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ORIGINAL ARTICLE **OPEN ACCESS**

Effect of industrialization on ground water quality, Miraj-Kupwad MIDC, M/S, India

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ABSTRACT
Miraj-Kupwad MIDC is hub of varies industries like food processing industry, starch industry and foundries etc. The study on water pollution reveals that this area has high water contamination. It may be due to improper effluent disposal. Study of ground water samples from five sites in MIDC area were analyzed for pH, EC, Turbidity, total alkalinity, DO, BOD, total hardness COD, sulphate, phosphate, chloride, nitrate, fluoride, lead, arsenic and chromium parameters as per APHA procedures. The obtained results were compared with Indian Drinking Standards IS 10500:2012 and it was observed that the parameters like turbidity, alkalinity, hardness, sulphate, nitrates, chlorides, fluoride, lead, chromium, arsenic exceed the acceptable limit while all sites show phosphate within limit. Presence of these contaminant in water sample shows the contaminated groundwater in study area.
Keywords: *ground water quality***,** *DO, BOD, total hardness COD, Metals*

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INTRODUCTION

Water is one of the vital components for living form on earth. In India, about 30% of the urban population and over 90% of the rural population both rely on groundwater for residential and drinking needs [1]. India is a developing country which leads to development of various industries like metal processing, fertilizers, food processing, pharmaceutical and other industries like dye, plastic, paints, detergents etc. Industrial development required availability and use of tremendous amount of water which results into generation of huge amount of wastewater. Improper management of sewage, industrial wastewater, dumping of solid waste results into contamination of groundwater. Ground water contamination is typically irreversible, meaning that it is challenging to return the aquifer's original water quality once it has been poisoned. Groundwater that has been too mineralized loses quality and develops an unpleasant flavor, odor, and excessive hardness. As a result, it is always preferable to safeguard ground water up front rather than relying on technology to purify tainted water down the road [2].

The Sangli-Miraj-Kupwad urban complex is primarily where the district's industrial development has occurred. Sangli District has a total of eleven MIDCs, with Miraj-Kupwad MIDC Industrial Area being one of the oldest in the district. The Miraj MIDC Industrial Area has 166.48 hectares of land with no effluent collection system and sewerage line availability. Kupwad Industrial area consists of foundries, fabric possessing industries with 223.63 hectares area with no effluent Collection System, Sewerage Line availability, sewerage Treatment Plant Availability. The construction of a common effluent treatment plant with a 1 MLD capacity, known as M/s. Krishna Vally Pvt. Ltd., MIDC Kupwad, Tal- Miraj, Dist- Sangli, has not yet been completed due to five pending court cases involving neighboring people. Additionally absent from the MIDC region is a facility for the disposal of common hazardous waste. Vast industrial growth results into various environmental issues. Studies show that bore water from the Kupwad industrial area shows an excessive amount of TDS, sodium, cadmium, chloride, nitrate, and dissolved solids which make water not fit for drinking [3]. Effluent from eight textile industries from Ichalakaranji shows a high amount of Cadmium, Iron, Copper, Chromium, Lead, Nickel, Zinc, and Arsenic which shows the high amount presence of all these heavy metals from sites from the Panchaganga river where effluent mixes in the river [3].

It also showed that the water in this industrial region is highly polluted and which represents high TDS & hardness showing the TDS value and some samples are also showing MPN values indicating the water is not suitable for drinking [4]. Assessment of the water quality of Krishna river from Sangli shows the

presence of contaminants in the river as compared to other water sources [5] also, it shows the spread of diseases like Cholera, Typhoid, Diarrhea, Jaundice, Gastro, etc. in the community nearby Krishna river [6]. The Sheri Nala basin of Sangli's groundwater pollution study revealed total hardness, total dissolved solids, and chloride values higher than standards values, and the primary cause of the issue was industrial pollution in Madhavnagar and Kupwad sub-basins. Additionally, it was noted that 9% of households were experiencing cholera, 13% were experiencing jaundice, 64% were experiencing gastroenteritis, and 14% were experiencing typhoid diseases. [7]. Groundwater (bore well and dug well) in the region near Sangli Miraj Kupwad, MIDC, is exceeding BIS Standard limits [8]. Groundwater quality of the Sangli-Miraj-Kupwad industrial area shows exceeding the levels of sodium, chloride, nitrate, DS, heavy metals (including mercury, lead, cadmium, and arsenic), and other contaminants higher than the permitted limits. The correlation data demonstrate a strong association between EC and TDS and DS, Magnesium, and Chloride. The mathematical relationship between EC and TDS, TDS and Chloride in, and Ferrous and Mercury was used to illustrate the regression procedure. [3].
To date enough attention is not given to study of the diversity of water sources in the rural area. Understanding its physico-chemical properties along with species reveals necessary facts required for the management of the ecosystem and habitat.

