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Groundwater Quality Assessment of an Aquaculture Affected Area

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Abstract

Problems related to water are one of the major issues in India. Large number of population suffers from various waterborne diseases due to unavailability of potable water. Ground water is the only/main source of drinking water in Allavaram mandal. Testing of this ground water is essential to determine its quality. Water quality field testing kits is easy & user-friendly, cost-effective and take less time for determining the parameters. Collection of water samples from all villages of Allavaram mandal was carried out. The values are shown in tabulation and chart preparation. Taking Allavaram mandal map, then the data will be feed in digitalization process for development of thematic map using Geographical Information System (GIS) software. Allavaram mandal water quality thematic map were developed. The availability of Iron in this mandal is almost zero, only except in Tadikona village is 0.1 mg/l. The presence of copper in this mandal is almost zero. Only in Devaguptam village shown 2 mg/l of copper. The presence of lead is serious in this mandal. Every village has more than 1 mg/ of lead. The permissible level of lead in drinking water is 0.015 mg/l.Among 14 villages nitrate is found in 5 villages in small quantity which is shown in graph. The presence of nitrate in this mandal is visible in some places. Bacteria is present in all villages except Tadikona and Bodasakurru. This research outcome is very useful for everyone living in Allavaram mandal as well as Government officials to take necessary alternative action to supply safe drinking water to public at Allavaram mandal.

KeyWords: Ground water quality, Testing, GIS, Graph, Thematic maps.

INTRODUCTION

Groundwater is an essential and vital component part of our life support system and is used primarily for drinking and irrigation purposes. Water quality has a great impact on human health and agricultural development. Surface water and groundwater are the main water bodies accessed by ecological and social consumers. In contrast with surface water, groundwater has unparalleled advantages of spatial-temporal availability, good stability, easy accessibility, good quality, resistance to pollution, etc. Thus, groundwater has been the primary water resource supporting socio-economic development. It is estimated that over 50% of the global population relies on groundwater resource to satisfy daily water demands, and groundwater is the sole available water resource for people living in many arid and semiarid region.

Groundwater moves slowly through an aquifer, and unlike the surface water of a stream, it has a lot of contact with the surrounding rock or sediment. In most aquifers, the geological materials that make up the aquifer are relatively inert, or are made up of minerals that dissolve very slowly into the groundwater. Over time, however, all groundwater gradually has more and more material dissolved within it as it remains in contact with the aquifer. In some areas, that rock or sediment includes some minerals that could potentially contaminate the water with elements that might make the water less than ideal for human consumption or agricultural use. Examples include copper, arsenic, mercury, fluorine, sodium, and boron.

The objective of this study is to assess the quality of groundwater and to classify the water in order to evaluate the water suitability for drinking, domestic and irrigation purposes.

Drinking Water Quality Standards in INDIA

Drinking water is water intended for human consumption for drinking and cooking purposes from any source. It includes water (treated or untreated) supplied by any means for human consumption. The quality standards for drinking water in India is prescribed by Bureau of Indian Standards laid down IS 10500 : 2012.

Effects on Human Health

More than 80% of sewage generated by human activities is discharged into rivers and oceans without any treatment, which results in environmental pollution and more than 50 diseases. 80% of diseases and 50% of child deaths worldwide are related to poor water quality. Groundwater contamination is a global problem that has a significant impact on human health and ecological services.

Groundwater contamination can impact human health, environmental quality, and socioeconomic development. For example, many studies have shown that high levels of fluoride, nitrate, metals, and persistent organic pollutants are a health risk for human populations. This is especially critical for infants and children who are more susceptible to the effects of these contaminants than adults. For example, “blue baby syndrome,” also known as infant methemoglobinemia, is caused by excessive nitrate concentrations in the drinking water used to make baby formulas. Human health also can be affected by the groundwater contamination through effects on the food production system. Irrigation with groundwater contaminated by heavy metals and wastewater containing persistent contaminants can result in the accumulation of toxic elements in cereals and vegetables, causing health risks to humans.

