ASSESSMENT OF GROUNDWATER QUALITY IN MAILAM VILLAGE,VILLUPURAM DISTRICT,TAMILNADU.

P.Ramamoorthy,

Assistant Professor, Department of Civil Engineering
Mailam Engineering College, Mailam, Villupuram District, Tamil Nadu

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Abstract:
An attempt has been made in this present work to determine the groundwater quality in Mailam village, Villupuram district. A total 16 groundwater samples were collected and analysed for various physico-chemical parameters and compared with the WHO standards of drinking water quality and irrigation purpose with the following water quality parameters namely EC, TDS, Ca , Mg, Cl , Na, K, F, Na % ,SAR, KI etc.

Key words: Drinking water, Mailam, TDS, pH, Ca, KI, SAR .

1.Introduction:

Water is essential for sustenance of life. India, like any other developing country of the world, is facing increasing environmental problems. The vast population and ever increasing industrial activities in India, makes its water resources more vulnerable to water quality deterioration. The groundwater resources are at higher risk as its remediation is very difficult. The major anthropogenic activities for continuous groundwater quality deterioration are urbanization, industrialization, and agriculture run off. Also the problem of drinking water contamination, water conservation, and water quality management has assumed a very important role for sustainable development of countries, such as India (Prashant et al., 2010).

During the past two decades, the water level in several parts of India has been falling rapidly due to an increase in extraction (Gupta and Deshpande, 2004). The quality of water is vital owing to its suitability for various purposes since it is directly linked with human welfare. Groundwater quality variation is a function of physical and chemical patterns in an area influenced by geological and anthropogenic activities (Subramani et al., 2005). The chemical composition of groundwater is very important criteria that determine the quality of water. Water quality is very important and often degraded due to agricultural, industrial and human activities. Even though the natural environmental processes provide

by means of removing pollutants from water, there are definite limits. It is up to the people to provide security to protect and maintain quality of water (Ikhane Philips et al.,2010) Drinking water with good quality is very important to improve the life of people and to prevent diseases(Adewoya B.L. and Oludura A.O,2007)

1.1.MATERIALS AND METHODS

1.2. Study Area

The study area Mailam village (Fig:1) covers an area of 5.6 $Km^{2.}$ The study area lies between N 12° 1' 13.44" latitude and E 79° 47' 0.6" longitudes. The study area Mailam is located in Villupuram district of Tamilnadu. It is near by 28 KM from district head quarters and 145 KM from State capital Chennai towards North. In the West side, Mailam is connected to Tindivanam town by State Highway.

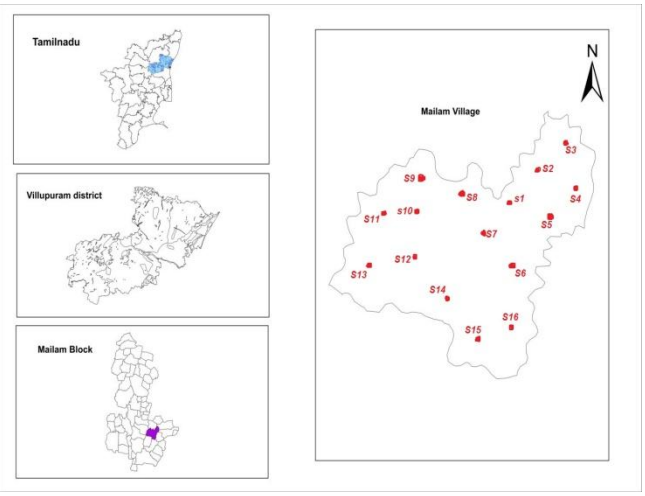

Fig :1. Location map of study area

2. Methodology:

Water samples were collected from the bore wells and open wells. A total of 16 samples are collected. The sampling locations are named as stations (S1 – S16). The collected samples were stored in cleaned polythene glass bottles (1 L), Chemical characteristics were analysed following the procedure given in America Public Health Association (APHA, 1995).These bottles were labeled with respect to the collecting

location with date and time to avoid any error between collection and analysis. The quality analysis has been carried out for the parameters like pH, total alkalinity, electrical conductivity, total dissolved solids, total hardness, calcium hardness, magnesium hardness, nitrites, nitrates, sulphates, chlorides and fluorides by following the standard methods prescribed as per WHO(1984).

