PHYSIO CHEMICAL ANALYSIS OF GROUNDWATER USING GEOGRAPHICAL INFORMATION SYSTEM IN RASIPURAM MUNICIPALITY, NAMAKKAL DISTRICT, TAMILNADU, INDIA

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ABSTRACT:
Groundwater is the major source of drinking and irrigation water supply in rural and urban area in the country. Groundwater facing threats due to anthropogenic activities in india. Nitrate is of anthropogenic origin. Beside loading the water with bacterial & nitrate contamination, infiltration of leachates from domestic sewage disposal system in stream and river could impact the groundwater quality as human waste are known to contain sodium, calcium, magnesium and chloride ions. The objective of the study is to analyze groundwater using GIS. The project reports the groundwater quality of Rasipuram Municipality of Namakkal district, Tamilnadu. GIS not only facilitates data capature and processing but also serve as powerful computational tool that facilitate multimap integration. The samples were collected from bore holes and wells on Rasipuram municipality and analyzed in various physico chemical parameters and major ion chemistry like pH, K^+,HCO_3^-,Cl^-,SO_4^{2-},NO_3^- &F^- EC,TDS,Ca^{2+},Mg^{2+},. TH during pre-monsoon period. The strategically analyzed results are presented in a GIS based water quality mapping. Not permissible water quality zone cover about area respectively. While, maximum allowable water quality zone cover an area of. The most desirable water quality zone an area for drinking and domestic purposes.

Keywords
Hard-rock aquifer, spatial distribution map, interpolation, overlay.

Academic Discipline And Sub-Disciplines
Civil engineering

SUBJECT CLASSIFICATION
Water quality

TYPE(METHOD/APPROACH)
Spatial approach

INTRODUCTION

Ground water plays a major role in our life cycle. According to the estimate, it accounts that for 80 percent of the rural domestic water needs and 50 percent of the urban area water needs in India is mainly ground water. Ground water is less susceptible to pollution than surface water sources. Natural contamination also take place by salt water intrusion, salt rock dissolving etc. Almost in India ground water is the major source for all human activities and industrial purposes. Over exploitation also cause a reduction in ground water potential, this leads to lack of water for regular usage. Over exploitation of ground water lead stodrying of aquifers. So a proper and safe usage of ground water should be done. Ground water is mainly polluted or contaminated due to improper disposal of effluent, leachate formation from solid waste, defective effluent storage well sand defective septic tanks. These faults and features form the opening for effluent water to get settled into soil through normal infiltration. Ground water may even get affected by pesticides, pollutants, and even pathogenic organisms causing disease. Both textiles and tanners dispose of the effluent directly into bore wells or running streams or rivers that pollute ground water through percolation.

STUDY AREA DESCRIPTION

Rasipuram is part of ancient Kongu Nadu and the region is known as Rasipura Nadu, an internal division of Kongu. The town is famous for its ghee, handloom silk saree sand education. The study area is located at Namakkal district in the Southern Province of India. The study area is bounded on the north by latitude 11°18’23.69 N to 11°34’58.33” on the east by longitude 78°2’0.69”E to 78°28’33.08”E as shown in Figure 3.1 covering an area about 815.53 sq. km and fall in Taluk map and having population 3,39,790 as per 2011 Census. Rasipuram is located on the highway NH7 which connects Salem and Namakkal. The town is located on the new broad gauge line which connects Salem andKarur.

