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Impact study of groundwater quality in Sivakasi command area

S. Rajesh*
Civil Engineering department, Bharath University, Chennai, Tamilnadu, India
***Corresponding author:E-Mail: rajeshskr06@gmail.com**

ABSTRACT

The aspire of the present study is to assess the groundwater quality in Sivakasi area for the purposes of irrigation with indication to optional standards prescribed by (WHO, 1984).

The application of chemical constituents in the aquifers of the area has been investigation. Plan to appraise the concentration of some of the major constituents of groundwater such as pH, EC, TDS, Chloride, Bicarbonate, Calcium, Magnesium, Sodium, Potassium, Sulphate, SAR. Groundwater samples have been collected from various well points and samples are analysis as per standard method.

The analytical results show that water is suitable for irrigation purpose with a few exceptions SAR value is high at some sites restricting its irrigational usability. Calcium shows low percentage in ground water quality this owing to lack of insufficiency calcium to offset the disperse property of the sodium. Excessive sodium might also craft it awfully difficult to furnish enough water to meet the crop water demand. Potassium also above the standard limits from the consequence.

Salinity problems are existing in the study area. The remedial measure for above problems are suggested as mixing with an alternate source of water with the available of water, frequent irrigation, growing crop with low water requirement(dry crops), growing salt tolerant crops, organic matter application

KEY WORDS: pH, EC, TDS, BOD, COD, Total Hardness, Sodium, Potassium, Calcium, Magnesium

1. INTRODUCTION

Groundwater is a foremost source for drinking purpose. In the recent civilization, industrialization, urbanization and augment in population have lead to fast poverty of ground water quality. Water is the most important substance for domestic, irrigation an water sources are polluted with municipal sewage, industrial toxics, heavy metal, fertilizer chemical, radioactive substances, land sediments and oil etc., The pollution at a point spreads to the nearby places which adds momentum for the spreading of pollution to the nearby tanks, lakes, ponds etc from which water is explicitly taken for agriculture practices other uses. Because of this pollution problem there is an intense loss of agricultural yield leading to the lamentation of the farmers of the polluted lands. Irrigation agriculture is reliant on an ample water supply of usable quality. There is a need to consider a marginal quality of water for Irrigation and also for other purposes. Use of untreated wastewater is being practiced over the years. Continuous usage of wastewater may cause groundwater degradation. There is a need to assess the pollution load on the water and subsequent measures to control the pollution. It is difficult to predict the level of the pollution in many cases and hence there is a need for sophisticated technologies to assess the pollution of the surface water.

Objectives

- To investigate the groundwater quality of study area for irrigation suitability;
- To suggest the remedial measures of management the groundwater quality.

Analysis of ground water: Groundwater samples have been collected from identified sources. The well locations were identified with respect to distance and Azimuth (angle) using Global Positing System (GPS) survey. Analysis is to be carried out for the following parameters namely pH, Electrical Conductivity, Bicarbonate, Chlorides, Calcium, Magnesium, sodium, Sulphate, potassium, SAR for the collected samples to compare with the irrigation water standards. Groundwater samples are collected in 1 liters bottle, before collecting the sample bottle should be wash with the distil water and label the location. To analysis of samples for as per the standard methods.

The Laboratory procedure for analysis of the above listed parameters is detailed in section.

Chloride: 20 ml of taster was taken in a flask. To this 2 ml potassium chromate indicator solution was added and titrated against standardized $AgNo_3$ solution. The end point was given by the appearance of a red brown tinge. A blank titration was done using 20 ml. distilled water in the place of the sample. Chloride is calculated by the following equation.

- Chloride, mg/L = ((A-B) x N x 35450)/ mL of sample
- Where,
- A is titration for the sample in ml,
- B is titration for the blank in mL and is normality of $AgNo_3$.

pH: The test for pH decides the acidic or alkaline nature of Water. The pH values were determined by using pH meter

Total hardness: 20mL sample was taken in an Erlenmeyer flask. To this, 2mL ammonium acetate buffer solution and drop Eriochrome Black-T indicator was added and titrated against 0.01N EDTA solution. The end point was given by change of colour from wine red to steel blue. Total hardness was calculated by the following equation.[10]

Total hardness as (mg/L) = (A x B) x1000/mL sample

Where A is titration for sample in mL and B is titration for blank in mL

Calcium: Take 20 mL sample in a beaker. Add 2 mL 1N NaOH and mureoxide. Titration against EDTA until the colour changes from red to blue violet.

