Study of Non Point Pollution of Water Resources of Kaithal District

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Abstract- Kaithal district is one of the 21 districts of Haryana state in northern India. Kaithal town is the district headquarters. Kaithal district is situated in the North- West of the state . The district occupies an area of 2317 km² located between 29°31': 30°12' north latitudes and 76°10': 76°42' east longitudes. The Kaithal city, occupies an area of 43.76 sq. km within the municipal limit. This district came into existence on 1 November 1989. There are 277 villages and 253 Panchayats in Kaithal districts. Kaithal district comprises of five administrative blocks including Pundri, Rajaund, Kaithal, Kalayat and Siwan.. According to the 2011 census Kaithal district has a population of 1,072,861. This gives it a ranking of 423rd in India (out of a total of 640). The study is carried in the Kaithal district of Haryana. Since the Kaithal district in Haryana state of India .The district has a population density of 463 inhabitants per square kilometre (1,200 /sq mi). Its population growth rate over the decade 2001-2011 was 13.39%. Mainly villages of Pundri block showed problem of Total dissolved solids and Hardness in water samples. One or two villages showed high value of fluoride content also.Five to six villages out of fifteen villages chosen showed high content of total dissolved solids , sulphates and alkalinity. In Rajaund block out of seven sample stations two to three stations showed high values of alkalinity and sulphates. Two villages had high fluoride content..In Kalayat block out of four village stations one station showed high value of hardness, total dissolved solids ,sulphates and fluorides.

Keywords: Pollution, Ground Water, River, Contaminated, Sub Area: Civil Engineering, Broad Area: Environment Engineering

I. INTRODUCTION

The study is carried in the Kaithal district of Haryana**.** Since the Kaithal district in Haryana state of India has agriculture based economy. Hence, availability of groundwater in good quality and quantity is of utmost importance for the area. For conducting the present study the ground water samples were collected from various sources. from different villages of the four blocks of Kaithal district. The samples were analyzed for the following physicochemical parameters; pH, Total Dissolved Solid (TDS), Total Alkalinity(TA), Chloride, Total Hardness(TH), Ca hardness, Mg hardness, Nitrate, Sulphate, Fluoride and Iron. The physicochemical analysis of water samples were carried out in accordance to standard analytical methods. Natural resources are the important wealth of our country, water is one of them. Water is extremely essential for survival of all living organisms. In India, most of the population is dependent on groundwater as the only source of drinking water supply. The term groundwater is usually reserved for the subsurface water that occurs beneath the water table in soils and geologic formation that are fully saturated.

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Ground water plays a vital role in the development of arid and semi-arid zones. It is believed to be comparatively much clean and free from pollution than surface water. It is estimated that 80% of domestic needs in rural areas and 50% in urban areas is met by ground water. India's total replenishable groundwater has been estimated at 431.8 km^3 by the Central Statistical Organization. The average level of groundwater development in India is 32%, although some states have exploited their resources to a much greater extent (94% in Punjab, 84% in Haryana, 60% in Tamil Nadu, 64% in Lakshadweep, 51% in Rajasthan). 85% of ground water extracted is used for irrigation purposes and 15% for Industrial and domestic purposes. Water from underground sources gets automatically filtered through different strata of the earth and carries almost negligible suspended matter: however, a lot of soluble materials from the earth's strata (salts, hardness, organic matter, etc.) get dissolved in it during the course of filtration. Ground water is not as susceptible to pollution as surface water, but once polluted, its restoration, even if possible is difficult and long term. Most pathogenic organisms and many undesirable substances are removed by the filtering action of soil particles.

a. Contamination of Groundwater

The natural chemical composition of ground water is influenced predominantly by type and depth of soils and subsurface geological formations through which ground water passes. Ground water quality is also influenced by contribution from the atmosphere and surface water bodies. However in present time the ground water sources are getting contaminated due to anthropogenic activities. Though natural soil strata is also a good cause of ground water contamination. The leaching of soil minerals specifically the basic salts such as $CaCO_3$ and the minerals which contain calcium and magnesium etc and their chlorides and sulphates lead to excessive occurrence of these salts in ground water. In addition the salts of fluorides, iron, manganese, arsenic etc also make the ground water unsuitable for potable purposes. Excessive use of fertilizers and pesticides in agriculture and improper disposal of urban/industrial waste can cause contamination of ground water resources to a large extent in nearby regions. Contamination of ground water also results from discharge of industrial effluents without proper treatment into nearby rivers. Domestic sewage and solid waste dump also causes contamination of ground water.

b. Impact of Contaminated Water

This contaminated ground water can create various health problems. According to World Health Organization; about 80% of all the diseases in human beings are caused by water. Once the groundwater is contaminated, its quality cannot be restored by stopping the pollutants from the source therefore it becomes very important to regularly monitor the quality of groundwater and to device ways and means to protect it A large number of chemicals that exist naturally in the land or are added due to human activity dissolve in the water, thereby contaminating it and leading to various diseases.