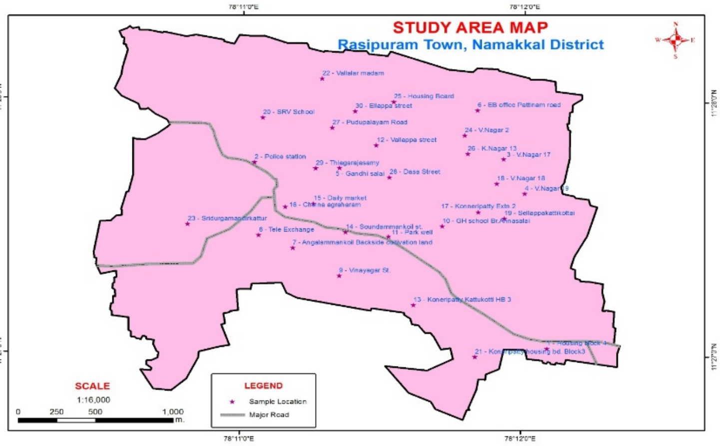
The study area experiences dry climate during February to July and sub- tropical climate during November to January. It experiences both southwest and north east monsoon swith summer showers in the months of March to May. Relative humidity is high from September to December. The temperature ranges from 25°C to little more than 40°C in the study area. The Tamil Nadu State is exposed to both southwest and northeast monsoons. The area bordering Bailnadu hill and Kolli malai hill ranges i.e., the northern and eastern portions of the study area The study area is characterized by almost an elevated topography withsome undulation and hills. General slope is towards south and southwest direction. The maximum elevation of Kollimalai hills is an about 1358mts. Above Mean Sea Level (AMSL) and the minimum elevation is137.2mts.

The entire study area is mainly by basaltic lava flows belonging to the Deccan volcanic province that flooded during upper Cretaceousto Eoceneage. The strati graphic sequence and lithology is as indicated in Table 3.1. The prominent geological units observed in the study area are the horizontally disposed basaltic lava flow sand each flow has distinct two units. The upper layers consist of vesicular and amygdulezeoliticba salt whiles the bottom layer consists of massive basalt. This basaltic lava flows are the only water bearing formations in the area. The weathered and fracturedmantles of the trapsareforming water table aquifers in the area where ground water occurs under phreatic conditions. A number of lineaments which are fracture zones have been identified on the satellite imagery due to linear pattern, exhibited by darker tone and straight drainage course. These lineaments are favourable for occurrence of groundwater.

METHODOLOGY

This methodology involves in the collection of spatial data and non-spatial data and integrating this data to identify potable and non-potable areas of ground water in the study area. GIS software adds intelligence to spatial data, whether the data is generated in the field with GPS or remotely with LIDAR and photo grammetry. You can enterraw data, measurements, and field sketches directly in to the GIS, enabling you to efficiently manage your data in a geo-database with other spatialin formation. The base map was prepared using the survey of india toposheet on 1,50,000 scale. The various attributes were added and analyzed in Arc GIS software using the spatial distribution maps of various groundwater quality parameters through GIS.

FIGURE 1. BASE MAP OF STUDY AREA



RESULT AND DISCUSSION

Based on the World Health Organization (WHO) standard limit, drinking water classification has been made for the analysed water elemental concentration. Inpreandpost-monsoon seasonsp Hand magnesium (Mg) value was noticed in all the samples fall in desirable limit category. EC values for pre and post-monsoon seasons were calculated and most of the samples fell under not permissible nature. This is due to the heavy rock-water interaction and the meagre amount of water infiltrated in the hard rock terrain. In pre and post- monsoon season, the TDS concentration indicates that 30.27% and 19.45% of the groundwater samples belongs to the Not permissible limit. Most of the study area Fe^{3+} and NO3 elements concentration is more than WHO limiting value during pre and post-monsoon seasons. Potassium element concentration shows that most of the samples fall under not permissible category. Post-monsoon season groundwater sample concentration high compare with pre-monsoon due to monsoonal effect.The fallowing elements like Ca, HCO3, F concentration as for the WHO standard small portions are not permissible category. Some of the samples moved into not permissible category from pre-monsoon to post-monsoon because due to anthropogenic activities.

