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PHYSICOCHEMICAL ANALYSIS OF GROUND WATER AND SURFACE WATER IN BUNDI REGION, RAJASTHAN, INDIA

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ABSTRACT

The present study has been focused on analysis of physicochemical parameters (pH, Turbidity, Alkalinity, Total Hardness, Total dissolved solids, Conductivity, Chloride, Sulfate, Fluoride content) in major surface water and ground water bodies of Bundi Region. All results were compared with the standard limits as per WHO guideline for drinking water. The deterioration in the quality of water could be accounted to rapid urbanization. The result of present work reveals that surface water and ground water collected from selected sites showed alkalinity, except surface water of site II and IV whereas parameters such as turbidity, total solids, total hardness, chloride, sulfate, fluoride content values were high at site III and IV, while in case of conductivity site III showed highest degree of occurrence indicating adverse impact of anthropogenic activities in Bundi.

Figures : 13 References : 19 Table : 01

KEY WORDS : Anthropogenic activities, Ground water, Physicochemical parameters, Surface water.

Introduction

Of all the natural resources, water is unarguably the most essential and appreciated. Life began in water and spirit is nurtured by water. It is a universal solvent which provides the ionic balance and nutrients which supports all forms of life. Water is one of the abundant resources on earth. About 97% of the earth water is saline water in the ocean and 3% is fresh water contained in the poles (in form of ice), ground water lakes and rivers which fulfill the most of human and animal needs. Nearly, 70% of this tiny 3% of the world's fresh water is frozen in glaciers, permanent snow cover, ice and permafrost. The other 30% percent of all fresh water is in ground, most of it in deep, hard to reach aquifers. Lakes and rivers together contain just a little more than0.25% of all fresh water. Lakes contain most of it[4].

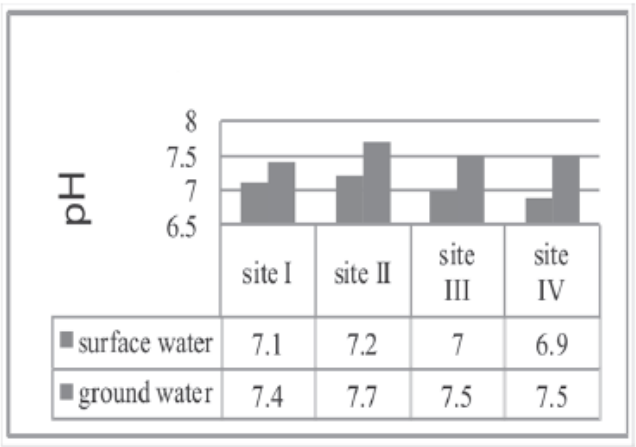

Fig. 1 : pH Analysis

In recent years, an increasing threat to ground water and surface water quality due to human activities has become of deep concern. The adverse effects on ground water and surface water qualities are the result of man's activity at surface, unintentionally by agriculture, domestic and industrial effluents unexpectedly by sub surface or surface disposal of sewage and industrial wastes[5]. The quality of ground water and surface water is of great importance in determining the suitability of particular ground water and surface water for certain use (public water supply, irrigation, industrial application, power house generation, *etc.*). Quality of ground water and surface water is the resultant of all the processes and reactions that have acted on the water.

Therefore, the quality of ground water varies from place to place and is primarily governed by the extent and composition of dissolved solids present in it. Most ground water quality problems are difficult to detect and

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TABLE-1: Physicochemical parameters of surface and ground water in Bundi Region (Rajasthan)

S. No.	Parameter	Indian Standard	WHO Standard	Surface Water				Ground water			
				Site I	Site II	Site III	Site IV	Site I	Site II	Site III	Site IV
I	pH	6.5 – 8.5	7 – 8	7.1	7.2	7.0	6.9	7.4	7.7	7.0	7.5
2	Conductance		300 µmho/cm	478	297	812	446	549	528	962	908
3	Turbidity	5 – 10	5	1.2	1.1	2.7	3.3	4.3	3.4	3.9	5.1
4	Total solids	500– 2000	500	373	232	633	348	428	412	750	708
5	Total Hardness	187 – 500	(Calcium) 100	140	90	190	50	150	150	180	180
			(Magnesium) 100	70	30	170	140	80	70	230	150
6	Total Alkalinity	200 – 600	100-200	200	110	270	100	270	240	410	350
7	Cl^-	250– 1000	250	30	20	90	70	30	20	70	100
8	SO_4^{-2}	200 – 400	250	2	3	2	3	3	4	5	7
9	F^-	1 – 1.5	1	0.40	0.24	0.32	0.34	0.47	0.41	0.48	0.42
10	NO_3^-	45	45	3	6	18	6	2	20	29	68
11	Na^+	200	200	16.6	6.2	81.9	46.3	31.4	9.9	70.1	54.2
12	K^+	12	12	2.9	4.7	22.9	6	3	2.3	5.2	1.1

(Except pH and conductivity, all results are in mg/l.)

