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GROUNDWATER STATUS STUDY IN AND AROUND, LONI

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ABSTRACT

Water is one of the basic needs of human being. The need to meet the growing food demand has resulted in development of high yielding variety seeds, increased production of chemical fertilizers, pesticides. Coupled with the increasing availability of water through irrigation, agriculture activity is becoming the source of groundwater pollution. Leaching of fertilizer, pesticide is causing groundwater pollution. Groundwater currently is becoming unusable at many places and in some places the cause of major health disorder, due to excessive contamination of certain parameters. 12 Groundwater sample are collected from villages of Chinchpur, Sadatpur, Adgaon, Dhad, Gogalgaon, Loni. Physico-Chemical Analysis of the samples show that the concentration of pH, EC, Ca, Mg, Na, Cl, SO_4,are within the acceptable and maximum permissible limit for drinking and irrigation. About 50%samples had higher bicarbonate concentration, RSC value showed 3 samples under moderate and 2 sample unsuitable for irrigation purpose.

Keywords*: *Chemical Fertilizer, Food Demand, Groundwater Pollution, Health Disorder, Leaching, Irrigatin

I. INTRODUCTION

India receives rainfall during 4 months of monsoon to be utilized for the rest of the year. Rainfall is the chief source of groundwater recharge along with recharge by irrigation canal and other sources by other water bodies like lake, river etc.

61.6% of water for irrigation is derived from through wells, including dug wells, shallow tube-wells and deep tube wells followed by canals with 24.5%. Although quantum of surface water is more than groundwater, groundwater forms a major source for various uses. About 89% of ground water extracted is used for irrigation sector, 9% is used for drinking purpose, 2% for industrial purpose.85% of rural domestic requirement, 50% of urban domestic requirement is met by ground water. Anthropogenic activity has resulted in abuse of groundwater at an alarming rate both in quantity and quality. Arsenic, fluoride, nitrate and iron, are the commonly observed contaminants, in addition to human activity induced contaminants like bacteria, phosphates, heavy metals, Leaching of domestic sewage, agricultural and industrial effluents like contamination by landfills, septic tanks, leaky underground gas tanks, and from overuse of fertilizers and pesticides are the major source of groundwater contamination.[1]

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Studies conducted by [2] have showed that application of NPK fertilizer about 100% to 150% of recommendation, significantly increased the crop yield in pea based cropping system, as there was an increased nutrition availability.

Studies conducted by [3] in and around Cairo, showed that groundwater quality was affected by excess of sulphate, manganese, iron leading to industry as pollution agent, excess of Ammonia, phosphate, nitrate, sulphate, iron leading to agricultural pollution, and excess of nitrate, sulphate, manganese, resulting in urban pollution.

Indian economy is mainly dependent on agriculture and currently agriculture products accounts to 17.9% of country's GDP. During 2011-12, the total cropped area was 195.2Mha; net sown area is 140.8 Mha..India had only 0.8% of total cultivable area under assured rainfall & 30% of area was dry. Independent India was left with 19% of cropped area under irrigation in 1947. Food grain production rose from a mere 52 M.MT in 1952 to 246 M.MT during 2013-14, and irrigation potential increased from Under Indian condition, average yield from irrigated land is about 2.5tonne/ha and from unirrigated land is only 0. 5 tonne/ha. [4]

(5), investigated the concentration of pH,EC, TDS,TH,DO,COD,Ca, Mg, Na,K,Cl, sulphate SO_4, PO_4,NO_3 in groundwater of Pravara region and found that the concentration was within the permissible limit of WHO and ISI standards. [5]

Groundwater status study on application of nitrogenous fertilizer on groundwater conducted by[6] showed that 20% of all groundwater sampled in the district of Ludhiana, Bhatinda, Muktsar, of Punjab had Nitrate concentration above 50 mg/L NO-3. Wells in 8 of 18 villages sampled have pollution level above safety limits. The study revealed that It was found that the fertilizer application was around 322 kg N/ha in 2008-09 compared to the prescribed 210 kg N/ha for 2006-07

NEERI, Nagpur carried out groundwater studies and found that , 27% of the water samples of about 4696 showed Nitrate content beyond permissible limit.([7]