II. REVIEW OF LITERATURE

Bishnoi *et al*. (2008) analysed various ground water samples in Panipat city to evaluate its suitability for domestic purposes. Various physico-chemical analyses were carried out. The ground water quality was found to vary from locality to locality. Higher values of certain chemical constituents indicate its unsuitability for drinking purpose. This may be due to geological reasons, unplanned sewage system and dumping of solid waste etc. Sunita *et al.* (2008) assessed the drinking water quality at Moga, Punjab (India) as this area lies in central Punjab where consumption of fertilizers and pesticides is the highest in the state. It was found that the major physico-chemical parameters of drinking groundwater were within the permissible limits. But certain parameters such as total dissolved solids, electrical conductivity, total hardness and magnesium content were above the WHO permissible limits at almost all the places in Moga city. Out of the total ten sampling sites, overall quality of water in terms of water quality index was found to be moderately to severely pollute at about six water sites. Goyal *et al.* (2010) analyzed the spatio-temporal changes in groundwater depth and quality in Kaithal district of Haryana. The study revealed a decline in average groundwater depth. Average EC of groundwater in the district was also found to degrade. Due to high EC, the groundwater in a part of Rajaund block was found unsuitable for irrigation. Western part in Siwan block was found critical due to fast depleting groundwater levels. The depletion of levels and worsening of groundwater quality in general, can be attributed to over-exploitation of groundwater and excessive use of agrochemicals in addition to natural factors. High EC and a nearly shallow water table observed in Rajaund and Kalayat blocks can be understood to be a combined effect of inadequate groundwater withdrawal, poor drainage conditions, effect of leaching, and geohydrological setting of the area. Singh *et al*. (2012) analyzed various ground water samples in rural areas of Faridabad to evaluate high Fluoride concentration. Various other water quality parameters were also measured. Majority of samples did not comply with Indian as well as WHO standards. The fluoride concentration of ground water varied from 1-4mg/l. overall water quality was unsuitable for drinking purpose without prior treatment. The higher concentration resulted because of weathering of rocks and anthropogenic activities. Suitable measures as deep fluoridating the ground water before use and recharging the ground water by rain water harvesting are the practices suggested to improve ground water quality. Also reduced use of chemical fertilizers for agriculture and adopting organic farming restore ground water quality of the area. Singh *et al.* (2012) assessed the extent of water pollution due to the excess use of fertilizers and pesticides in agriculture and its impact on ground water quality of three different dug wells in Dholpur district of Rajasthan, India. The different physic-chemical parameters like pH, Temperature, TDS, Conductivity, Nitrate, Sulphate, Dissolved oxygen Hardness, sodium, Potassium, Chlorides and Chemical Oxygen Demand were determined.

III. STUDY AREA

The study is carried in the Kaithal district of Haryana**.** Since the Kaithal district in Haryana state of India has agriculture based economy. Hence, availability of groundwater in good quality and quantity is of utmost importance for the area. Because of natural physiography, high population density, and intense agricultural activity, the groundwater levels and quality in the district is under high risk The Ghaggar and Markanda rivers are important seasonal rivers in the district and flows through the northern part of the district (covering Guhla block) in westerly direction and enters Patiala district of Punjab. Sirsa Branch of Western Jamuna Canal (WJC) with a network of distributaries and minors provides surface water in the district. The canal distribution is concentrated more in southern part as compared to northern parts. Net irrigated area in the district in 2001-02 was 1331 km^2, out of which, 521 km^2 (40%) was irrigated by surface water and 1852 km^2 (60%) with groundwater. In 2001-02, average density of shallow tube wells was 22 per km^2. According to the classifications followed by Soil Testing and Research Laboratory, Kaithal, the soils of the district are sandy to sandy loam in texture

Kaithal District AT A Glance

SL. No.	ITEMS	STATISTICS
1.	General Information	
	i) Geographical area (sq.km)	2317 Sq. km
	ii) Administrative Divisions Number of Blocks	05
	iii) Population (as on 2001 Census)	9,46,131
	iv) Normal Annual Rainfall (mm)	563 mm
2.	Geomorphology	
	Major Physiographic units	Alluvial Plain
	Major Drainages	Ghaggar and Markanda River
3.	Landuse (Sq.Km)	
	a) Forest area	20
	b) Net area shown	1970
	c) cultivable area	1970
4.	Major Soil Types	Sandy, Kallar or Rehi and Sierozem soil
5.	Area Under Principal Crops	Paddy 1568 Sq. km Wheat 1736 Sq. km
6.	Irrigation By Different Sources (Areas and Numbers of Structures)	
	Dugwells	Nil
	Tube Wells/Boreholes	53048/ 860 Sq. km
	Tanks/Ponds	11 Sq.km/ 292 Nos.
	Canals	990 Sq. km