MATERIAL AND METHODS

Area selected for study was Miraj-Kupawad industrial area which is situated at Miraj tehsil of Sangli District, M/S, India. Its geographical coordinates are 16° 52' 0" N, 74° 34' 0" E.

Sampling locations and chemical analysis:

To analyse several physicochemical parameters for the 2019–2020 academic year, groundwater samples were taken from five distinct places during the summer (February to May), rainy (June to September), and winter (October to January). Five sampling locations were selected as shown in Table 1 and Fig no.1. The samples were collected every month of each quarter. After 10 minutes of pumping, the samples were collected, put in one-liter sterilized screw-cap polyethylene bottles, and then examined in a lab. The samples that were taken from the study locations were tagged correctly. Temperature measured on site. Standard methods were used for the determination of various parameters such as pH was measured using pH meter, Electrical conductivity was measured using Elico–Digital conductivity meter-CM 180 digital, and Turbidity was measured using a Digital Turbidity Meter (Nephelometer) Model No EQ 813. Methyl orange and phenolphthalein were used as indicators in a visual titration method to calculate total alkalinity. Using the EBT indicator, the EDTA titrimetric method was used to measure both calcium and total hardness. The most common method of identifying the chloride ions was to titrate the samples against a standard AgNO3 solution while employing potassium chromate as an indicator. The water samples' sulphate, phosphate, and nitrate levels were calculated using a Labtronics LT-39 spectrophotometer. Using a flame photometer, Na+ and K+ were calculated. Flame photometer 128 from Systronics (India) Limited. Atomic absorption spectrophotometers are used to analyse heavy metals as arsenic, iron, chromium, and lead. Fluoride analyzed using Labtronics-LT-39-spectrophotmeter digital. The results of the analysis of different ground water samples during summer, rainy and winter.

Table no.1: Sampling sites with location details

Site number	Name	Location
Site1-S1	Dug Well near Chougule mala- near Miraj MIDC	74.64743N 16.85544E
Site2-S2	Bore well in Gulmohar colony (near Renuka Mandir)- near Miraj MIDC	74.63152N 16.84508E
Site3-S3	Bore well in Waghmode Nagar (in front of Biroba Mandir)-Near Kupwad MIDC	74.6276N 16.86415E
Site4-S4	Dug Well near RTO-near Kupwad MIDC	74.63934N 16.870445E
Site5-S5	Bore well in front of Mohite clinic-near Kupwad MIDC	74.6302N 16.883842E