Calcium hardness (mg/L) = (A x B x 1000)/ mL sample

Where A is the mL titrante of the sample and B is the normality of EDTA

Magnesium: Magnesium was calculated by following equation

Total hardness as $CaCo_3$ – Calcium hardness as $CaCo_3$ x 0.243

Sulphate: 100 ml of clear sample was taken in a 250 mL beaker and 5 mL of conditioning reagent was added to it. Care was taken so that conditioning reagent was not added to the entire sample simultaneously. This was added to each sample just prior to further processing. Sample was stirred and during stirring a spoonful (0.2 to 03g) of $BaCl_2$ crystals were added. Stirring was continued for 1 minute after the addition of $BaCl_2$. After stirring was completed, absorbance was measured using colorimeter at 420nm exactly after 4 minutes. Concentration of sulphate was found out from the calibration curve. Calibration curve was prepared employing the same procedure described above for thefrom 0 to 70mg/L of sulphate.

Sodium and Potassium: The amount of sodium and potassium content present in the water sample were analyzed by using Sodium flame emission photometer.

Determination of Acidity: This test is used to determine the acidity of the sample. The total acidity may be determined by adding 3 drops of phenolphthalein indicator to 100ml of the sample and titrating with standard sodium hydroxide solution. The mineral acidity may be determined by adding 2 drops of methyl orange indicator to 100ml of the sample and titrating with standard hydroxide solution.

2. RESULTS AND DISCUSSIONS

Groundwater quality study area: Groundwater sampling taking around the study area at Sivakasi. Water sample has been analysed for various parameters as per standard methods. Sampling results are compared to irrigation water quality standards limits. The analytical results were imported to graph with the WHO standard.

The analytical results show that water is suitable for irrigation purpose with a few exceptions SAR value is high at some sites restricting its irrigational usability. Calcium shows low percentage in ground water is owing to need of ample calcium to counteract the disperse possessions of the sodium. Tremendous sodium may also make it awfully difficult to supply enough water to convene the crop water demand. Potassium shows very highly effected in the study area it’s above standard limits.

From the analysis of groundwater samples, it is observed that the samples are saline in nature based on concentration of EC, bicarbonate, chloride and SAR as tabulated in Tables 1&2. The Electrical Conductivity (2.4 to 6.9) values shows that the groundwater contains high concentration of dissolved salts and also supported by concentration of sodium (ranges from 300 to 1300 ppm) is greater than nearly 300 times the permissible level. Along with the two minerals the other minerals such as bicarbonate and chloride favors the increase in salinity of groundwater.

Salinity problems correlated to water value occurs if the total quality of salts in the irrigation water is lofty adequate; the salts accrue in the crop root zone to the level that yields are affected. If the disproportionate quantities of soluble salts accrue in the crop root zone, the crop has superfluous difficulty in extracting as much as necessary water from the plant can outcome in slow or condensed growth and symptoms similar to those of drought such as early wilting.

For treating the salinity problems by apply gypsum and a superior amount of irrigate to the plant. This may render to increased plant productivity and more proficient irrigation. Amalgamation of groundwater and alternate water supplies through the intact irrigation season create poise between leaching salts from the soil contour and maintain the right soil salinity to stabilize.

Toxicity Problems and Management: Toxicity is the combination of the parameters such as sodium and chloride. Toxicity problem is different from the salinity problem. Toxicity certain ions are taken up with the soil-water and accumulate in the leaves during water transpiration result shows injure to the plant. The degree of dent depends upon moment, assimilation, crop sympathy and crop water utilize, and if dent is cruel enough, crop yield is reduced. The normal toxic ions in irrigation water are chloride, sodium and boron. Spoil may caused by apiece, individually or in recipe. Analysis results of groundwater quality showed tables that the concentration of sodium and chloride are more than the standard limits respectively. This shows the vulnerability of problem of toxicity prevailing in the study area. Perceptibly, the most valuable routine to foil the incidence of a toxicity problem is to craving irrigation water that has no potential to widen toxicity. But if such water is not accessible, there are frequently supervisory options than can be adopt to diminish toxicity and recover yields. Maximum concentrations tolerated in soil-water or saturation extract without yield or vegetative growth reductions. Maximum concentrations in the irrigation water are approximately equal to these values or slightly less. The potentially toxic ions sodium, chloride and boron can apiece be condensed by leaching in a mode correlated to that for salinity, but the vigor of water compulsory varies with the toxic ion and may in some cases become extreme. If leaching becomes unnecessary, countless growers amend to a more tolerant crop. Escalating the leaching or shifting crops in an endeavor to live with the elevated levels of toxic ions may oblige general changes in the agricultural system.