IV. METHODOLOGY

For conducting the present study the ground water samples were collected from various sources. The various sources were the tubewells from different villages of the four blocks of Kaithal district. The samples were analyzed for the following physicochemical parameters; pH, Total Dissolved Solid (TDS), Total Alkalinity(TA), Chloride, Total Hardness(TH), Ca hardness, Mg hardness, Nitrate, Sulphate, Fluoride and Iron. The physicochemical analysis of water samples were carried out in accordance to standard analytical methods. All the samples were collected in three liter capacity polythene bottle having doubly stopper. Prior to the collection, the well cleaned sample bottles were rinsed thoroughly with the sample water to be collected. After collecting the samples, the bottles were immediately closed tightly. The importance of various parameters is as follows:

pH: pH is measure of intensity of acidity or alkalinity of water. All chemical and biological reactions are directly dependent upon the pH of water system (Rao, 2006).It is measured using pH meter.

Total Dissolved Solids (TDS): 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 (Singh *et al.*, 2012).

Chlorides: Chloride contents in fresh water are largely influenced by evaporation and precipitation. Chloride ions are generally more toxic than sulphate to most of the plants and are best indicator of pollution (Rao, 2006). It is determined by Argentometric titration method.

Hardness: Hardness is the property of water which prevents lather formation with soap and increases the boiling point of water. Hardness of water mainly depends upon the amount of calcium or magnesium salt or both. The various parameters were analysed by the following methods:

pH : pH meter is used for measuring the pH of water sample. First standardize the pH meter using a standard buffer solution of pH 4 and 9. Then check the pH of the given sample.

TDS : Filter 500 ml sample in a crucible to free it from suspended matter. The filtrate is collected in a beaker and evaporated to 50ml volume. The 50ml liquid is transferred to weighed dish. Evaporate the soln. to dryness and dry the dish in an oven at about 100-110^{0}c for an hour. Cool it in desiccator and weight Weight of solids x 10^6/500=ppm of DS

Alkalinity : It is determined by titration with 0.02 H_2SO_4 using phenolphthalein indicator. Take 50ml of sample in a conical flask. Add 2 drops of phenolphthalein indicator. Titrate the pink color with 0.02 N H_2SO_4 till it becomes colorless. Alkalinity = ml of 0.02N H_2SO_4 x1000/ ml. of sample

Hardness : Take 100 ml of sample in a conical flask. Add 1 ml ammonia buffer solution and 3 drops of eriochrome black T indicator. Titrate with EDTA solution till color changes from wine red to blue. HN = (ml of EDTA solution)/(ml of sample taken)

Calcium : Take 50 ml of the sample in a flask and add 50 ml of distilled water to it. Raise the pH to 12-13 by adding 2 ml sodium hydroxide. Add 1-2 drops of Murexide indicator. Titrate with EDTA solution. The end point is pink to purple. Calcium = ml of EDTA titrant x 1000/ ml of sample taken

Magnesium: It is determined by simple calculation only. From the epm value of hardness subtract the epm value of calcium and we get the value of magnesium. Ppm value is obtained by multiplying the epm value by 12.16 i.e. atomic weight of magnesium.

Chloride : Take 100 ml of sample in a conical flask . Add 2 drops of potassium chromate indicator and titrate with N/35.5 Silver Nitrate solution. The color changes from yellow to reddish brown or brick red. Chloride= ml of $AgNO_3$ used x1000/ ml of sample taken

Sulphate: Take filtered glass filter and dry to constant weight in an oven and cool it and weigh. Take 250 ml of sample in a beaker. Add 1-2 ml HCl and heat it to boiling with stirring. Slowly add warm $BaCl_2$ solution until precipitation appears to be complete. Digest precipitate at 80-90^0 C for 2 hours. Filter the solution at room temperature . Wash the precipitate with small portions of distilled water. Dry the filter paper with precipitates at 105^{0}C , cool it and weigh. SO_4 =(Weight of filter paper- Weight of dry filter paper) x 411.6/ Vol of sample

Nitrate: It is determined by Ultraviolet Spectrophotometric method . Measure 25 ml sample into a flask and add 5 ml HCl of 1 N . Calibrate the spectrophotometer and then directly take the readings of the sample. This gives the ppm value of nitrates.