3.Results and Discussion

3.1.Evaluation of ground water quality for domestic use

pH

pH is used to determine whether a solution is acidic or alkaline. The pH values of all groundwater samples are found to be in the range of 7.05 - 7.78 .The highest value of 7.78 is observed at station S8 whereas the lowest value of 7.05 is observed at station S9. The permissible limit of pH for drinking water is 7.0 - 8.5 (WHO). The groundwater samples of study are fall within the acceptable limit of WHO. There is no abnormal change of pH in the groundwater samples. If the pH is found beyond the permissible limit, it affects the mucous membrane of cells(Koul Nishtha, et al.,2012) .

Electrical conductivity (EC):

The electrical conductivity values for all the groundwater samples are recorded within the range of 224 - 12440 (ohms/m). The sample S7 is beyond the permissible limit of WHO.The electrical conductance is a good indication of total dissolved solids which is a measure of salinity that affects the taste of potable water (Pradeep Jain,1998) . Several factors like temperature, ionic mobility and ionic valences also influence the conductivity(Mohamed Hanipha and Zahir Hussain,2013). The electrical conductivity value for all the groundwater samples are found within the permissible limit except one sample.

Total Dissolved Solids (TDS):

The total dissolved solids in water are due to the presence of sodium, potassium, calcium, magnesium, manganese, carbonates, bicarbonates, chlorides, phosphate, organic matter, and other particles(Bhattacharya et al., 2012).The values of the total dissolved solids for all the groundwater samples vary between 442 and 998 mg/l. The maximum allowable limit of total dissolved solids in groundwater for domestic purpose is 1500 mg/l (WHO). The maximum value (1720 mg/l) is recorded at station S16 and minimum value (159 mg/l) is recorded at station S9. There are two samples from the study area exceeds the permissible limit (S3 & S16).

Calcium(Ca) :

Calcium may dissolve readily from carbonate rocks and lime stones or be leached from soils. But calcium is an essential nutritional element for human being and aids in the maintaining the structure of plant cells and soils(Chari K.V.R. and Lavanya M.G.,1994) . In this study, the calcium values are observed between 89.6 to 236, mg/l. For most of the groundwater samples, the calcium values are found within the maximum permissible limit (200 mg/l),except two samples (S3 & S4). The concentration of Calcium in groundwater due to rock weathering minerals like feldspars, pyroxene, and amphiboles (Ramamoorthy and Rammohan, 2014).

Magnesium (Mg):

The magnesium values are recorded between 28.3 and 58.2 mg/l for the groundwater samples. The highest value of magnesium is observed at station S13 and the lowest value of magnesium is observed at station S10. The concentration of Magnesium in the study area shows within the maximum permissible limit (150 mg/l).The concentration of Magnesium in the groundwater is due to the exchange of minerals in soil and rock by water(Ramamoorthy and Rammohan, 2014).

Sodium (Na):

The sodium concentration in ground water is varied between 113 to 195 mg/l with an average of 153.18 mg/l. The highest value of sodium concentration is observed in S12. The concentration of sodium in groundwater samples fall within the maximum allowable limit. High concentration of sodium ion in drinking water may cause heart problems and High sodium ion in irrigation water may cause salinity problem (Chadrik Rout and Arabinda Sharma.,2011).

Potassium (K):

The concentration of potassium ranges from 2.4 to 5.2 mg/l with an average of 3.711 mg/l. Maximum was observed in S16 and minimum was observed in S2. Higher concentration of Potassium in groundwater is due to the presence of silicate minerals from igneous and metamorphic rocks (Zahir Hussain A. and Abdul Jameel. M., 2011).

Chloride (Cl):

The concentration of chloride ranges from 22.6 – 220.1mg/l. Most of the groundwater samples show chloride values within the acceptable limit (250 mg/l) of WHO. The groundwater sample at station S2 has maximum value. Abnormal concentrations of Chloride in groundwater may result due to pollution by

sewage wastes, salting for certain types of trees like coconuts and leaching of saline residues in the soil (Ramamoorthy et al., 2015). .

Fluoride(Fl):

The value of fluoride for the groundwater samples is recorded between 0.945 and 1.56 mg/l. The maximum allowed limit of fluoride according to WHO (1984) is 1.5 mg/l. The sample S9 has the maximum concentration of fluoride (1.56 mg/l). The high levels of fluoride, which accounts for the non-potability of groundwater, may be due to both, the natural processes as well as the involvement of human element (Ramamoorthy et al.,2015). Fluorides in excess of 1.5 mg/l may lead to a crippling and painful disease called fluorosis, which may be in the form of dental fluorosis, skeletal fluorosis and nonskeletal fluorosis (Shankar et al, 2008).

Nitrate(No_3):

The nitrate concentration ranges from 18.6 to 54 mg/l .The higher value of nitrate is the observed in the sample S7. Nitrate values for the study are within the permissible limit except S7 & S8 as per WHO. The maximum was observed in all the area these may be due to agriculture activity.