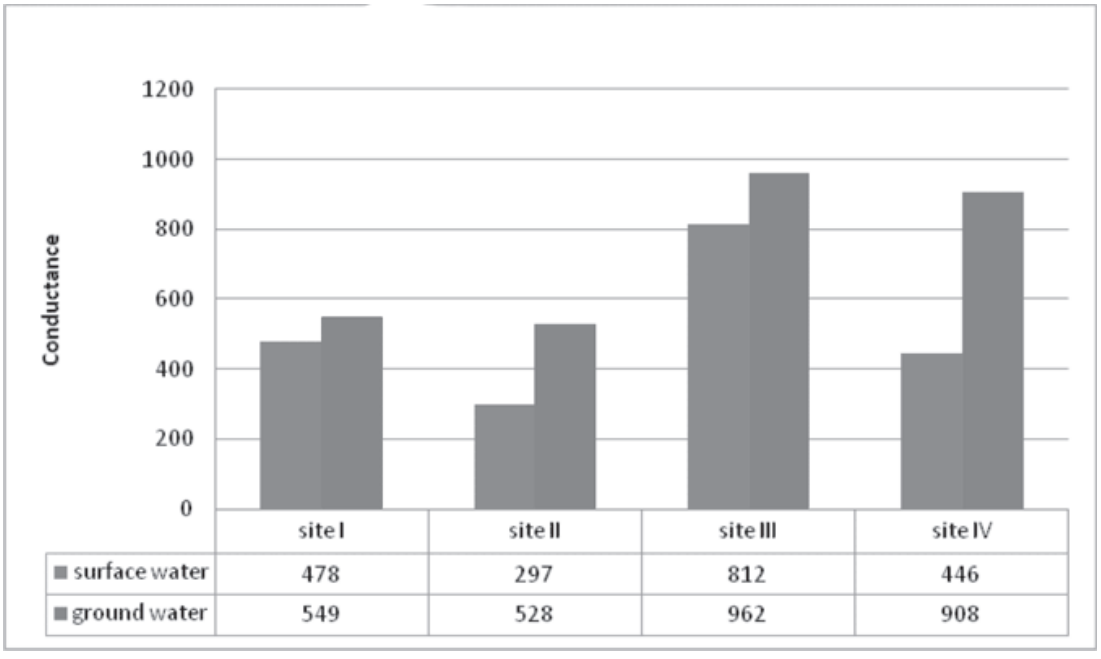
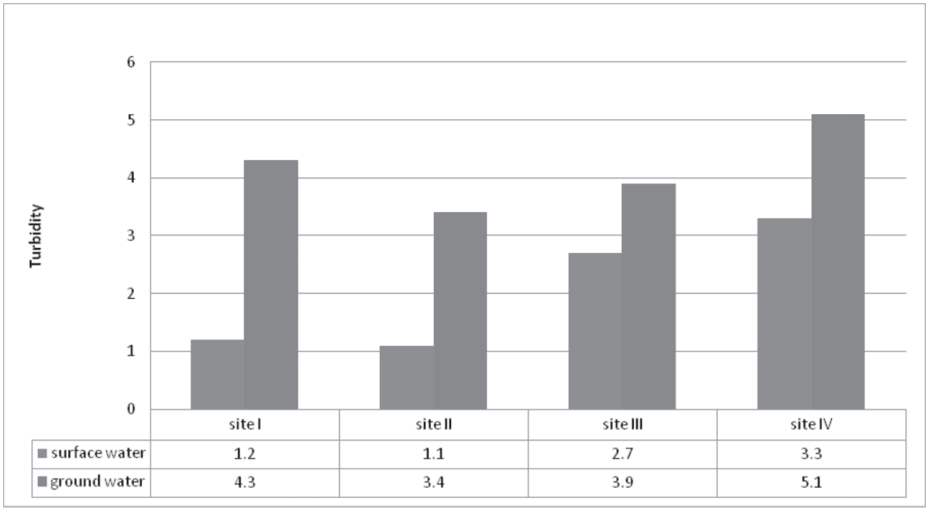