V. RESULTS AND DISCUSSION

Pundri Block

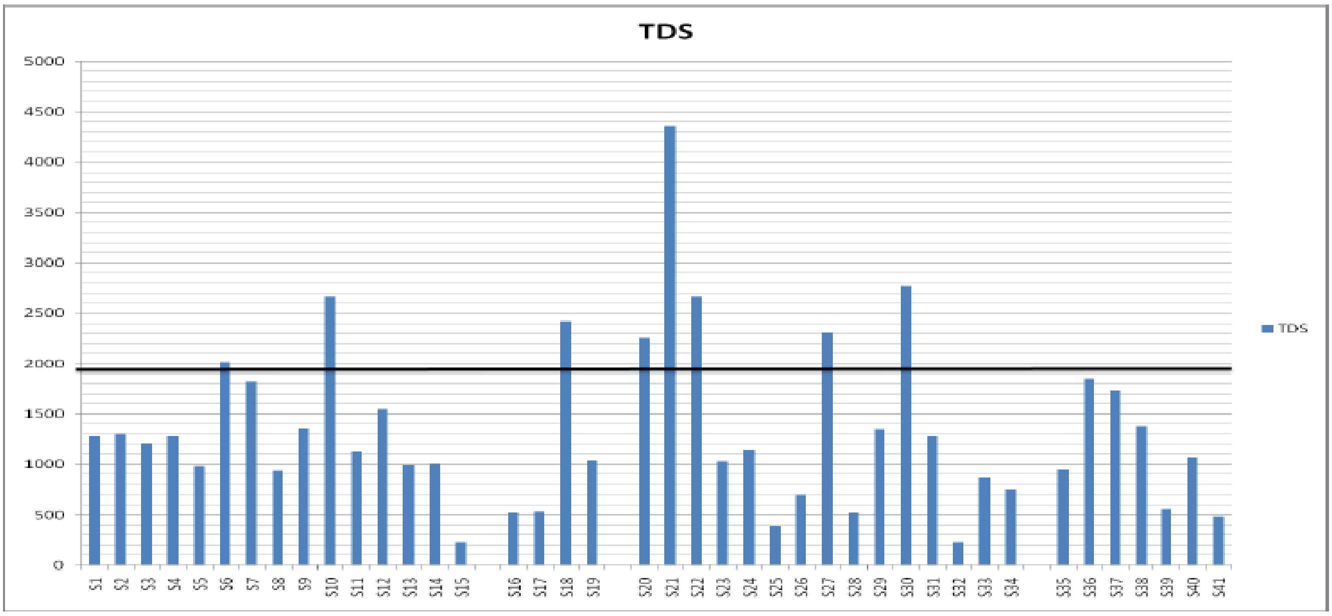
S. No.	source of sample	TDS	Hardness	Ca	Mg	Alk	Cl	SO_4	F	Iron	NO_3	pH	Remarks
1	S1	1282	360	36	64.8	430	241.4	590	1.37	0.06	1.3	8.05	Potable
2	S2	1300	720	76	127.2	400	170.4	255	0.73	0.04	16.8	7.33	HN,Mg
3	S3	1210	960	180	122.4	390	241.4	248	0.82	0.03	14.7	7.3	HN,Mg
4	S4	1284	810	148	105.6	350	184.6	180	0.8	0.06	27.4	7.46	HN,Mg
5	S5	985	250	88	7.2	440	177.5	104	1.12	0.02	2.9	8.25	Potable