Health department and GSDA joint survey of water sources in Chandrapur between November 2014 and March 2015. Report published in April says 5,893 water sources, of total 11,280 sources tested in 847 gram panchayats, positive for various pollutants, 63.72% of water sources tested positive for very high level of nitrates,16.15% sources found polluted with fluoride([8]

Agriculture is becoming a major source of groundwater contamination. Excessive application of fertilizer to boost the yield has polluted all natural resource like, soil, water and air. Researches have found that around 50 to 70% of the water resources are polluted by agricultural activities. Agro chemical like Biocides, herbicides, fungicides, rodenticides, pollute water due to continuous use, causing destruction of enzymes, blocking of energy generating oxidation processes, their by and sets off malignancy in the cells[9]

The most common cause of groundwater contamination in the state of Tamil Nadu, Orissa, Karnataka, Maharashtra, Bihar, Gujarat, Madhya Pradesh, Rajasthan and other parts of India is from Nitrate. In India where safe drinking water is not available to large population, it is estimated that that around 37.7 million, people are affected by waterborne diseases annually, 1.5 million children die every year due to diarrhea alone, and 73 million working days are lost due to waterborne disease each year. [10]

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Flouride content in drinking water in 14 states of India are above the prescribed standard of 1.5ppm and around 65% of water sources in Indian villages have fluoride contamination. High Arsenic content, above 50 ppb are reported six district of West Bengal. Similarly studies have reported high salanity, heavy metals, Iron above standard limits in different parts of India. [11]

Large scale Groundwater Pollution due to Hazardous chemical was first detected by Japan Environment Agency in 1982 [12]. Presence of trichloroethylene groundwater wells was detected in 1972. 1499 Water samples were analyzed from shallow, deep wells and surface, across Japan. Nitrate levels were above permissible limits in 10% of all wells sampled, highest concentration observed was 80mg/L. In addition to this trichloroethylene, tetracholoroethylene, tricholoroethane was also found in high concentration.

The poor or very poor water quality in Rahata taluka may be due to the high levels of hardness, Mg and nitrate as observed from descriptive statistics of this taluka as all samples of hardness, Mg and nitrate exceeded the permissible limit during the three years(2007-2009). The water quality indices evaluated for Rahata taluka showed that the water quality was very poor in 2007-08 while poor in 2009.([13]

Under MPCB network 7 taluka in 4 districts show Fluoride levels above permissible limits of 1.5 mg/l, 100% of the time. Groundwater in 29 taluka in 16 districts shows total hardness exceeding the permissible limits (600 mg/l) 100% of the time. The analysis shows that 6 taluka in 5 districts of Maharashtra shows 100% exceedance of permissible limit of TDS. For aesthetic reasons, a limit of 2000 mg/l as permissible limit has been established as part of the BIS – 10500 (2004-2005). pH Concentration in two taluka of 2 districts show 100% non compliance of BIS standard of 6.5-8.5 mg/l.Based on the three years data, it can be observed that water is not potable and proper treatment is required. [14]

The current study. is conducted to understand the groundwater status in context to the growing agricultural activity in and around Loni,Taluka Rahata Maharashtra, India.12 groundwater samples were collected from the study area from shallow wells the depth of which varied between 5m to 20m. The water samples are analyzed by standard methods [14].

II. STUDY AREA

The study area Loni, is located in Ahmednagar District of Maharashtra. Located 509m above MSL, the total geographical area is 759 km2, about 4.36% of the total area of Ahmednagar district, of which 689 km2 (90.8%) is agricultural, forest16.13 km^2 (2.12%) &53.67 km^2(7.07%) others. There are around 60 villages in Rahata taluka. It is surrounded by Kopargaon taluka in North , Shrirampur Taluka in East , Sangamner Taluka towards west , and Vaijapur Taluka towards East. The study area falls in the semi arid region of western Maharashtra, and has average rainfall of 520.19mm (2002-2011). Agriculture is the main occupation in Rahata Taluka. [15]

III. MATERIAL AND METHOD

Villages of Chinchpur, Sadatpur, Adgaon, Dhad, Gogalgaon, Loni falling under Sangamneer and Rahata taluka is selected for study. The villages are within 10 km radius from the study centre Loni. The study is aimed at investigating the concentration of parameters like pH, EC, Na, Cl, SO_4,Ca, Mg, K, SAR, RSC, in

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groundwater.12 groundwater samples from shallow wells are collected by standard method from the selected villages and standard methods as per [14] are adopted analysis.