Fig. 2 : Condutance Analysis

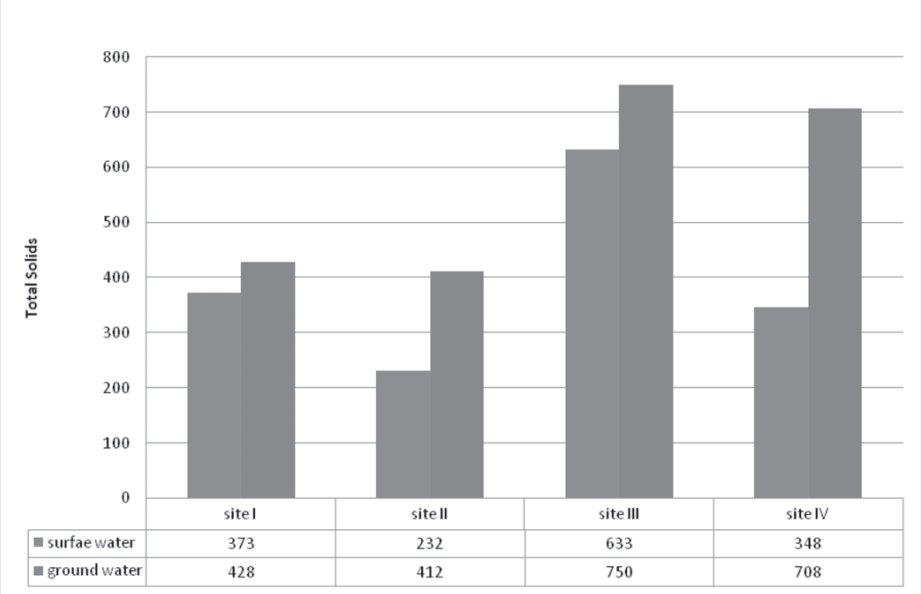
hard to resolve. The wide range of contamination sources is one of the many factors contributing to the complexity of water assessment[15].

Bundi is a city with 104,457 inhabitants (2011) and is in the Hadoti region of Rajasthan state in Northwestern India. The present water supply service level of Bundi is less than 135 lpcd. The water



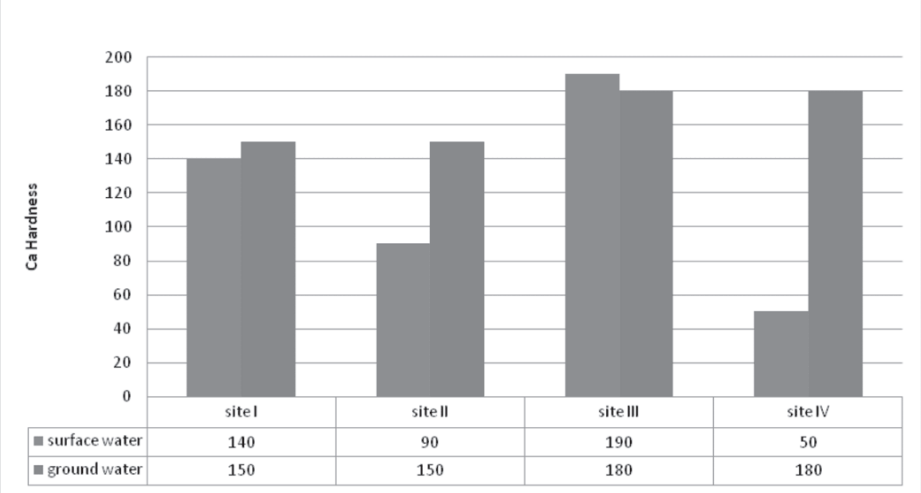
	site I	site II	site III	site IV
surface water	1.2	1.1	2.7	3.3
ground water	4.3	3.4	3.9	5.1

Fig. 3 : Turbidity Analysis



	site I	site II	site III	site IV
surfae water	373	232	633	348
ground water	428	412	750	708

Fig. 4 : Total Solids Analysis



	site I	site II	site III	site IV
surface water	140	90	190	50
ground water	150	150	180	180

Fig. 5 : Ca Hardness Analysis

supply of Bundi is sourced partly from tube wells and partly from Mangli River. The major short coming of the Bundi water supply is inadequate water service and deficiency of storage. 60% of the population is supplied with water through pipes and partly from public stand post and hand pumps[19]. Thus, regular physicochemical analysis of water resources must be carried out to determine the quality of it. The intensive use of water resources and the large production of waste in society pose a threat to ground water and surface water quality[5].