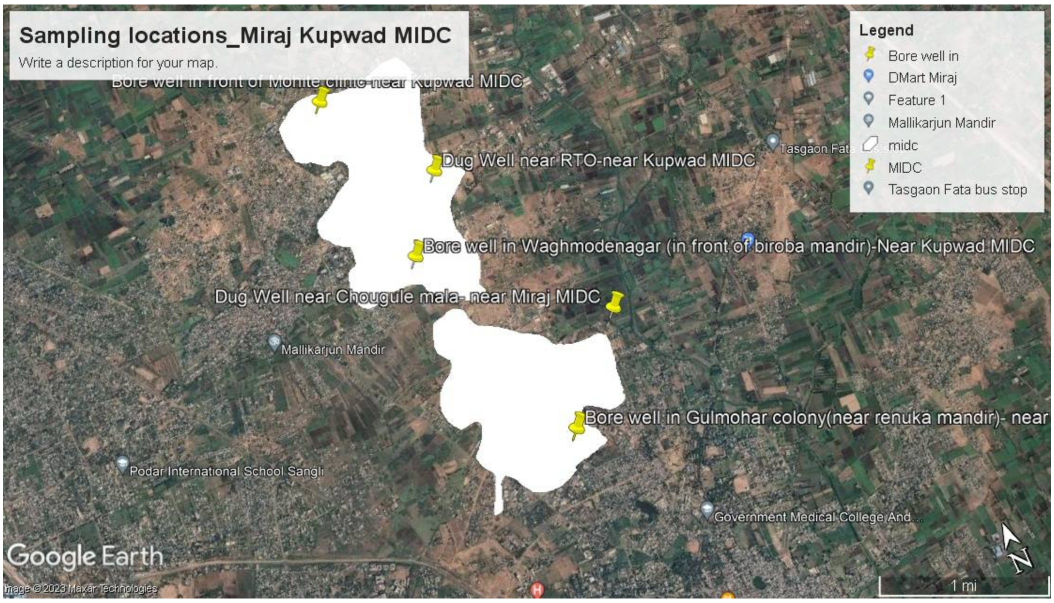

Fig no.1: Sampling sites with location details

RESULTS AND DISCUSSION:

a) Lowest value of pH observed on summer 5.5 on site S4. High decomposition processes in the summer cause high pH levels. A similar outcome was seen in the small Mahi River and the Yammuna River in Faridabad. [9]. Highest value of pH observed in summer at site 5 with 8.46 value. pH value observed higher than the desirable limit which ranges between 5.56-8.7. The maximum value observed at S2 and minimum value observed value at S4 in the limit from 5.56 as shown in Fig 2(a). The safe limit of pH lies between 6.5 to 8.5. Slight acidic and alkaline nature of water at some sites indicate impact of industrial effluent.

b) EC values in the ranges between 1.22 to 4.72 ms/cm. Lowest value observed at site S3 in rainy and highest value observed at site S4 summer as shown in Fig 2 (b). The suggested EC value for drinking water is 1400 S/cm. The samples that are above the safe limit levels may be a result of anthropogenic activity, mineral dissolution, or regional geochemical processes. [10].

c) Turbidity values observed in range between 5.92 to 19.43NTU as shown in fig 2 (c).All sampling sites exceeds the permissible limit of turbidity which indicates presences of high bacteria level, pathogens or particles that can shelter harmful organisms [11].

d) Total alkalinity observed between range of 353 in rainy season at S2 and highest value observed of 970 in summer at S1(Fig 2 (d)). It is observed that all sites exceed acceptable limit of Total alkalinity. Plants and other living things die and decompose throughout the summer as a result of the well's lower water level. Therefore, as this decomposes, CO_2 is released, adding carbonate and bicarbonate; this may also be one of the causes of the rise in alkalinity value. Similar results were seen in Dharwad, Karnataka's ponds and lakes. [9].

