloride content in fresh water is largely influenced by evaporation and precipitation. Chloride ions are generally more toxic than sulpahte to most of the plants and are best indicator of pollution .In present finding maximum chloride concentration were recorded at S4 (168.67 ppm) in post-monsoon and minimum at A1(45.17 ppm) in pre-monsoon season. These values are under the permissible limit according to WHO and thus do not appear to affect vegetation. (Fig. 6)

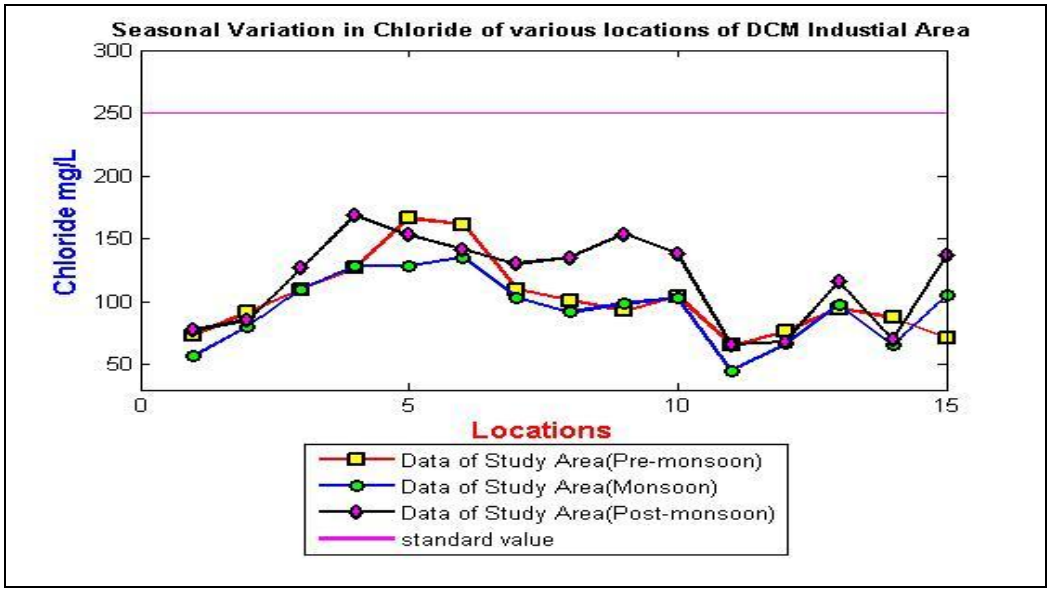

Fig. 6: Seasonal Comparison value of Chloride in Study area

Hardness of water mainly depends upon amount calcium and/or magnesium salts. In our findings hardness values varied from 118 ppm to 492 ppm, which are above the permissible limit in maximum samples (S3,S4,S5,S6,S7,S8,S9,S10)as prescribed by WHO and thus degrade water quality of the studied area. (Fig. 7)