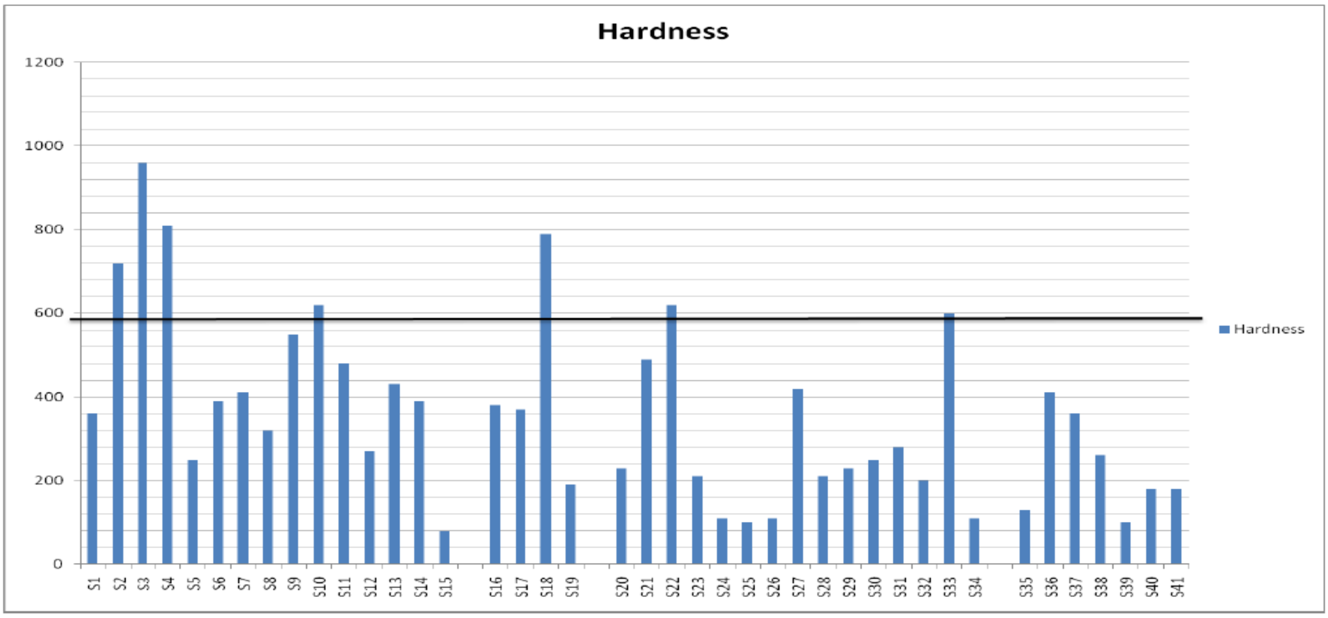
6	S6	2020	390	68	48	670	191.7	90	1.18	0.02	3.3	7.5	TDS,Alk
7	S7	1826	410	92	43.2	570	205.9	201	0.76	0.03	2	7.74	Potable
8	S8	940	320	16	67.2	380	78.1	57	0.8	0.01	1.7	7.75	Potable
9	S9	1356	550	60	96	390	191.7	36	0.38	0.03	5.6	7.35	Potable
10	S10	2670	620	156	55.2	570	255.6	540	1.5	0.01	4.9	7.99	TDS,HN,SO_4
11	S11	1132	480	52	84	360	134.9	54	0.66	0.12	1.8	7.56	Potable
12	S12	1552	270	56	31.2	610	92.3	164	4.12	0	1.5	7.65	F
13	S13	998	430	172	98.4	580	156.2	56	0.74	0.01	1.4	7.71	Potable
14	S14	1002	390	52	62.4	420	142	170	0.76	0.02	2.1	7.45	Potable
15	S15	230	80	16	9.6	200	24.85	34	1.91	0.01	0.7	8.39	F

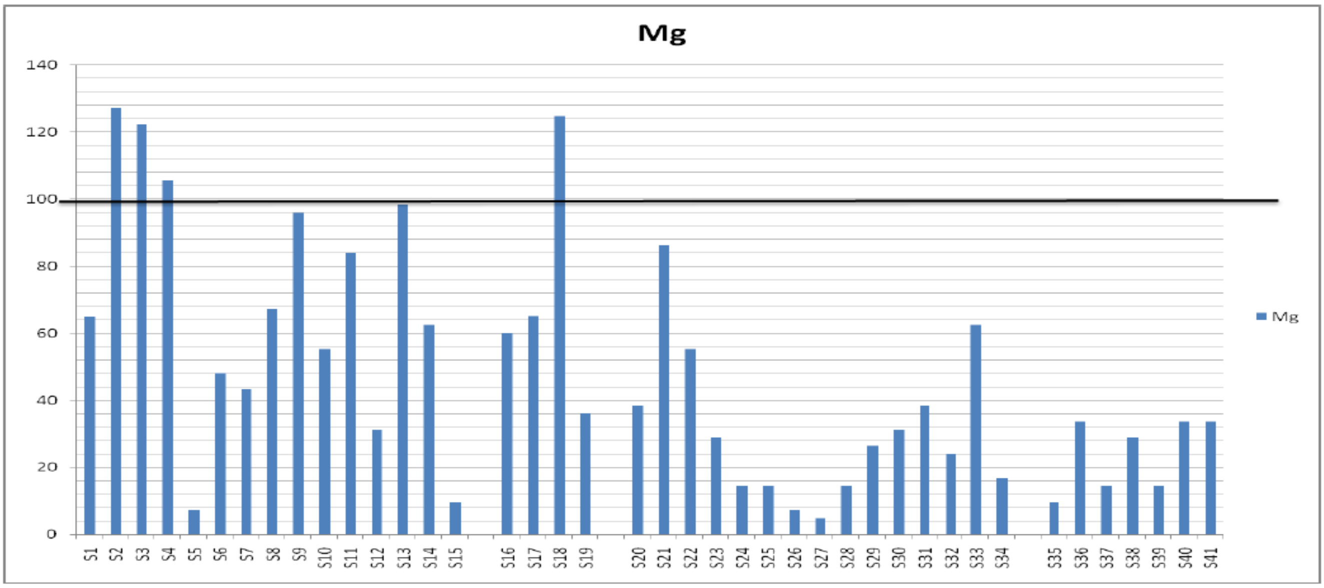
Kalayat Block													
S. No.	**source of sample**	**TDS**	**Hardness**	**Ca**	**Mg**	**Alk**	**Cl**	**SO_4**	**F**	**Iron**	**NO_3**	**pH**	**Remarks**
1	S16	520	380	52	60	370	35.5	76	0.9	0.09	2.6	7.51	potable
2	S17	534	370	56	65	380	32	88	0.8	0.08	2.8	7.46	potable
3	S18	2420	790	108	125	580	547	860	2	0.03	2.5	7.61	TDS,HN,Mg,F,SO_4
4	S19	1040	190	16	36	490	114	290	1.2	0.02	1.2	8	potable