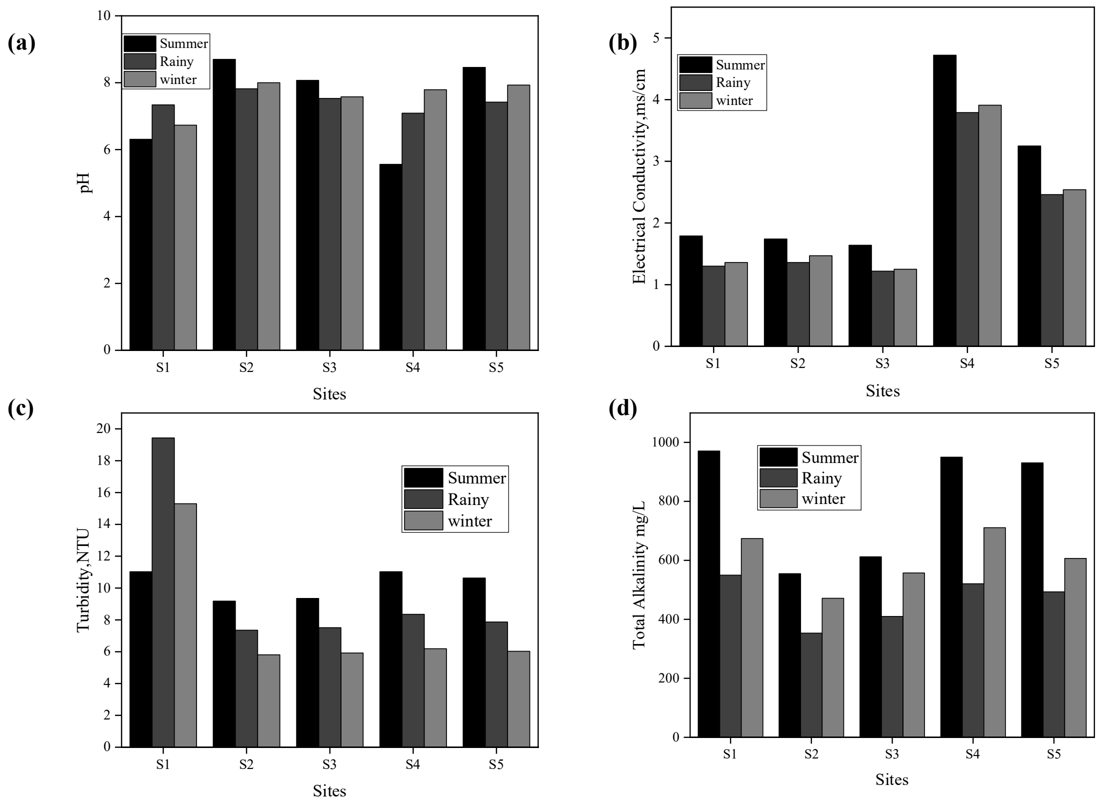

Fig.2: Seasonal water quality assessment at five sampling locations for (a) pH (b)Electrical Conductivity (c) Turbidity (d) Total Alkalinity

e) DO values was observed in between range 1.9mg/l in summer at S5 and highest value observed 10.82mg/l in rainy season at S1 as shown in Fig 3(e). The lowest DO at Site 5 may be due to increased amount of organic matter from industrial waste which need oxygen for decomposition.
f) BOD values observed between range of 183 to 382mg/l at site S3 during rainy and at Site S5 during summer respectivelyas as shown in Fig 3(f). High amount of BOD values at all sampling sites shows high level of organic pollutant present in water samples. The maximum allowed COD for drinking water is 10mg/l [12].
g) COD values were observed between range of 233 to 461 mg/l for site S4 at rainy season and site S5 summer season as shown in Fig 3(g), which shows the values of COD are much higher than allowed limit of COD shows contamination of water with industrial effluent. The results are far higher than what is predicted for drinkable water of good quality. Indices of organic contamination include COD and BOD. Drinking water supplies shouldn't have more COD than 2.5 mg/L, and water with a potable COD content of more than 7.5 mg/L is considered to be of low quality. [13].