3.2.Evaluation of ground water quality for Irrigational use:

Sodium Percentage (Na %):

Sodium concentration plays an important role in evaluating the groundwater quality for irrigation because sodium causes an increase in the hardness of the soil as well as a reduction in its permeability (Jafar Ahamed A. et al.,2013). The Na % indicates (Table:1) the ground water samples collected in the study are fall within the permissible limit, none of the samples fall in the fields of doubtful and unsuitable category. The sodium percentage (Na %) is calculated using the formula given below:

$Na\ \% = (Na^+ + K^+) \times 100/(Ca^{2+} + Mg^{2+} + Na^+ + K^+)$ Where all the concentrations are expressed in meq/l.

Table.1: Suitability of ground water for irrigation based on sodium percentage

% Na	Water Class	No. of Wells exceeding permissible limits
<20	Excellent	-
20-40	Good	S3,S4,S5,S6,S8,S9,S15,S16
40-60	Permissible	S7,S1,S2,S10,S11,S12,S13,S14
60-80	Doubtful	-
>80	Unsuitable	-

Sodium adsorption ratio (SAR)

SAR is the most commonly used for evaluating groundwater suitability for irrigation purposes (Ayers and Westcot, 1985). It is an important parameter for determining the suitability of irrigation water, because it is a measure of alkali sodium hazard for crops (Richards 1954). SAR is expressed as shown below (Hem, 1991):

$$SAR = \frac{Na^{+}}{\{[Ca^{2+} + Mg^{2+}]/2\}^{0.5}}$$

Table.2: Suitability of ground water for irrigation based on Sodium adsorption ratio

SAR	Water Class	No.of Wells exceeding permissible limits
<10	Excellent	All samples
10-18	Good	-
18-26	Doubtful	-
>26	Unsuitable	-

The SAR values range from 2.4 to 5.6. In the present study SAR value of groundwater samples fall under < 10 category. The result indicates it is suitable for irrigation purposes (Table.2).

USSL diagram

The analytical data plotted on US salinity diagram(Fig:2) (Richards 1954) illustrates that most of the ground water samples fall in the field of C3,S1 and C2,S1, it indicates high salinity and low sodium water. Based on sodium the prominent ground water samples are suitable for irrigation purpose. Few samples fall in the field of C4, S1, it indicating very high salinity and low alkalinity hazard. This can be suitable for plants having good salt tolerance and also restricts their suitability for irrigation, especially in soils with restricted drainage (Karanth 1989).

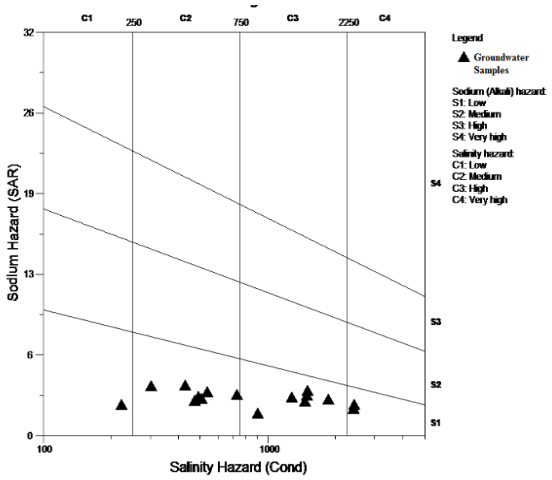

Fig :2. USSL diagram for irrigation water quality classification

Kelly Index (KI):

Sodium measured against Ca^{2+} and Mg^{2+} is used to calculate Kelley's Index ratio (Kelly et al 1940).

The formula used in the estimation of Kelley's ratio is expressed as,

Kelly's Ratio (KR) = Na^{+}/ Ca^{2+} + Mg^{2+}

A Kelley's Ratio (KR) of more than one indicates an excess level of sodium in waters. Hence, waters with a Kelley's Ratio less than one are suitable for irrigation, while those with a ratio more than one are unsuitable for irrigation. In the current study 93.75 % of samples are <1 it is suitable for irrigation purposes except S2 (1.06).

4.Conclusion:

The analysis of groundwater samples from the study shows that most of the samples fall within the permissible limit except few places. TDS values of groundwater reveals that 60% of sample in the study

shows fresh water category it is fit for drinking purposes. The concentrations of Ca, Mg, Na, K, Cl, No_3, and Fl are fall within the permissible limits for drinking except in few places. The output of Na%, SAR, USSL, KI, shows that study area is suitable for irrigation purpose. This study attributes that groundwater quality should be monitor regularly to avoid the further contamination.

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