The elements (Cl, SO4 and TH) most of the study area fall in not permissible category. According to WHO standard limits, the exceeding limit of higher concentrations are not coming under permissible limit for drinking use. It is due to the rock water interaction and interpreted in Gibbs graphical interpretation method. This interpretation shows that few locations come under good quality of groundwater in the study area. This is due to poor porosity and permeability. A simple arithmetical model has been adopted to integrate various thematic maps. The final pre and post-monsoon season (Drinking water quality) maps reveals that there are 3 combinations like good, moderate and poor categories. This methodology it is highly helpful in assessing the best groundwaterqualityzoneinthestudyarea.Poorwaterqualityzonecoverabout area pre and post-monsoon season 126.81 Sq.km and 87.29 Sq.Km respectively, while Moderate water quality zone cover an area of preand post-monsoon season 242.10 Sq.Km 280.94 Sq.Km. Good category of groundwater quality for drinking purposes area about pre and post-monsoon season 208.09 Sq.km and 208.78 Sq.Km. The plot of chemical data on Pipertrilinear diagram interpretation reveals that the chemical characters of the groundwater water samples are CaHCO3 (8 and 11 Samples), Mixed Ca-Mg-Cl (21 and 25 Samples), NaCl type (2 and 4 samples) and CaCl (14 and 5 samples) type. From the plot, alkaline earths (Ca^{2+} and Mg^{2+}) significantly exceed the alkalis (Ca^{2+} and Na^{+}) and strong acids (Cl^{-}) ($SO4^{2-}$) exceed the weak acids Ca-HCO3.

Parameters	WHO International standard (1996)		Pre-monsoon No. of Samples exceeding permissible limits	Post-monsoon No. of Samples exceeding permissible limits	Undesirable effect
	Most desirable limits	Maximum allowable limits			
pH	6.5 – 8.5	9.2	Nil	Nil	Taste
TDS (mg/l)	500	1500	18	11	Gastrointestinal Irritation
EC	1500	-	30	29	Gastrointestinal Irritation
TH (mg/l)	100	500	29	29	(i) Scale formation in boilers (ii) Cardio vasculardisease
Na^{+} (mg/l)	-	200	13	12	-
K^{+} (mg/l)	-	12	25	25	Bitter taste
Ca^{2+} (mg/l)	75	200	6	11	Scale formation
Mg^{2+} (mg/l)	50	150	Nil	Nil	Scale formation
Cl^{-} (mg/l)	200	600	10	5	Salty taste indicates pollution
SO_4^{2-} (mg/l)	200	400	4		Laxative effective,
NO_3^{-} (mg/l)	45	-	32	32	Blue baby diseases
Fe^{2+} (mg/l)	-	0.3	22	22	Taste, colour, turbidity andstaining problems
F^{-} (mg/l)	-	1.5	1	1	Fluorosis
HCO3	300	500	2	13	Temporary hardness.
CO3	-	-	-	-	-
Alk	500	-	7	6	Rice on cooking turns yellow.