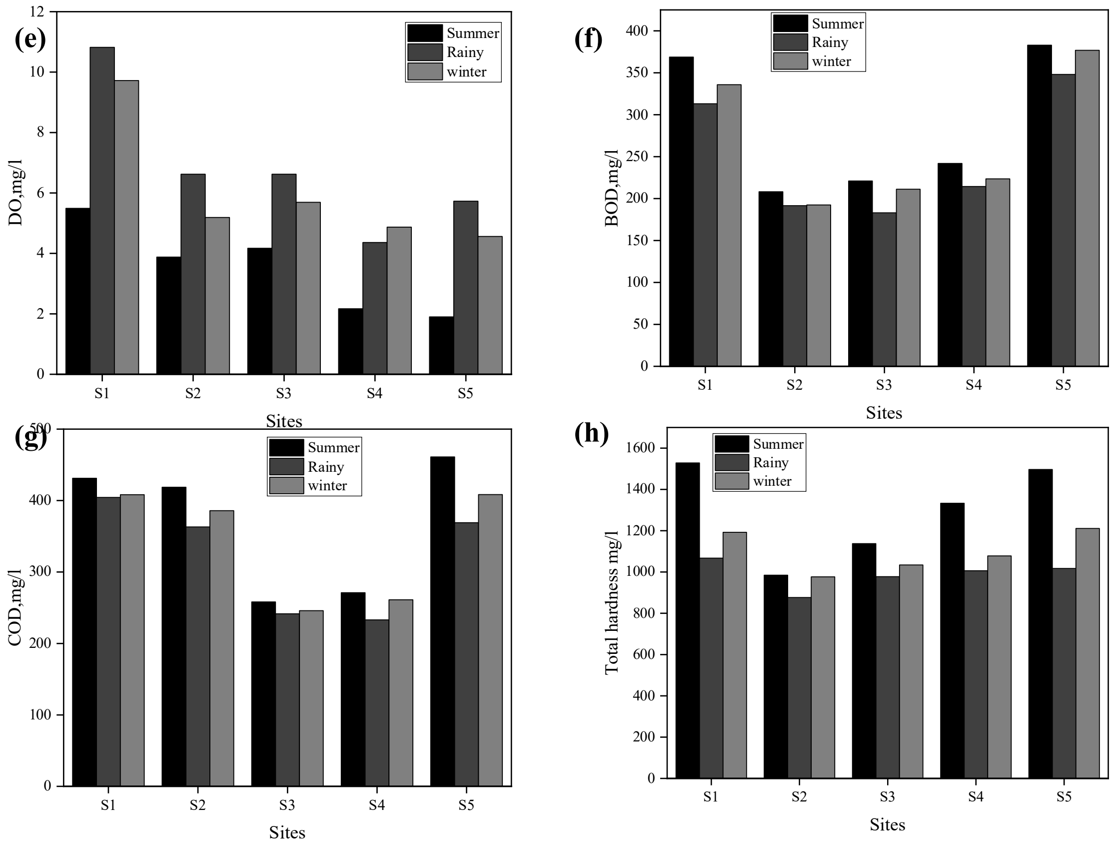

Fig.3: Seasonal water quality assessment at five sampling locations for (e) DO (f)BOD (g) COD (h) Total Hardness

h) Calcium and magnesium ions, which are generally formed by the breakdown of carbonated rock, are the principal regulators of groundwater hardness (Hd). [14]. Total hardness values were observed in between range of 876 to 1528 mg/l at site S2 during rainy and S1 during summer as shown in Fig 3(h). The Acceptable limit of hardness is 200mg/l and permissible limit in absence of alternative source is 600mg/l max. Total hardness at all sites at all seasons exceed the acceptable as well as permissible limit. So, water from Sites can't be used for drinking purpose as it is very hard water.