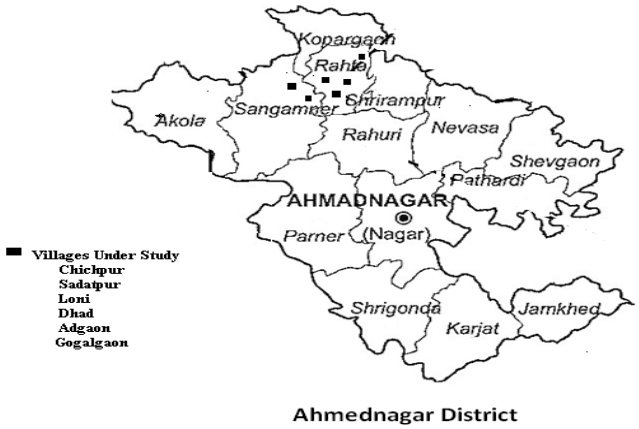

Fig1: Map of study area

Table1: Details of Sampling stations

Sr No	Sample No	Village
1	S1,S9,S10,S12	Chichpur
2	S2,S8	Sadatpur
3	S3,S5,S6	Loni
4	S4	Dhad
5	S7	Adgaon
6	S11	Gogalgaon

Table 2: Physico-chemical analysis of Groundwater

Sample No	**pH**	EC dsm^{-1}	Ca mg/l	Mg mg/l	Na mg/l	K mg/l	CO_3 mg/l	HCO_3 mg/l	CL mg/l	SO4 mg/l	SAR meq/l	RSC meq/l
S1	7.73	0.18	8.02	14.58	94.3	0	0	244.08	142	72.04	1.56	2.4
S2	7.8	0.83	20.04	29.16	193.2	1.564	0	292.89	170.4	129.2	6.51	9.4
S3	7.67	0.49	24.04	34.02	197.8	3.91	0	366.12	213	119.6	6.08	2
S4	7.83	1.3	44.08	65.61	326.6	3.91	0	463.75	312.4	212.8	7.28	0
S5	7.2	1.85	76.15	82.62	259.9	37.14	0	488.16	284	174.3	4.9	0
S6	7.4	1.45	44.08	58.32	181.7	3.91	0	536.97	326.6	162.3	3.94	0.8
S7	7.37	0.57	28.05	29.16	216.2	5.474	0	268.48	184.6	128.7	6.81	0.6
S8	7.44	2.82	32.06	31.59	184	5.474	0	366.12	241.4	158.5	5.52	1.8

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S9	7.38	1.51	56.11	72.9	209.3	3.91	0	561.38	326.6	158.5	4.33	0.4
S10	7.4	1	20.04	26.73	213.9	1.564	0	244.08	163.3	90.8	7.35	0.8
S11	7.65	1.16	40.08	55.89	243.8	3.91	0	610.2	397.6	132.1	4.83	3.4
S12	7.4	1.1	40.08	48.6	188.6	3.91	0	439.344	269.8	171.0	4.38	0.2