Groundwater contamination also can negatively affect the quality of lands and forests. Contaminated groundwater can lead to soil contamination and degradation of land quality. For example, in many agricultural areas in arid regions, high groundwater salinity is one of the major factors influencing soil salinization. The soluble salts and other contaminants, such as toxic metals, can accumulate in the root zone, affecting vegetation growth. Groundwater contaminants also can be transported by surface water-groundwater interactions, leading to deterioration of surface water quality.

Sustainable economic development requires a balance between the rate of renewal of natural resources and human demand. Freshwater is probably the most valuable of the natural resources. However, chronic groundwater contamination may reduce the availability of freshwater, breaking the balance between water supply and demand and leading to socioeconomic crises and even wars. Water shortages induced by contamination may become a factor causing conflicts among citizens in the future, possibly delaying the socioeconomic development of a nation. Groundwater contamination is not only an environmental issue but also a social issue, demanding collaboration between both natural scientists and social scientists.

Inorganic pollutants in water can be extremely harmful and lead to a range of chronic and fatal health problems ranging from poisoning to organ damage and cancers. Organic and radiological contaminants can also lead to a range of dangerous health impacts on the body such as cancers, liver and kidney damage, reproductive and endocrine disorders, birth defects etc.

STUDY AREA

Allavaram Mandal

Allavaram is a Town and Mandal in East Godavary district of Andhra Pradesh. In India, a mandal is a sub-division of a district that is responsible for the administration and revenue collection of a particular area within the district. It is an important part of the local governance structure, and plays a crucial role in the development and administration of its local community.

According to census 2011 information the sub-district code of Allavaram Block (CD) is 04940. Total area of allavaram mandal is 104.92 km². Allavaram mandal has a population of 68,242 peoples out of which 34,034 are males while 34,208 are females. The average sex ratio is 965. The total literacy rate of is 78%.

Allavaram mandal has a population density of 624.8 inhabitants per square kilometer. There are about 17,853 houses in the sub-district.

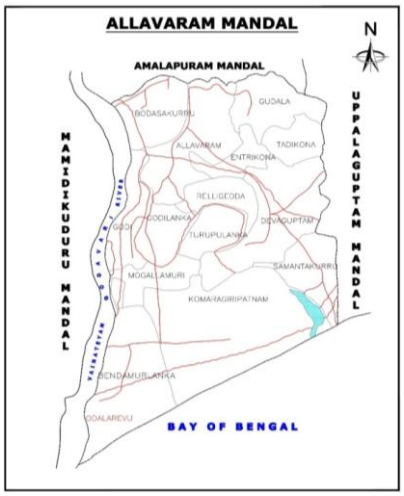

Figure1 Allavaram mandal map

METHODOOGY

To carry out the present project work the following methodology has been adopted which is shown in the following figure.

Collection of water samples in different villages of allavaram mandal. We collect water samples from various source of water such as tubewell, deep well. We found that in somewhere extremely yellowish water too & they used to drink such water.

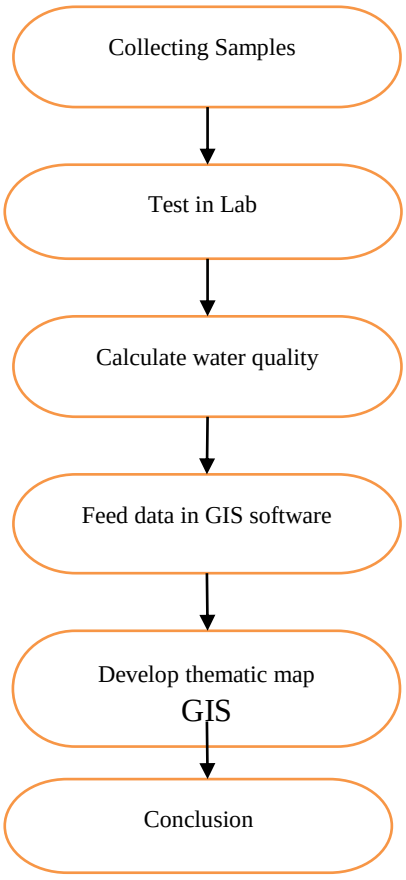

Figure.2. Methodology adopted

Figure.3 Water samples from different villages in Allavaram mandal

TESTING OF WATER SAMPLE PROCEDURE

16 PARAMETERS WATER TEST STRIP has been used.

TEST USE:

This water test strip can be used to detect levels of certain unwanted contaminants commonly found in water (tap, ground, well).