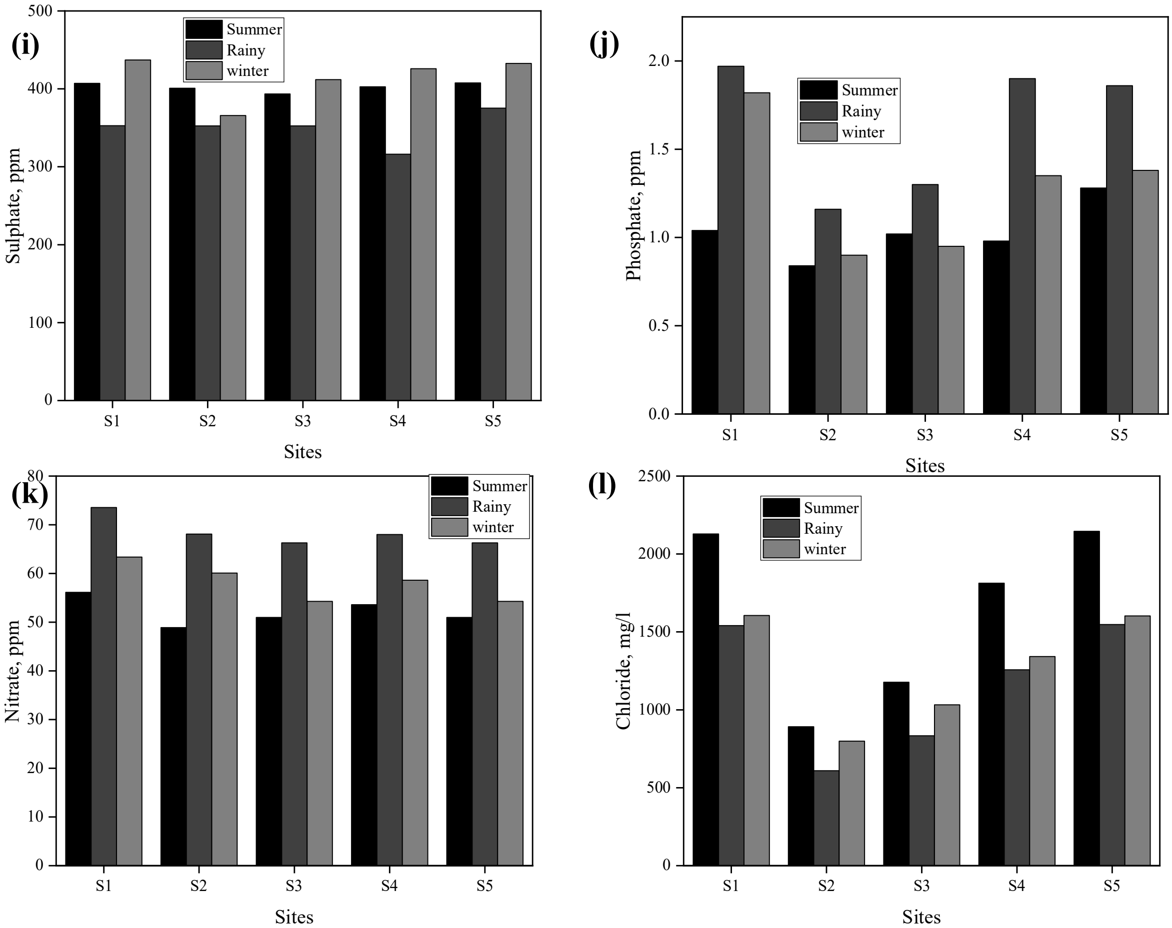

Fig.4: Seasonal water quality assessment at five sampling locations for (i) Sulphate (j)Phosphate (k) Nitrate (l) Chloride

i) Sulphate values observed were varies from 316mg/l to 437mg/l at SiteS4 and S1 respectively as shown in Fig 4(i). Acceptable limit of Sulphate is 200mg/L. At all sites the values of sulphate exceed the acceptable limit. Its concentration tends to rise with the discharge of home sewage and industrial waste. [15].

j) Observed Phosphate values ranges between 0.84 to 1.97 ppm at S2 in summer and at S1 in rainy season as shown in Fig 4(j). WHO recommend limit of phosphate is 5mg/l [15] which shows all samples has phosphate within WHO limit.

k) Acceptable limit of Nitrate is max 45mg/l. Nitrate values observed in study area ranging from 48 to 73 ppm which shows all sites samples exceed acceptable limit for nitrate as shown in Fig 4(k). High level of nitrate contain is result of anthropogenic activities resulting in leaching of nitrate from surface to underlying aquifers resulting in high nitrate contain [16].

l) Acceptable limit of chloride is max 250mg/l. Chloride values observed were ranging between 609 mg/l to 2145mg/L at Site S2 in rainy and Site S5 in summer respectively as shown in Fig 4(l). At all sites the values exceed the acceptable limit if chloride. Both natural and man-made causes, such as run-off containing salts, the usage of inorganic fertilizers, landfill leachates, septic tank wastes, animal feeds, industrial effluents, and irrigation drainage, can lead to high chloride levels in ground water.[17]