There is no water quality monitoring station in Bundi. The most nearest monitoring station is at Chambal River which is located 46 km from Bundi[19].

Materials and Methods

The present study deals with study of physicochemical parameters of ground water and surface water in Bundi region of Rajasthan (India). Surface water and ground water were collected from following sites-

1) Jait Sagar Lake
2) Sukh Sagar Lake
3) Nawal Sagar
4) Phool Sagar lake

The surface water samples were collected from four sampling sites, (Jait Sagar Lake, Sukh Sagar Lake, Nawal Sagar Lake and Phool Sagar Lake). The water samples were collected in November 2017 in morning hours. The samples were collected in cleaned plastic bottles and brought to laboratory in ice box to avoid unusual change in water quality. Prior to the sampling all the bottles were washed and rinsed thoroughly with distilled water. The physicochemical parameters (TDS, TSS, pH, electrical conductivity, turbidity, total hardness, total alkalinity,

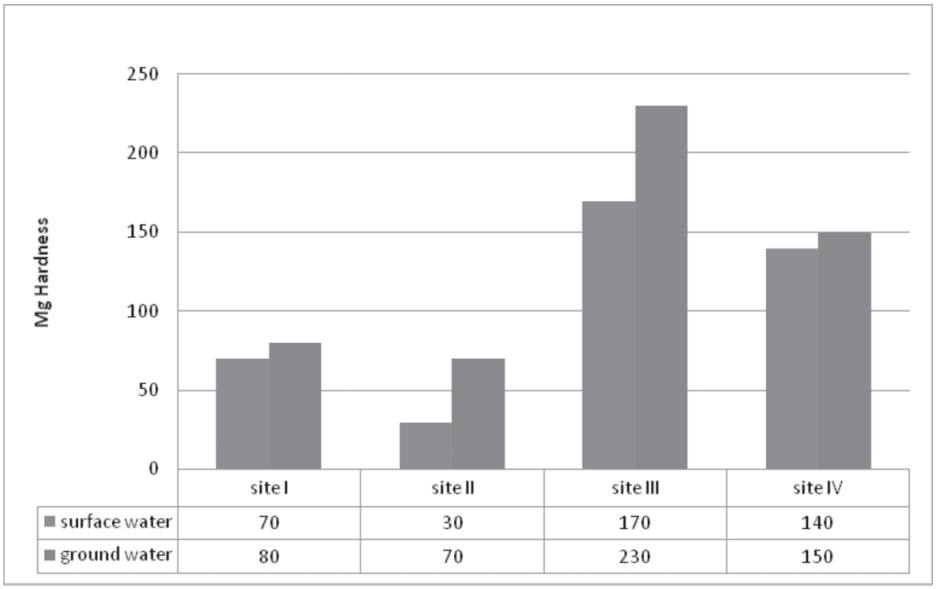


Fig. 6 : Mg Hardness Analysis

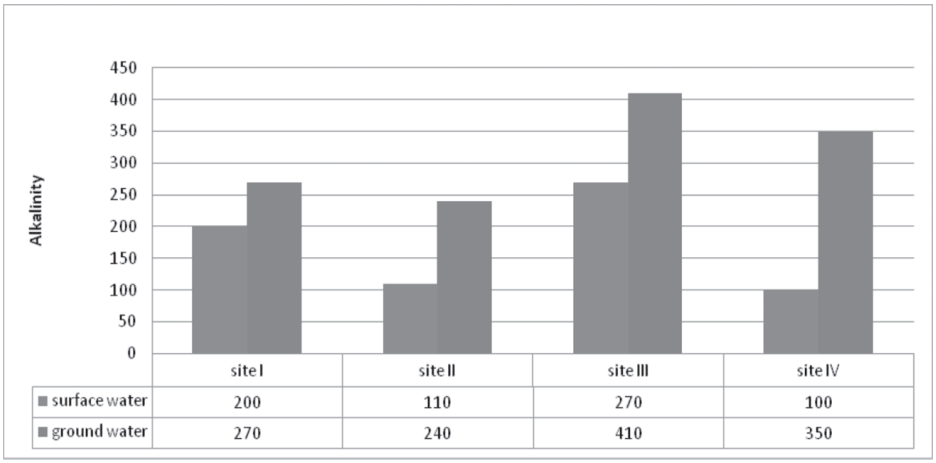


Fig. 7 : Alkalinity Analysis

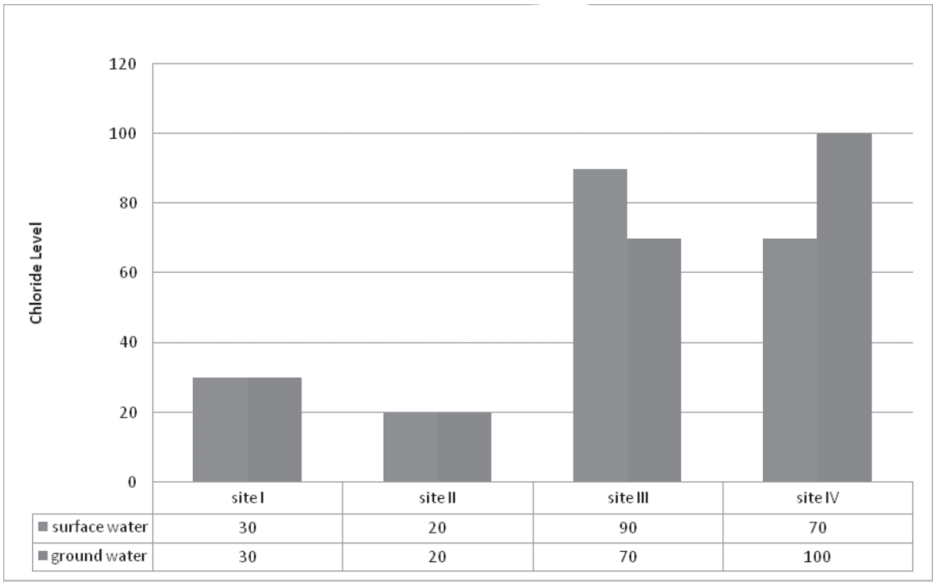


Fig. 8 : Chloride Analysis

Chloride, Fluoride, Sulfate, Nitrate, Potassium, Sodium, Lead content) were analyzed for the water samples by standard methods.

Area lying within 0.5-1km of surface water collecting sites was selected for the collection of ground water samples for comparison with respective site. Total four bore wells in selected areas were chosen for the sample collection. Water quality parameters were selected, which are considered to be important as per the drinking water standard [16].

Result and Discussion

pH –- The pH is a measure of acidity of surface water and ground water. It shows acidic and alkaline nature of water[13]. A pH of 7 is considered as neutral. Therefore, a pH less than 7 is acidic and greater than 7 means that the water is basic in nature[11]. The present study shows the variations in pH of ground water and surface water in the selected sites. The study reveals that ground water is alkaline as compared to surface water in all the selected sites, as the pH of ground water is higher than the surface water (Fig.1). The alkaline nature of ground water can be a result of greater value of total dissolved solids in it[7]. Improper waste disposal may lead to higher alkalinity of ground water in the Bundi region of Rajasthan.

Conductance – The ability to conduct an electric current is governed by the migration of solution and is dependent on the nature and the number of the ionic species in the water[14]. Following the analysis, it is seen that surface water of site III (812µmho/cm) has highest conductivity amongst all the surface water sampling sites. Ground water of every site has higher conductance in comparison to respective surface water (Fig.2).