Kaithal Block													
S. No.	**source of sample**	**TDS**	**Hardness**	**Ca**	**Mg**	**Alk**	**Cl**	**SO_4**	**F**	**Iron**	**NO_3**	**pH**	**Remarks**
1	S20	2260	230	28	38.4	400	184.6	600	1.35	0.2	3	7.69	TDS,SO_4
2	S21	4360	490	52	86.4	500	504.1	1140	1.21	0.13	0.6	7.42	TDS,SO_4
3	S22	2670	620	156	55.2	570	255.6	540	1.5	0.01	4.9	7.99	TDS,HN,SO_4
4	S23	1032	210	36	28.8	380	78.1	102	0.77	0.01	2.1	7.85	potable
5	S24	1146	110	20	14.4	480	63.9	400	1.29	0.43	0.9	7.1	Iron
6	S25	395	100	17	14.4	180	21.3	49	0.69	0.02	1.3	8.41	potable
7	S26	698	110	32	7.2	310	106.5	155	0.93	0.01	0.4	7.57	potable
8	S27	2310	420	160	4.8	690	276.9	690	1.2	0.04	1.6	7.73	TDS,Alk,SO_4
9	S28	526	210	60	14.4	390	21.3	45	0.95	0.01	2.2	7.97	potable
10	S29	1350	230	48	26.4	690	170.4	56	2.7	0.04	2.4	7.58	Alk,F
11	S30	2770	250	32	31.2	433.1	770	46	7.95	0.02	0.4	7.68	TDS,Alk,F
12	S31	1282	280	48	38.4	520	156.2	330	1.07	0.07	4.8	7.95	potable
13	S32	230	200	40	24	160	35.5	47	0.36	0.02	1.1	8.12	potable
14	S33	872	600	136	62.4	149.1	380	44	0.64	0.02	1.9	7.8	potable
15	S34	756	110	16	16.8	310	71	230	1.13	0.15	1.2	8.12	potable

Rajaund Block													
S. No.	**source of sample**	**TDS**	**Hardness**	**Ca**	**Mg**	**Alk**	**Cl**	**SO_4**	**F**	**Iron**	**NO_3**	**pH**	**Remarks**
1	S35	952	130	36	9.6	290	22.1	260	1.29	0.01	0.6	8.2	potable
2	S36	1850	410	108	33.6	680	255.6	580	0.82	0.03	0.8	7.6	Alk,SO_4
3	S37	1740	360	120	14.4	650	255	450	0.98	0.01	0.5	7.74	Alk,SO_4
4	S38	1380	260	56	28.8	400	241.4	400	1.01	0.01	0.6	8.5	potable
5	S39	560	100	16	14.4	360	78.1	60	1.78	0.05	0.9	8.32	F
6	S40	1068	180	16	33.6	440	127.8	306	1.5	0.04	0.8	8	potable
7	S41	483	180	16	33.6	330	42.61	138	3.14	0.01	0.7	8.5	F