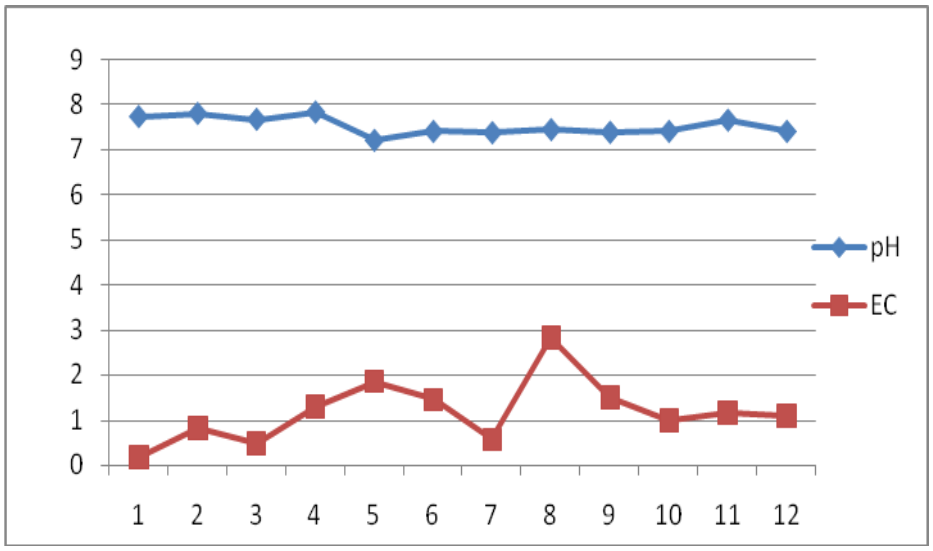

Fig2: Graph showing variation of pH & EC

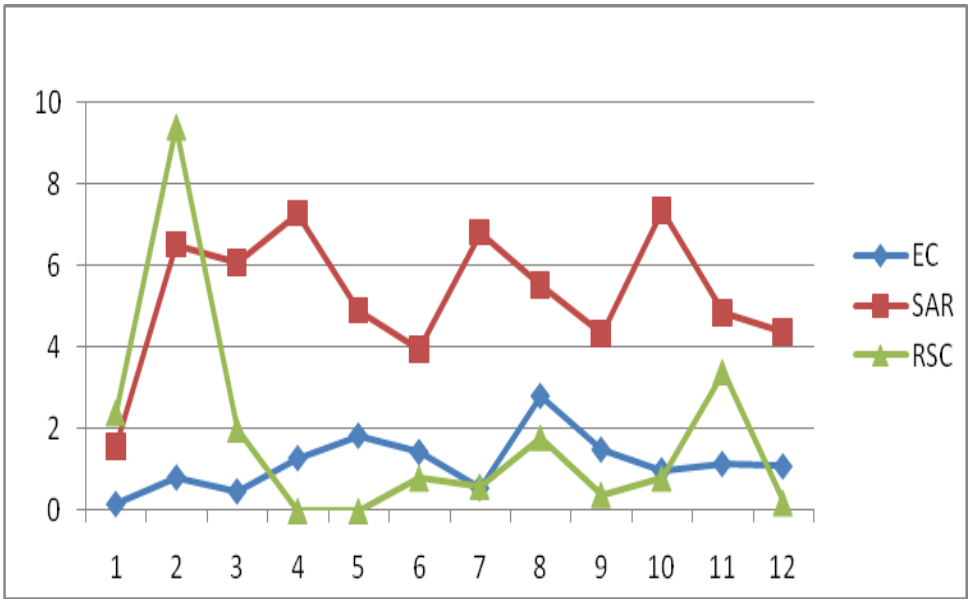

Fig3: Graph showing variation of, SAR and RSC with EC

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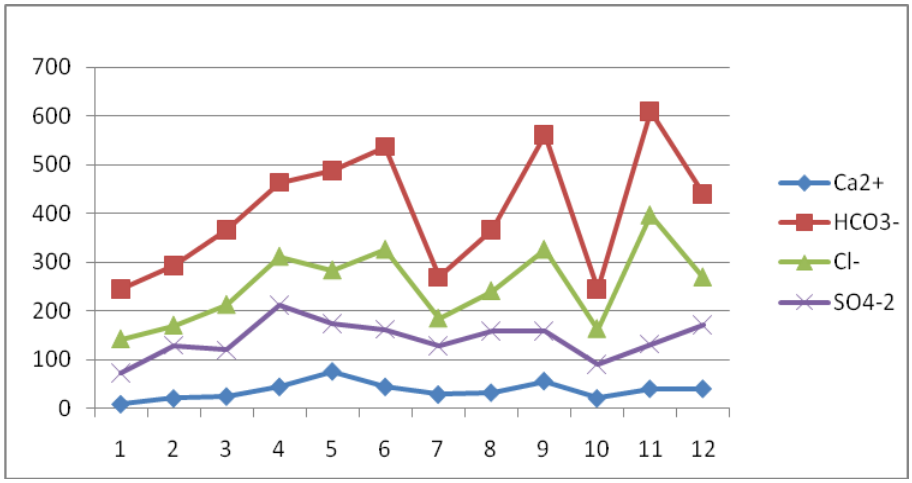