Fig 2.TDS Spatial Distribution Map

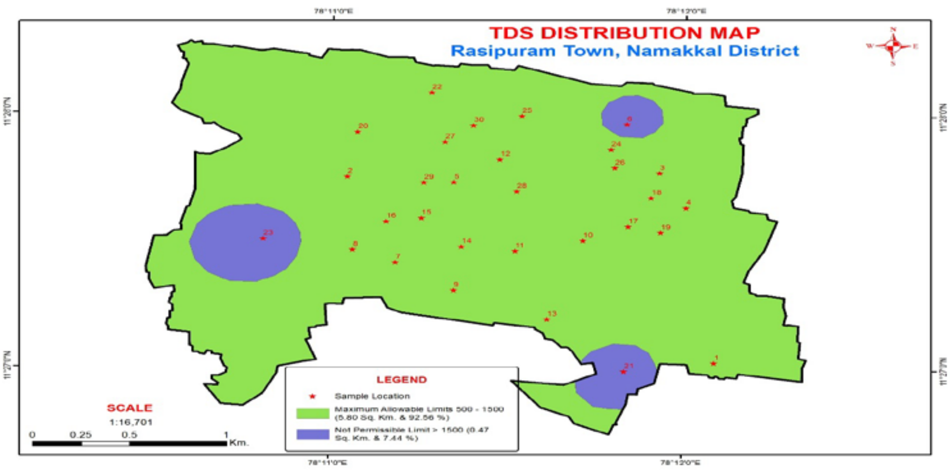


Fig 3. Ca Spatial Distribution Map

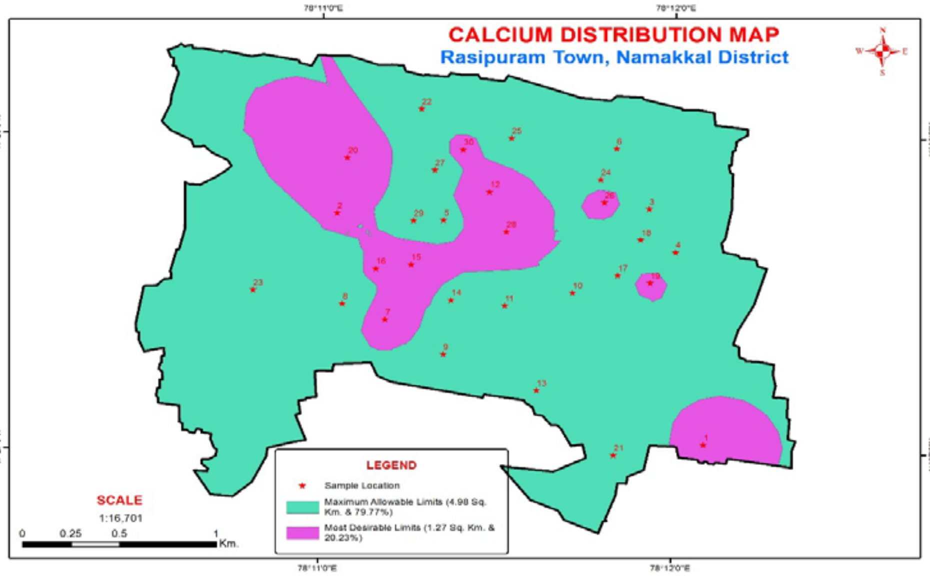


Fig 4.Na Spatial Distribution Map

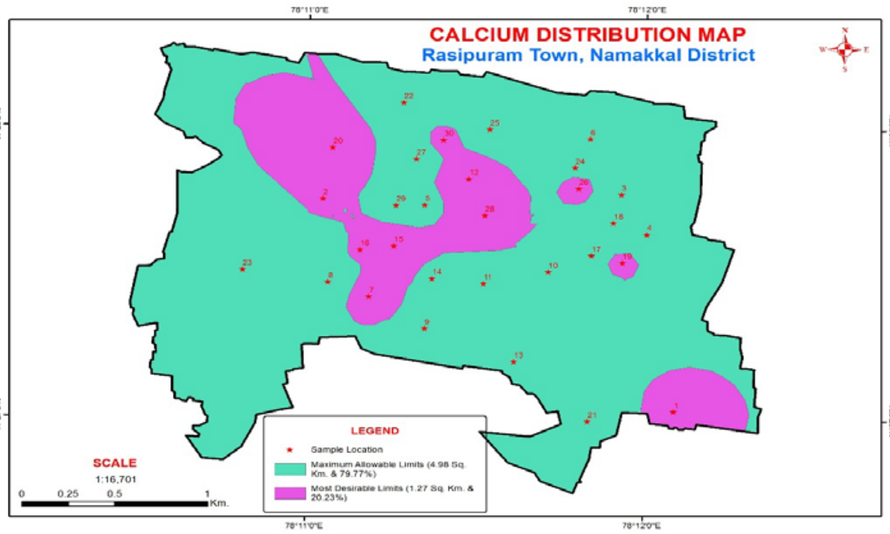


Fig 5. Fe Spatial Distribution Map

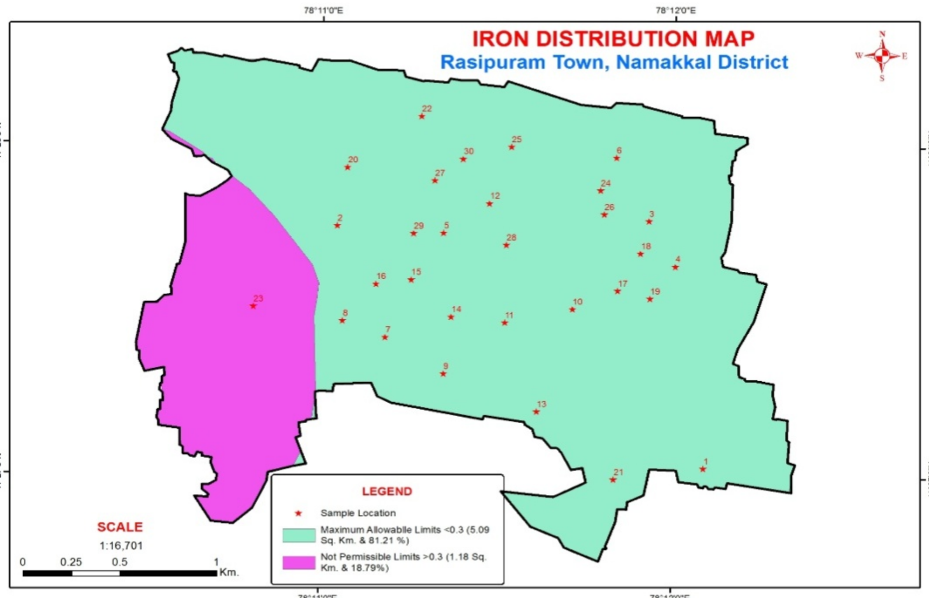


Fig 6. Cl Spatial Distribution Map

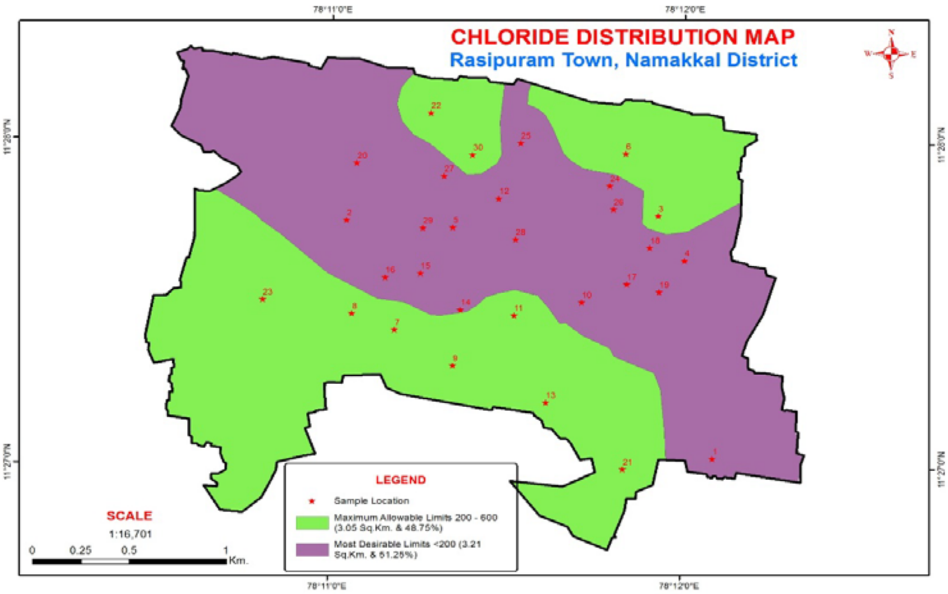


FIG 7.F Spatial Distribution Map

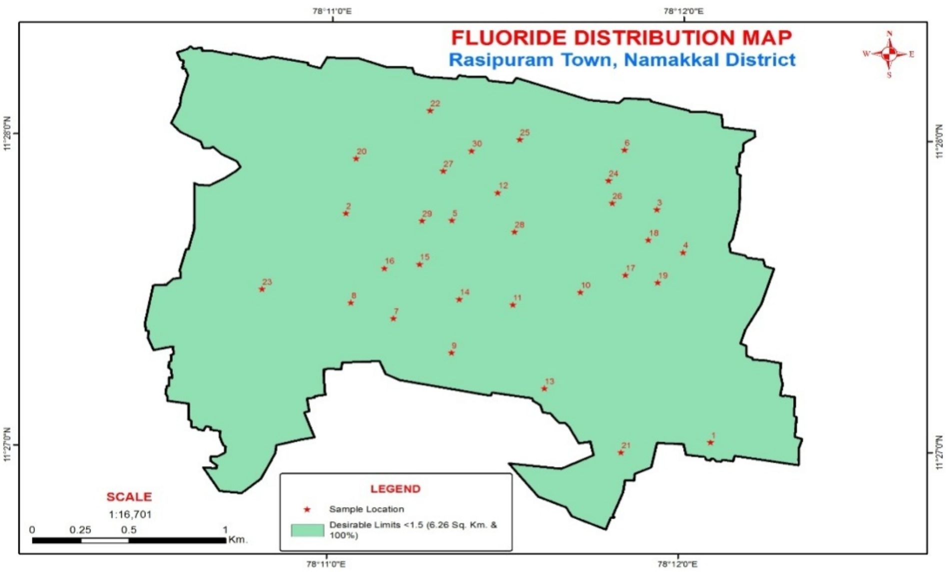


FIG 8. TH Spatial Distribution Map