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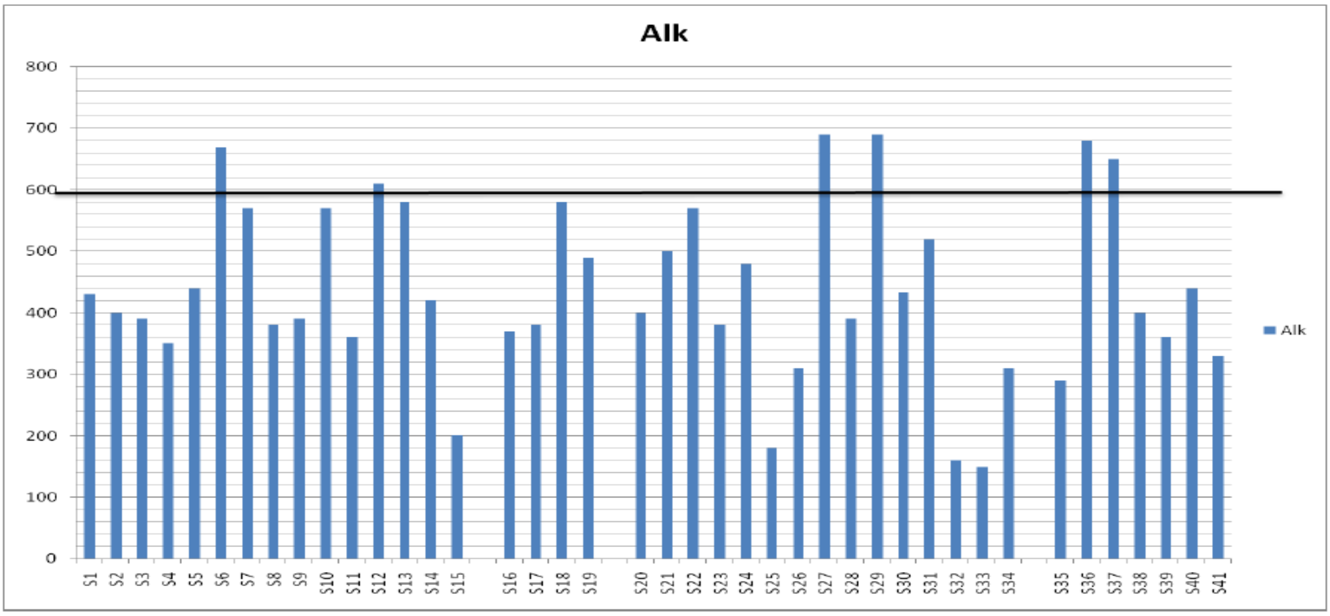
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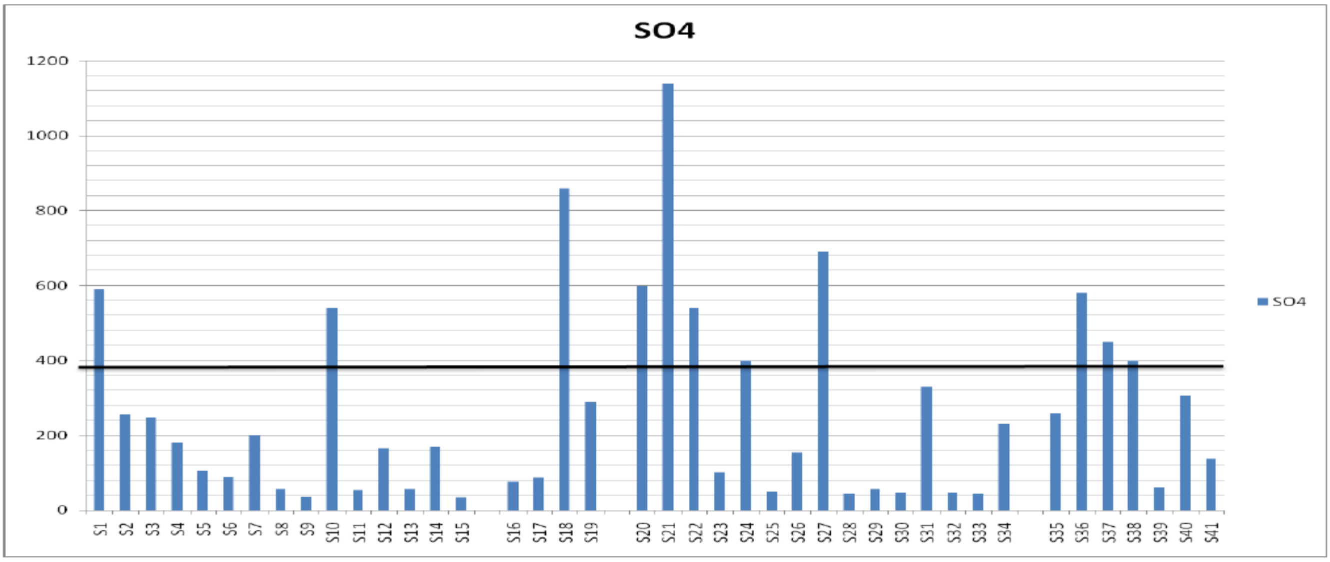
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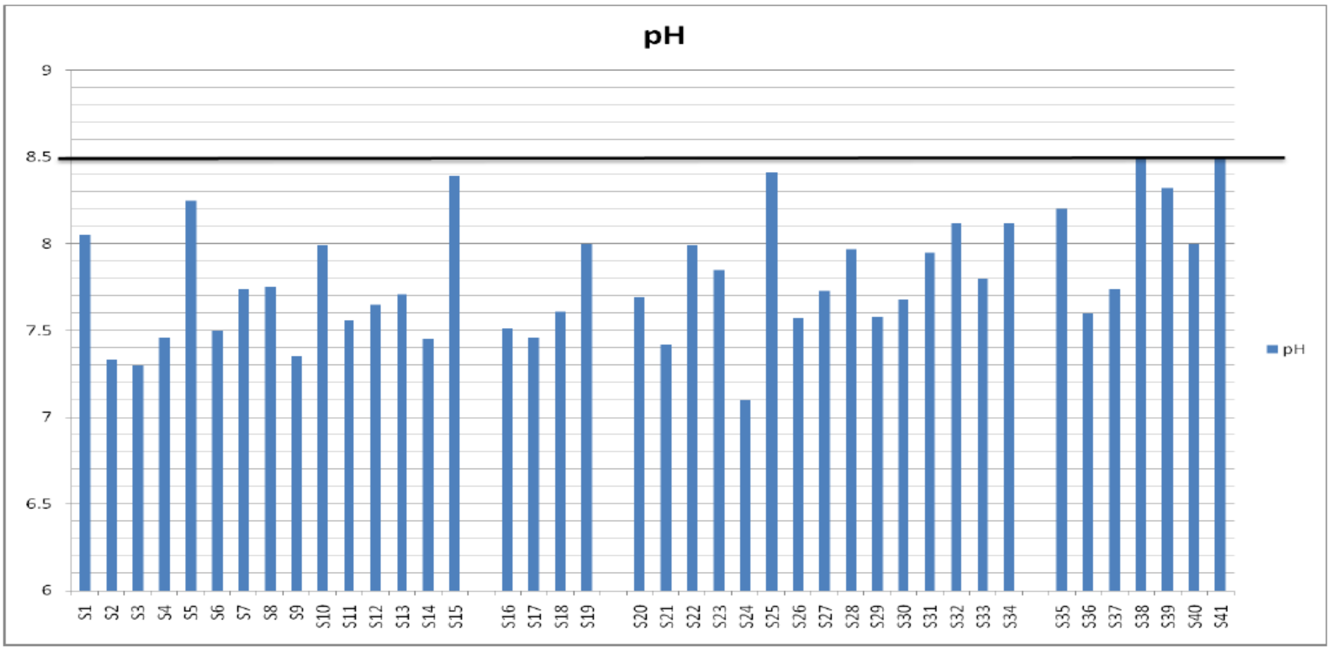