IMPORTANT TO KNOW:

Test for 60 seconds;

When using the 16 parameters water test strip, result are completely (ready to compare) after dipping the test strip and shaking off excess water. The test strip can be dipped directly into the water source being tested. Alternatively, you can fill the clear test tube and proceed ti dip the strip. Upon complection, make sure to compare your results immediately. To do this, place the handle of the test strip at the bottom of the color chart facing upwards. This test strip is no longer valid outside of a 60 second testing period. Discard the test strip after 60 seconds as any further color change will be meaningless.

PRIMARY AND SECONDARY DRINKING WATER REGULATION:

The EPA sets legal limits on over 90 contaminants in drinking water. There are two categories, primary and secondary. Primary contaminants are substances the can toxic in small amounts. On the other hand secondary contaminants are less toxic species and would include cosmetic issues (Color, teste, odour) of drinking water. These test strip for the most commonly found primary contaminants (Lead, fluoride, copper, mercury, chlorine, nitrite, nitate) as well as the most commonly found secondary contaminants (Sulfate, zinc, manganese, iron and pH.)

Figure.4: Strip compare with color chart

RESULTS & DISCUSSION

The results of the experimental work carried out were presented in the following Tables.

Table.1:-Test Results of Allavaram

Allavaram

Name of Testing	**Sample 1st**	**Sample 2nd**	**Sample 3rd**	**Sample 4th**	**Sample 5th**	**Average**
PH value	8	8	8	8	7.5	7.9
Hardness	250	425	250	250	100	255
Hydrogen Sulphide	0	0	0	0	0	0
Iron	0	0	0	0	0	0
Copper	0	0	0	0	0	0
Lead	5	5	5	5	5	5
Manganese	0	0	0	0	0	0
Total Chloride	0	0	0	0	0	0
Mercury	0	0	0	0	0	0
Nitrate	0	0	0	0	0	0
Nitrite	0	0	0	0	0	0

Sulphate	200	0	0	0	200	80
Zinc	0	0	0	0	0	0
Fluoride	0	0	0	0	0	0
Sodium Chloride	2000	2000	2000	1000	1000	1600
Total Alkalinity	180	180	240	240	40	176
Coliform Bacteria	Bacteria	No Bacteria	Bacteria	No Bacteria	Bacteria	
Latitude	*16.518°*	*16.517°*	*16.519°*	*16.512°*	*16.518°*	
Longitude	*81.986°*	*81.988°*	*81.988°*	*81.989°*	*81.988°*	

Table.2:-Test Results of Bodasakurru

Bodasakurru Village

Name of Testing	**Sample 1st**	**Sample 2nd**	**Sample 3rd**	**Sample 4th**	**Sample 5th**	**Average**
PH value	8	7.5	7.5	7.5	8	7.7
Hardness	425	425	250	250	425	355
Hydrogen Sulphide	0	0	0	0	0	0
Iron	0	0	0	0	0	0
Copper	0	0	0	0	0	0
Lead	5	5	5	5	5	5
Manganese	0	0	0	0	0	0
Total Chloride	0	0	0	0	0	0
Mercury	0	0	0	0	0	0
Nitrate	25	0	0	0	0	5
Nitrite	10	0	0	0	0	2
Sulphate	0	0	0	200	200	80
Zinc	0	0	5	0	0	1
Fluoride	0	0	0	0	0	0
Sodium Chloride	2000	0	0	0	0	400
Total Alkalinity	0	240	0	0	180	84
Coliform Bacteria	No Bacteria	No Bacteria	No Bacteria	No Bacteria	No Bacteria	
Latitude	*16.522°*	*16.526°*	*16.527°*	*16.531°*	*16.533°*	
Longitude	*81.971°*	*81.974°*	*81.973°*	*81.975°*	*81.976°*	