Turbidity – Turbidity is caused by

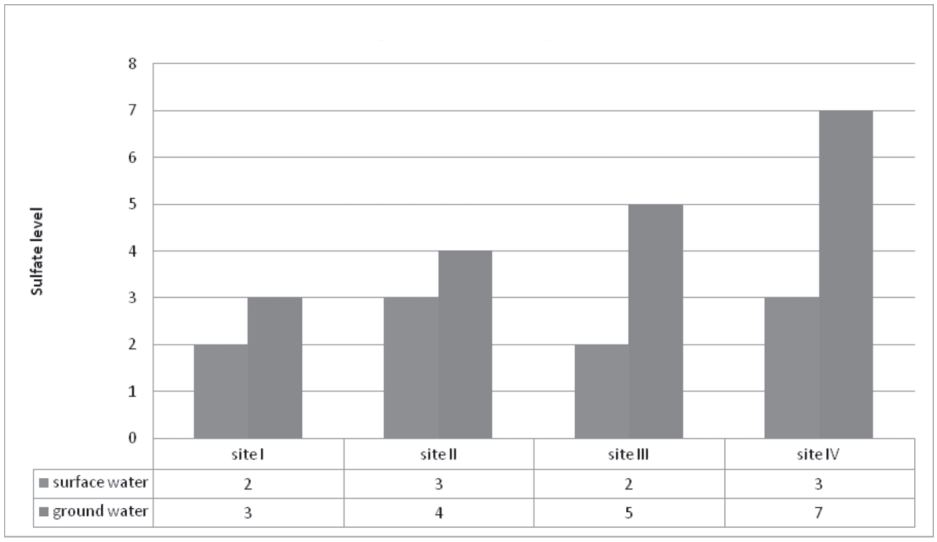


Fig. 9 : Sulfate Analysis

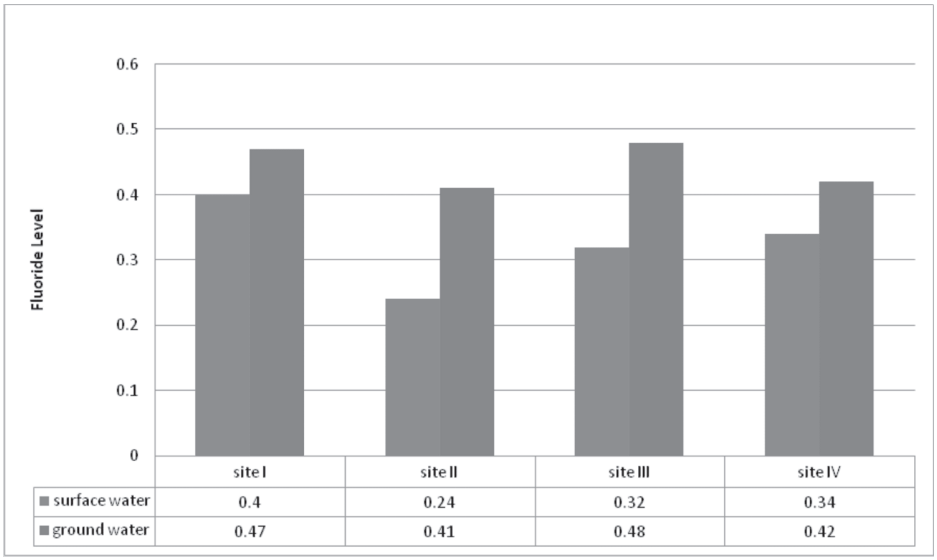


Fig. 10 : Fluoride Analysis

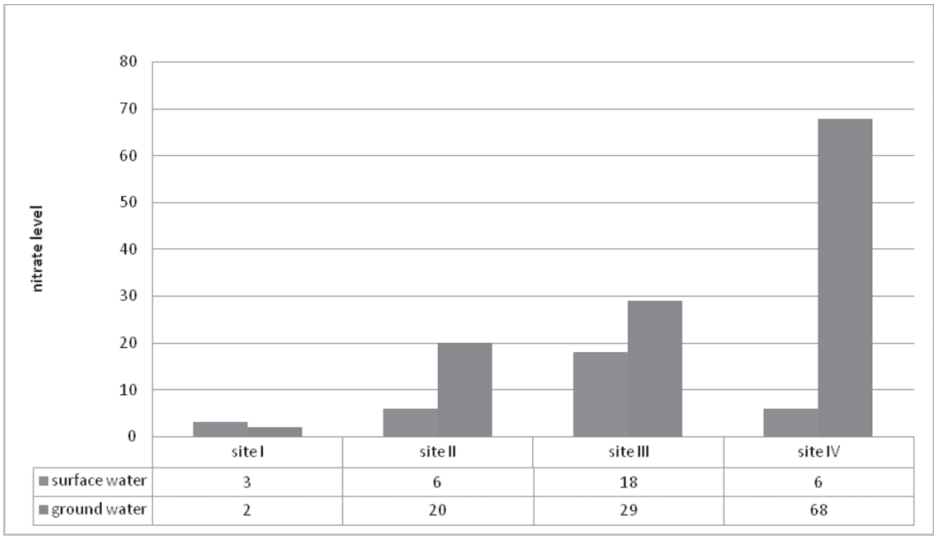


Fig. 11 : Nitrate Analysis

very small particles suspended in the water. So small in fact they weigh almost nothing and may not be visible[10]. Overall turbidity of ground water is higher than that of surface water in respective sites, ground water in site IV has highest turbidity of all the sites which is beyond permissible limit (Fig.3). The following graph shows comparative analysis of surface water and ground water in selected sites of Bundi region of Rajasthan (India).