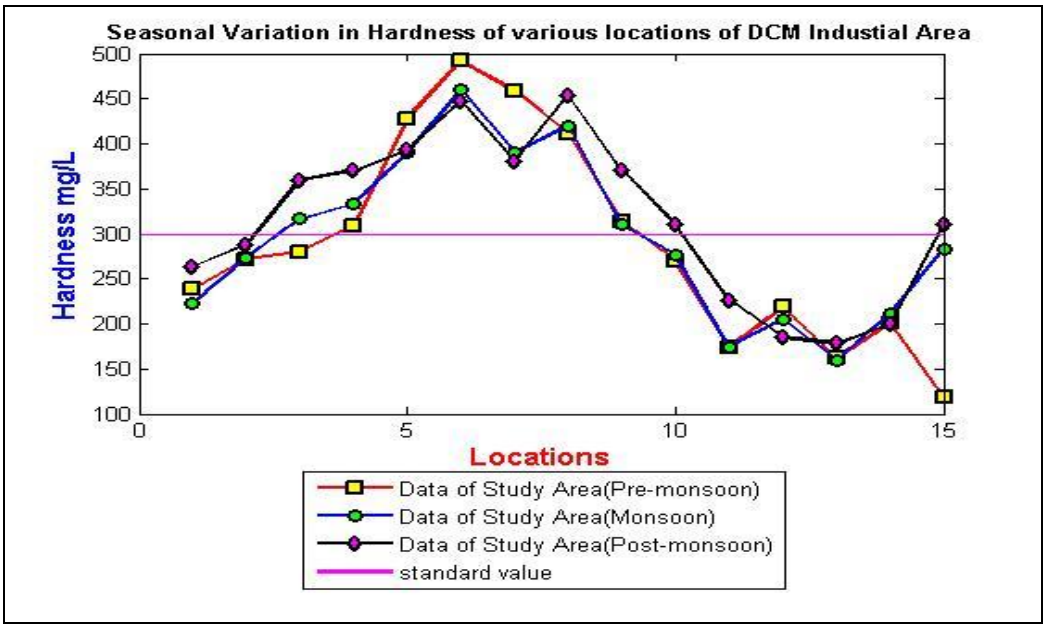

Fig. 7: Seasonal Comparison of Hardness values in Study area

The microbiological analysis was carried to assess E. coli in water. The total coli content varied from 14.67 to 2313.33 MPN/100 ml. The micro biological observations reflect the presence of E. coli in water samples but showed wide variations as is indicative from range of <2 to >2400. The results showed that almost all water samples were not fit for drinking purposes as per WHO recommendations. The coli form bacterium is the primary bacterial indicator for fecal pollution in water [13]. The total coli was found to be maximum in pre-monsoon season and ranged from 14.67 (S9) to 2313.33 MPN/100 ml (S4); in monsoon season values ranged from 60.00(S9) to 253.30(S3) MPN/100 ml whereas in post-monsoon they ranged from 93.33 (S9) to 1166.67 MPN/100 ml (S1). Figure 8 shows that order of values of total coli-form was in order of: Pre-monsoon > Post-monsoon > Monsoon. (Fig. 8)

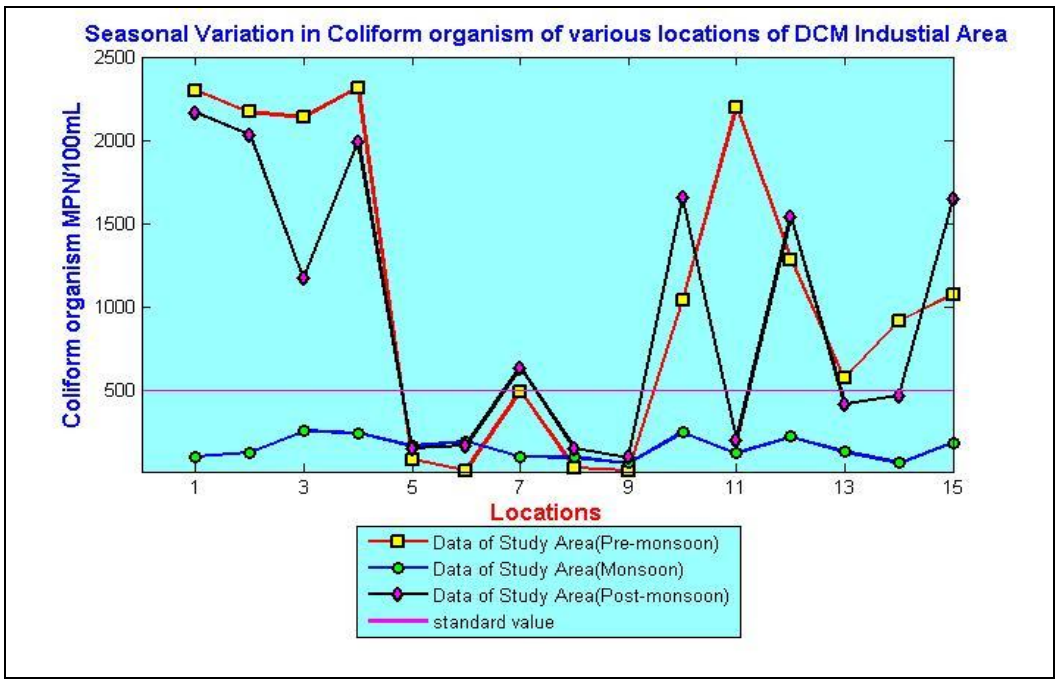

Fig. 8: Seasonal Comparison of Hardness values in Study area

V. CONCLUSIONS

Pollution in the area of study urbanization and industrial activities appears to be the cause of deterioration of water quality. Most of the study areas have been found to be polluted by human and animal wastes. Bacteriological analysis reveals that contamination increases in pre and post monsoon seasons and can become a cause for an epidemic in future, especially in pre and post monsoon seasons. The study indicates that water management for conservation and proper quality checks before utilization are mandatory steps to have potable water in the area and ground water stations need to be protected from further contamination.

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