Sodicity Problems and Management: Irrigating more often with small quantity of water is a valuable way to supervise water with a sodicity hazard. Condensed permeability of the soils restricts stream supply to the roots. Also applying hefty amounts at a time can consequence in surface stagnation which affects most crops negatively. Numerous irrigations could also diminish the precipitation of calcium by rejoinder with bicarbonates in water by observance the soils wet. By means of sprinkler irrigation with the aptitude to supply illegal amounts of water at a time should be considered where realistic.

Type of crop: Crop growth depends on the uptake of water and nutrients. The qualities of water and soil should be in such a level of maintaining permeability and aeration. However, some crops are highly salt tolerant whereas others are easily damaged by excess salt concentration. According to the salt tolerance level, crops can be separated into three groups as indicated in table 1.

Table.1. Crops can be separated into three groups as indicated

Sensitive	Semi-Tolerant	Tolerant
Gram	Wheat, Rice, Millets, Mize	Barely,
Arhar	Tomato, Cabbage, Potato	Beat, Tobacco
Moong	Onion, Guava, Mango	Mustard, Cotton,
Peas	Banana, Orange, Lemon	Sugarcane

3. SUMMARY AND CONCLUSION

Irrigation with wastewater is widespread in India. It is noted that practically all irrigation water contain some amount of dissolved salts. These salts tend to concentrate on soil particles during irrigation unless they are leached out. Saline water, squat soil permeability, insufficient drainage, low rainfall and pitiable irrigation management may all contribute to salinity condition which in turn may affect the crop growth and yield. Excess continuous usage of wastewater may cause the degradation of groundwater quality and soil characteristics of the command area. Groundwater quality and soil characteristics were analyzed to study the impacts of waste water irrigation. The ground water and soil samples were collected around the study area and analysed for various parameters in the laboratory as per standard procedures. Result shows that the ground water is polluted highly. The salinity problems are existing in the study area. The remedial measure for above problems are suggested as mixing with an alternate source of water with the available of water, frequent irrigation, growing crop with low water requirement(dry crops), growing salt tolerant crops, organic matter application.

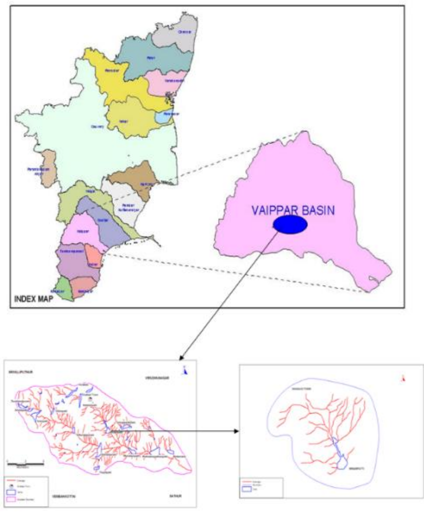

Figure.1. Study Area Map

Table.1. Sample Collected from Sivkasi town (Samples 1 to 6)

Parameters	well 1	well 2	well 3	well 4	well 5	well 6	Irrigation Standards
pH	8.2	7.8	6.9	7.3	8.6	8.4	6.5 - 8.4
EC	4.90	3.26	3.46	4.01	3.8	2.4	0 - 3 dS/m
Bicarbonate	825	736	698	768	825	634.4	200 - 600 ppm
Chloride	463.28	386.12	363.44	428.13	1142	475.7	140 - 703 ppm
Calcium	62	120	68	70	90	60	75 - 200 ppm
Magnesium	134.6	190	139	142	178	72	30 - 100 ppm
Sodium	126.11	169.6	136.12	86.56	82	35	0 - 90 ppm
Potassium	4.56	3.82	4.12	3.92	3.82	3.84	1 - 1.5 ppm
Sulphate	618	524	493.72	516.33	563.25	501.23	0 - 480 ppm
SAR	54.58	37.17	49.81	53.35	49.63	37.56	1 - 26 ppm

Table.2. Sample Collected from Sivkasi town (Samples 7 to 12)