Total Solids- It is the term used to describe any number of dissolved inorganic matter in the water. Total solids in water are composed of carbonates, bicarbonates, chloride, phosphates *etc* salts and other particles[8]. As per the analysis the value of total solids in Site III both ground water (750mg/l) and surface water (633mg/l) and ground water in site IV (708mg/l) was beyond desirable limit whereas all other sites had within desirable values (500mg/l) (Fig.4). On comparison between ground water and surface water of respective sites, it was found that the ground water had higher Total solids than surface water.

Total Hardness – Total Hardness is primarily caused by Calcium and Magnesium ions in the water[16]. According to the analysis the value of total hardness at site III both ground and surface water was higher than desirable limit whereas when it was compared between ground water and surface water of respective sites, the ground water in every site was harder than surface water. Calcium Hardness of water samples ranged from 50mg/l to 190mg/l (Fig.5) (under desirable limit). Magnesium Hardness of collected samples ranged from 30mg/l to 230mg/l (Fig.6).

Total Alkalinity – Alkalinity of

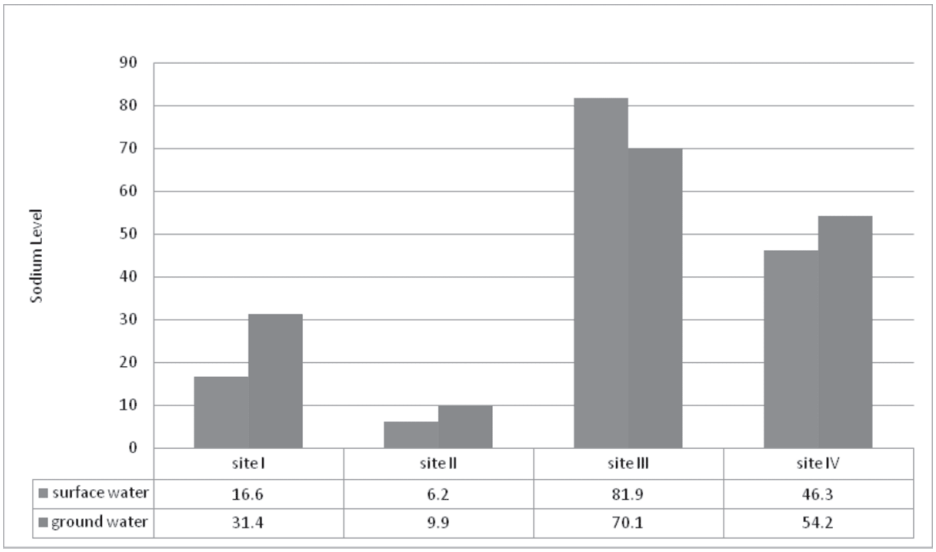


Fig. 12 : Sodium Analysis

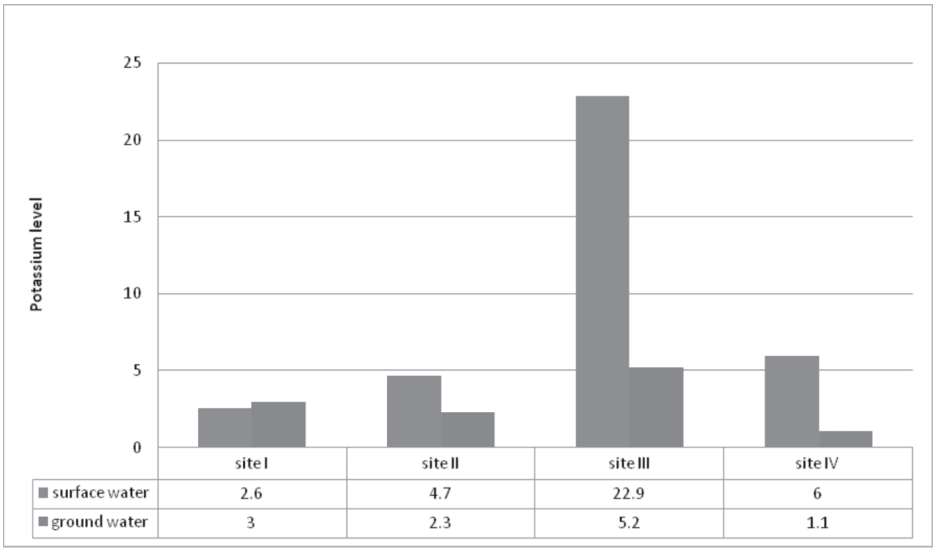


Fig. 13 : Potassium Analysis

water is caused mainly due to OH^-, CO_3^{-2}, HCO_3^- ions. Alkalinity is an estimate of the ability of water to resist change in pH upon addition of acid[8]. The acceptable limit of alkalinity is 200mg/l (16). The present study reveals that alkalinity in the Ground water of the selected sites ranged from 240mg/l (site II) to 410mg/l (site III) and that in surface water ranged from 100mg/l (site IV) to 270mg/l (site III) (Fig.7). Alkalinity in ground water was higher than surface water in respective sites. Higher values of alkalinity in these sources of water could be an impact on various anthropogenic activities.

Chloride – Concentration of Chloride in the collected water samples in selected sites ranged from 20mg/l to 100mg/l (Fig.8). All these values were found to be within permissible limit. These sources of water face a severe threat of being polluted by municipal wastes. Site III surface water receives sewage waste water which results in higher level of Chloride content.

Sulfate – Concentration of Sulfate in water sample ranged from 2mg/l to 7mg/l (Fig.9) almost negligible. Sulfate is a nontoxic anion but ailments like Catharsis, Dehydration and Gastrointestinal irritation have been linked with it when concentration is high[17].