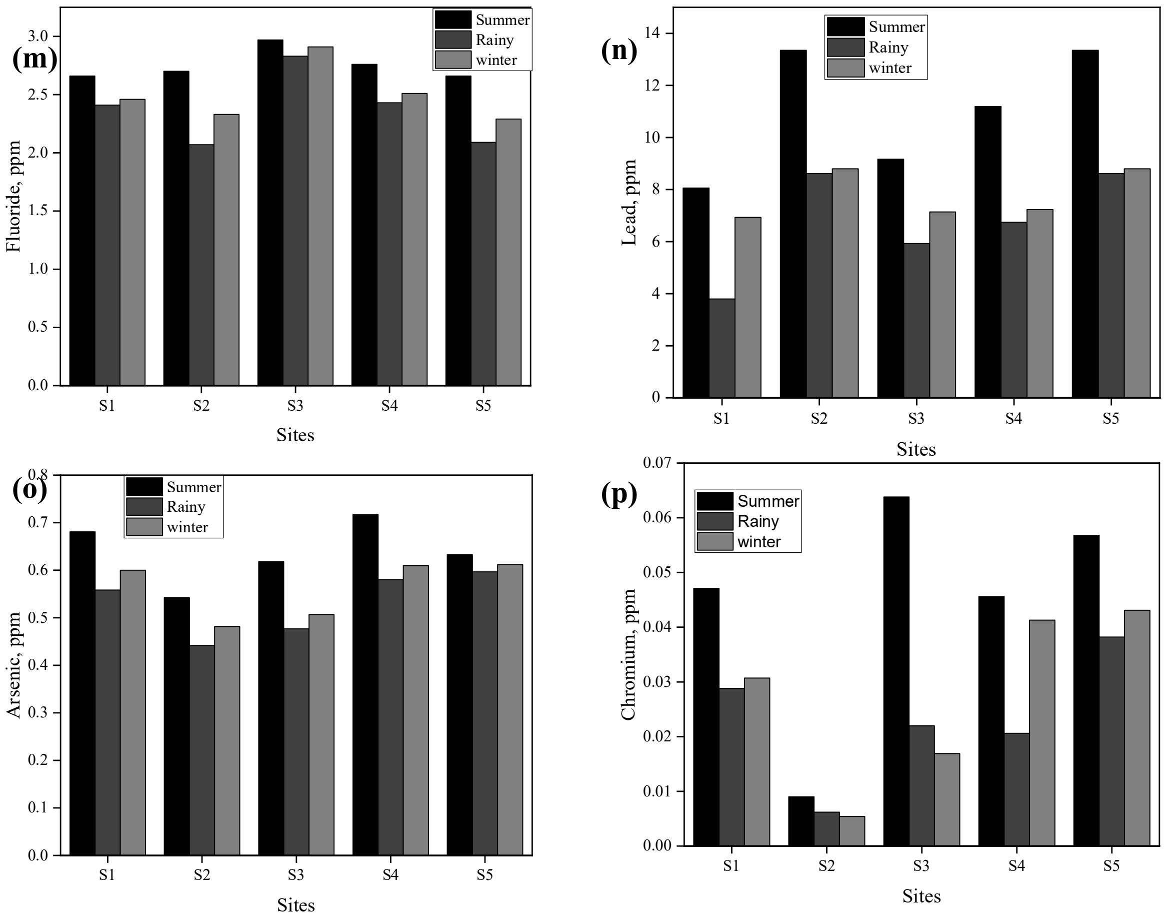

Fig.5: Seasonal water quality assessment at five sampling locations for (m) Fluoride n)Lead (o) Arsenic (p) Chromium

m) Acceptable limit of fluoride is max 1mg/l. Observed values of fluoride varies in between 2.07 to 2.97mg/l at site S2 in rainy season and Site S3 in summer as shown in Fig 5(m). Fluoride concentration at all sites exceed the acceptable limit. An excessive amount of fluoride in water can seriously harm the teeth and bones of humans, leading to disorders including dental fluorosis, muscular fluorosis, and skeletal fluorosis that exhibit symptoms of disintegration and decay. [18].

n) Acceptable limit of lead is max 0.01mg/L. Lead values observed were varies in between 3.79 mg/L to 13.34mg/l at Site S1 in rainy season and Site S5 in summer as shown in Fig 5(n). Amount off lead in natural water increases mainly because of anthropogenic activities. The presence of lead in natural water suggests that groundwater contamination was caused by industrialization and urbanization. [19].

o) Acceptable limit for Arsenic is max 0.01mg/l. Observed Arsenic values range in between 0.4 mg/l to 0.7mg/l, which shows that arsenic exceed at all sites as shown in Fig 5(o).

p) Acceptable limit of chromium is max 0.05mg/l. The values of chromium observed were vary in between range of 0.005mg/l to 0.06 mg/l. Chromium values at Site S5 & S3 exceed acceptable limit in summer as shown in Fig 5(p). High content of chromium may be due to various anthropogenic activities, industrial effluents, tanneries, old plumbing and household sewages [20].

CONCLUSION

It was observed that ground water samples from Miraj-Kupwad MIDC shows the high level of contamination of fluoride, sulphate, nitrates, chlorides, lead, chromium, turbidity, Hardness. If such highly contaminated water is used for daily activities it may result into serious health issues. Excessive addition of these contaminates mainly due to some anthropogenic activities which involves urbanization and industrialization. Insufficient effluent treatment plants and inadequate treatment facilities at industries leads to increase in industrial effluents which contaminates the aquifers. The study area requires proper disposal of effluents. It will help to save these natural water sources and future water scarcity issues.

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