Parameters	well 7	well 8	well 9	well 10	well 11	well 12	Irrigation Standards
pH	8.1	8.3	8.2	8.6	8.23	8.4	6.5 - 8.4
EC	3.02	2.68	2.54	2.73	4.4	2.4	0 - 3 dS/m
Bicarbonate	439	488	378	359	698	634.4	200 - 600 ppm
Chloride	563	162	463	278	928.7	475.7	140 - 703 ppm
Calcium	52	56	112	106	76	60	75 - 200 ppm
Magnesium	84	25	20	75	62.4	72	30 - 100 ppm
Sodium	432	326.32	284.64	312.51	549.7	305	0 - 90 ppm
Potassium	2.68	2.53	2.6	2.69	3.92	3.84	1 - 1.5 ppm
Sulphate	496	368	283.14	348	493.72	501.23	0 - 480 ppm
SAR	36.23	32.25	31.26	34.63	42.63	37.56	1 - 26 ppm

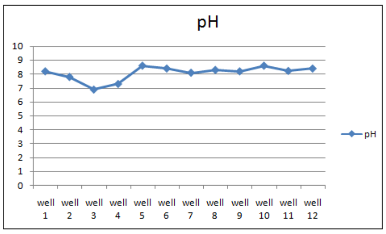

Figure.2.Variation in the pH values around the study area wells.

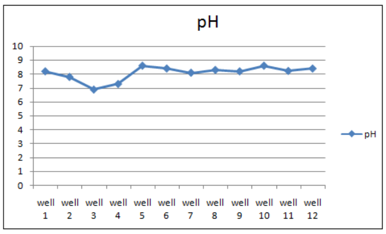

Figure.3.Variation in the EC values around the study area wells. From the graph EC value more than the standard limits it indicate that water is more salt contain

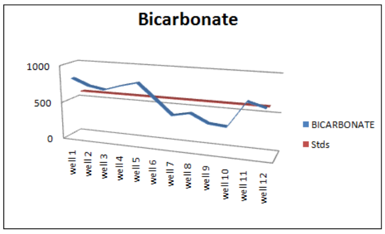

Figure.4.Variation in the bicarbonate values around the study area wells

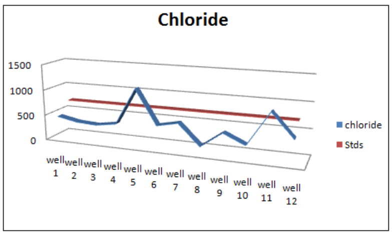

Figure.5.Variation in the chloride values around the study area wells.

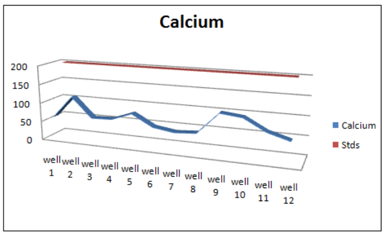

Figure.6.Variation in the calcium values around the study area wells

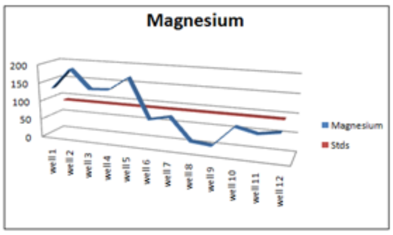

Figure.7.Variation in the magnesium values around the study area wells

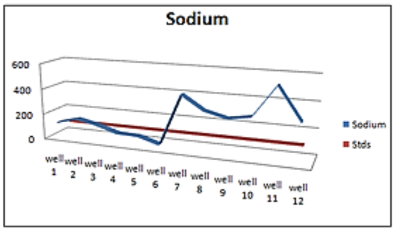

Figure.8.Variation in the sodium values around the study area wells

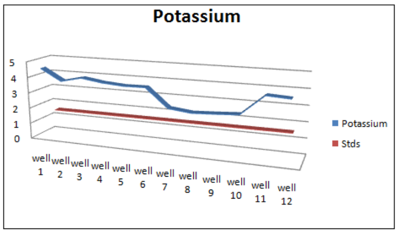

Figure.9.Variation in the potassium values around the study area wells and it shows more than standard limits

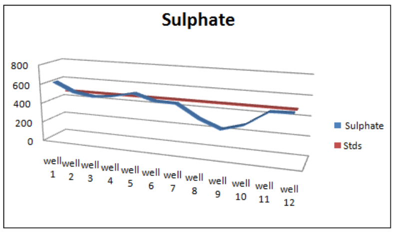

Figure.10.Variation in the sulphate values around the study area wells

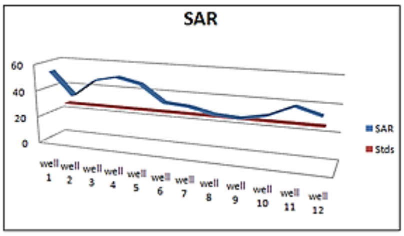

Figure.11.Variation in the SAR values around the study area wells

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