Fluoride – The concentration of fluoride in the studied ground water and surface water samples ranged from 0.24mg/l (site II surface water) to 0.48 (site III ground water) (Fig.10) which were found to be under desirable limit. The low concentration of fluoride has been considered beneficial but high concentration may cause dental fluorosis (tooth motting) and more severely skeletal fluorosis[12].

Nitrate – Nitrate is naturally occurring ion that is part of nitrogen cycle. Higher concentration of nitrate in ground water of site IV (68mg/l) was observed whereas in surface water, site III (18mg/l) showed highest concentration of it (Fig.11). High level of nitrate in water might be due to excessive use of agriculture fertilizers, decayed vegetable waste, domestic effluents, sewage disposal, industrial discharge, leachable from refuse dumps etc.[9].

Sodium – Sodium compounds naturally end up in water. Not only seas, but also rivers and lakes contain significant amounts of sodium concentration. However it is much lower, depending on geological conditions and waste water contamination[18]. From the laboratory analysis the surface water of site III (81.9mg/l) recorded highest Sodium concentration and site II (6.2mg/l) the lowest. This result shows the contamination of surface water in site III. In case of ground water site III (70.1mg/l) had highest and site II (9.9mg/l) had the lowest (Fig.12). It can be seen that ground water of every site had high concentration of Sodium than respective surface water except site III which may be a consequence of urban wastes.

Potassium – Potassium occurs in various minerals, from which it may be dissolved through weathering processes. A number of Potassium compounds, mainly Potassium nitrate, are popular synthetic fertilizers. Potassium salts

and mixture of Magnesium and Calcium compounds are also applied regularly. Regeneration releases waste water that is hazardous when discharged on surface water[18]. The study reveals the concentration of Potassium in surface water and ground water of the selected sites. The potassium concentration in surface water ranged from 2.9mg/l (site I) to 22.9mg/l (site III) and in ground water from 1.1mg/l (site IV) to 5.2mg/l (site III) (Fig.13). The analysis shows the high level of pollution in surface water of site III.

Summary and Conclusion

The selected sites in Bundi city of Rajasthan (Jait sagar, Sukh sagar, Nawal sagar and Phool sagar) serve not only as source of water in city but also have a great aesthetic and economic values. The uncontrolled urbanization and anthropogenic activities had degraded the natural quality of these water resources. From the above results it can be concluded that all the lakes specially, Nawal sagar also known as Nolakkha Jheel is highly polluted as it receives untreated sewage and domestic waste.

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