pH: In our analysis pH varied from 7.3 to 8.5 which comes in permissible values according to ISI standards .

Total Dissolved Solids (TDS): In our analysis TDS varies from 230 mg/l to as high as 436mg/l. So some of the villages of Pundri and Kaithal block showed values above the permissible limits .

Hardness: Our analysis showed the variation of hardness values from 80- 960mg/l. So many villages in Pundri block and one village in Kalayat block showed high values of hardness.

Chlorides: The chloride values varied from 21.3mg/l to 547mg/l. So all the villages were under the maximum desirable limit of chlorides according to Indian standards.

Alkalinity: The alkalinity values varied from 160 -690 mg/l. Two villages of Rajaund block and two villages of Kaithal block and one village of Pundri block showed values above the permissible values of alkalinity.

Sulphate: The sulphate values varied from 34-1140 mg/l. Only one village f Pundri and Kalayat block but mainly villages of Kaithal and Rajaund block showed high values above the maximum desirable values of sulphates.

Fluorides: The fluoride values varied from 0.36 – 7.95mg/l. Two villages each of Pundri, Kaithal and Rajaund block showed values above the maximum desirable levels according to Indian Standards. Iron: All the villages taken for analysis showed values of Iron within the permissible limits of Indian Standards.

VI. CONCLUSIONS

- Mainly villages of Pundri block showed problem of Total dissolved solids and Hardness in water samples. One or two villages showed high value of fluoride content also.
- Five to six villages out of fifteen villages chosen showed high content of total dissolved solids , sulphates and alkalinity.
- In Rajaund block out of seven sample stations two to three stations showed high values of alkalinity and sulphates. Two villages had high fluoride content.
- In Kalayat block out of four village stations one station showed high value of hardness, total dissolved solids , sulphates and fluorides.

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