Fig4: Graph showing variation of HCO_3- Cl^- and SO_4^{-2} with Ca^{2+}

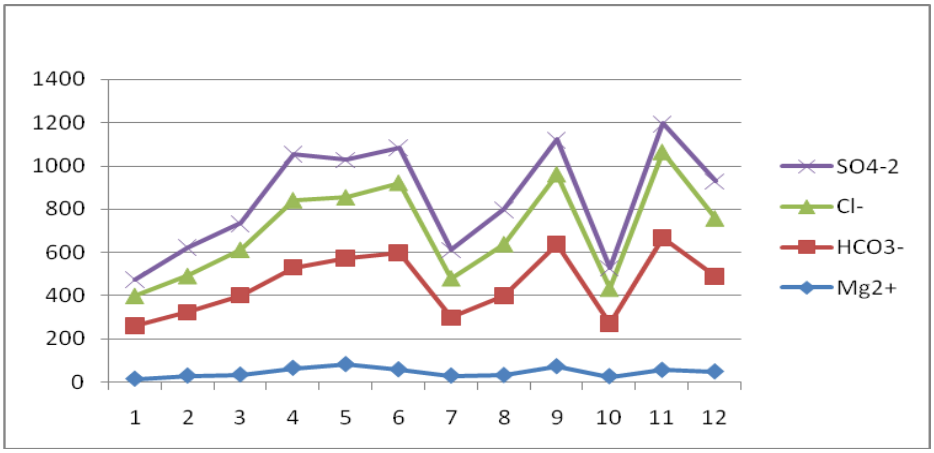

Fig5: Graph showing variation of Mg^{2+} and HCO_3- ,Cl^- ,SO_4^{-2}

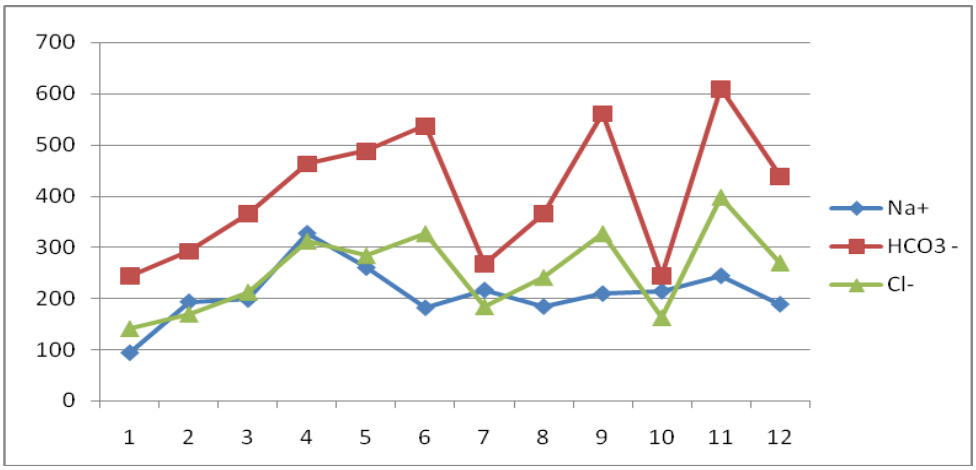

Fig6: raph showing variation of HCO_3 &- Cl^- with Na^+

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IV. RESULT AND DISCUSSION

The result of physico –chemical analysis is presented in Table 2. The effect relations between various parameters are shown through Fig 2 to Fig 5.