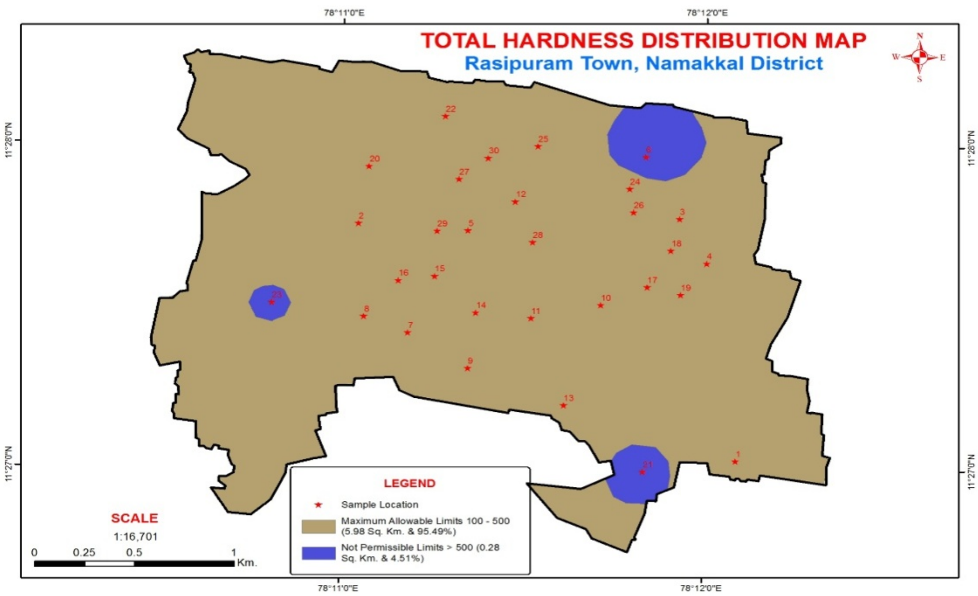


FIG 9. pH Spatial Distribution Map

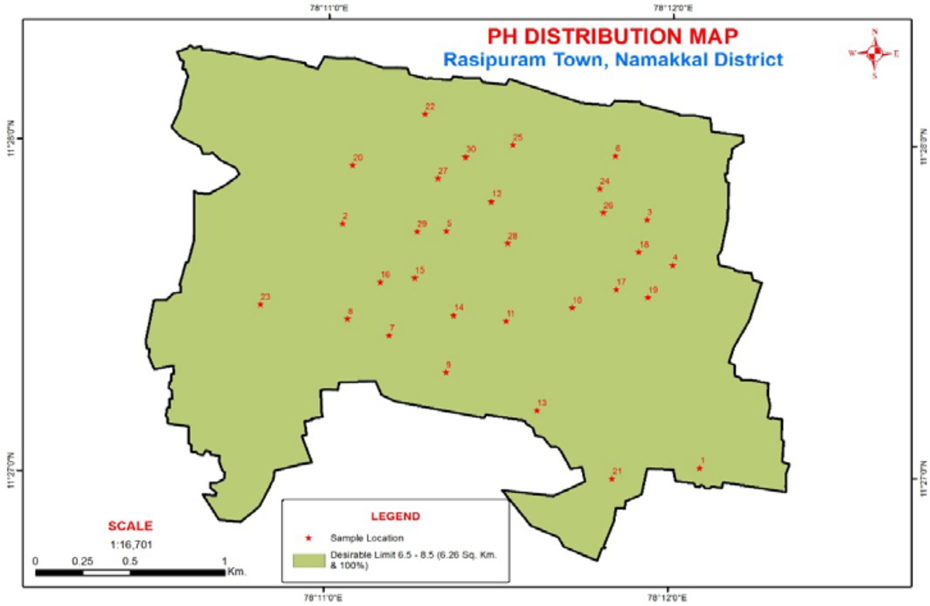
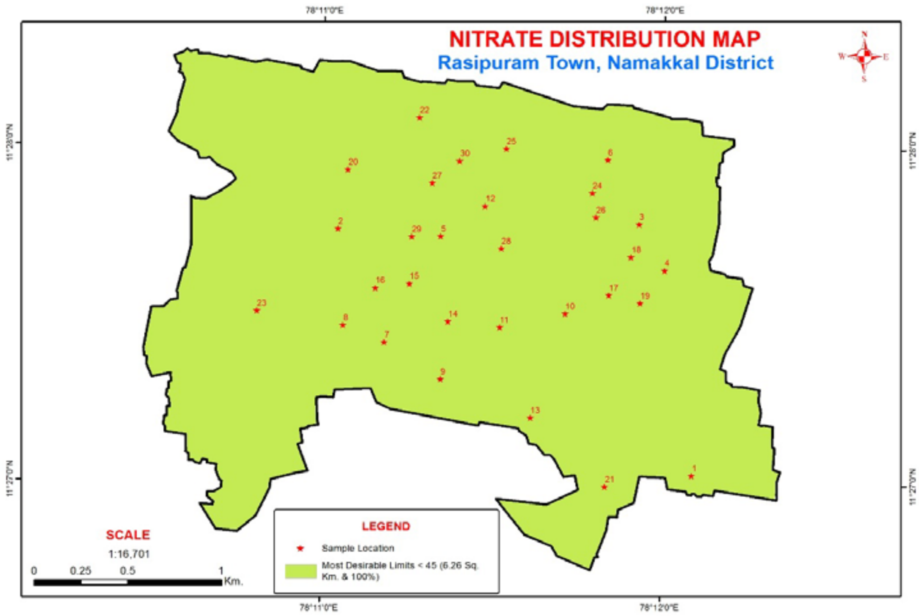


FIG 10. NO ^{3}Spatial Distribution Map



DATA AND MAP ANALYSIS FOR DRINKING

Each thematic map such as TDS, calcium, magnesium, sodium, potassium, Iron Fe^{3+}, TH, chloride, SO4, NO3 and F provides certain clues on for the quality of ground water. In order to get all these information unified, it is essential to integrate these data with appropriate factor. Therefore, numerically these information are integrated through the application of GIS. Various thematic maps are reclassified on the basis of weightage assigned, and brought into the"Raster Calculator" function of Spatial Analysis tool for integration. A simple arithmeticalmodelhasbeenadoptedtointegratevariousthematicmaps.Thefinal pre and post-monsoon season (Drinking water quality) map is shown in Figure 5.29 and 5.30 reveals that the reare 3 combinations like good, moderate and poor categories. This methodology it is highly helpful in assessing the best groundwater quality zone in the study area. Poor water quality zone cover about area pre and post-monsoon season 126.81 Sq.km and 87.29 Sq.Km respectively, while Moderate water quality zone cover an area of pre and post-monsoon season 242.10 Sq.Km 280.94 Sq.Km. Good category of ground water quality for drinking purposes area about pre and post-monsoon season 208.09 Sq.km and 208.78 Sq.Km.

CONCLUSION

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