4.1 pH

The acidic or alkaline nature of water is represented by pH, and it groups the water into alkali or acidic, based on its value. A maximum value pH of 7.83(S4) and minimum value of 7.2(S5) was observed for the water samples. All the samples are within the BIS &WHO limits for groundwater [16]

4.2 EC

The Electric conductivity is a measure of inorganic dissolved solids, ions carrying positive & negative charges,& depends on the temperature of water.EC is an effective tool to classify water into good, medium, bad and very bad category. During the study the EC of water varied between 2.82 ms/cm(S8) (2820µmho/cm) to 0.18 ms/cm (S1)(180µmho/cm) All water sample except S8,S5,S9,S6 were fit for drinking water as per WHO guidelines. Sample S1, is excellent, S3&S7 is good, S2, S4,S5,S6,S9,S10,S11 &S12 is medium, and S8 is bad for irrigation purpose. [16&18]

4.3 Calcium & Magnesium

Calcium and Magnesium results in hardness in natural water due to leaching of sources like limestone, marble, calcite, magnasite, dolomite etc.(21)The concentration of calcium varied between 76.15 mg/l to 8.01 mg/l .All samples were under acceptable and permissible limit.((16&18). The concentration of Magnesium varied between 82.62 mg/l to 14.58mg/l. Sample S1,S10,S7,S2 were within acceptable limit of BIS&WHO and all other samples were within the permissible limits of BIS & WHO standards[16&18]

4.4 Carbonate and Bicarbonate

Carbonate minerals in nature like limestone, magnasite, dolomite etc results in the presence of carbonate and bicarbonate in groundwater and affects the pH of water. Presence of limestone as geological formation contributes to carbonates leading to increase in hardness and alkalinity.Carbonate concentration was found to be 0.00 mg/l in all the samples. Bicarbonate concentration varies between 610.2mg/l to 244.08 mg/l. All samples were found to be above permissible limits (120mg/l). [16&17]

4.5 Sodium and Potash

Natural activities like weathering, extraction of geological formation, like feldspar results in presence of Sodium in groundwater. Sodium concentration was found to vary between 326.6 mg/l to 94.3mg/l. Sodium concentration in 50% of the samples at S1, S2,S3,S6,S8,S12, were within permissible limits(200mg/l ,WHO).and remaining, above permissible limit. Potash concentration varied between, 37.14 mg/l to 1.56 mg/l and in sample had zero concentration. All samples had potash concentration below the specified limit except S5 which had very high concentration[16&18]

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4.6 Chloride

Various natural activities like weathering, leaching leads to accumulation of chloride in groundwater**.** Chloride values varied between 397.6mg/l to 142 mg/l.50%of samples (S1,S2, S3, S7, S8, S10)were within acceptable limits of 250mg/l & remaining within maximum permissible limit of 1000mg/l

4.7 Sulphate

Sulphate in groundwater results due to oxidation of sulphate ore, waste from industries Groundwater sample analysis showed sulphate to have a maximum value of 212.8mg/l to minimum value of 72.04 mg/l. All samples were within the acceptable limits of 200mg/l, except S4, (212.8 mg/l) which was within maximum permissible limit(400mg/l). [16]

4.8 SAR & RSC

The permeability of soil is affected by the sodium concentration in soil which due to process of deflocculation of ingredients of soil results in clogging of soil pores leading to reduced movement of water, affecting the calcium and magnesium concentration .SAR measures comparative concentration of sodium with calcium and magnesium concentration and express the suitability of water for use. During the study SAR values for varied between 7.35 meq/l to 1.56 meq/l and water was observed to be of good quality

RSC is another tool for measuring sodium risk to the soil. For all values above zero, sodium risk in soil increases as water appends more carbonate than divalent cations. During study maximum value of 9.4 meq/l and minimum 0.20meq/l and 2 samples S4&S5 had zero value. From irrigation point of view sample, S6,S7,S9,S10,S12were observed to be of good quality,S1,S3,S8was doubtful,S2&S11was found to be unsuitable for irrigation. ([17&18]

V. CONCLUSION

Groundwater degradation in quality and quantity is a cause for concern .Anthropogenic activity is to be restricted to allow for groundwater rejuvenation. The study reveal that groundwater is good for consumption as seen from the values of pH &EC obtained. Ca^{2+} ,Mg^{2+},Cl^{-} ,$S0_4^{-}$,were within acceptable and maximum permissible limits of WHO& IS10500-2012 indicating good to medium quality of water. However high bicarbonate concentration in more 50% of sample indicating that water is turning alkaline due to magnesium values observed above acceptable values. Although SAR values observed showed good quality of water for irrigation, the RSC value indicated that alkalinity is slowly increasing. In general the water quality currently is good to moderate, but the trends show that groundwater is susceptible to contamination under the current agricultural and disposal practices.

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