THEMATIC MAPS USING GIS SOFTWARE

For better visibility and readability to even by an uneducated person, the thematic maps showing the spatial distribution of various parameters were developed and presented here.The spatial and attribute database generated were integrated for the generation of the spatial distribution maps of all water quality parameters along with the map. The water quality data (attribute) is linked to the sampling location (spatial) i.e. Allavaram Mandal and maps showing spatial distribution were prepared using Arc GIS 10.8 software. The flow chart is shown below:

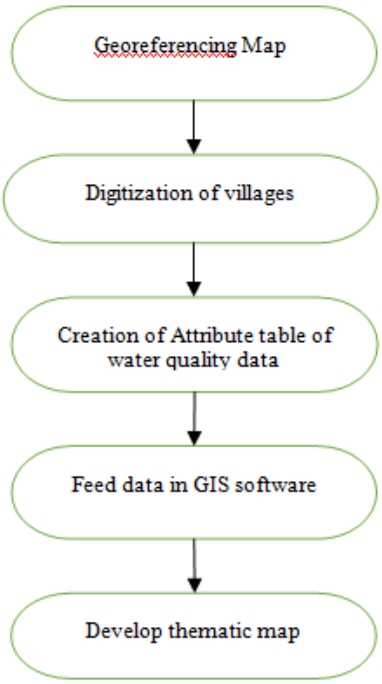

Figure.5: Flow chart for creation of thematic maps

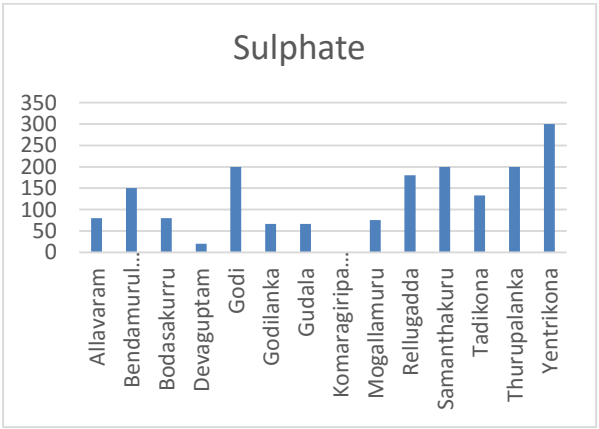

Figure.6:- Bar chart showing the Sulphate values in different villages

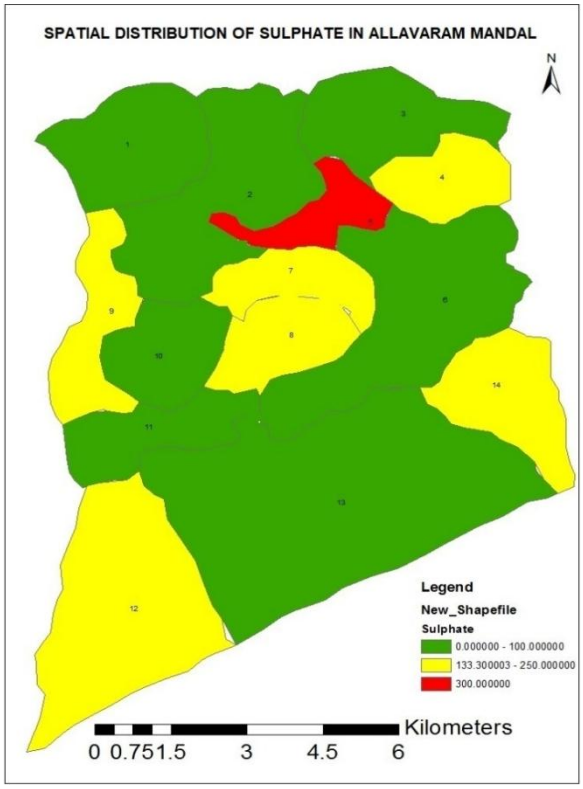

Figure.7: Spatial distribution of Sulphate in the study area

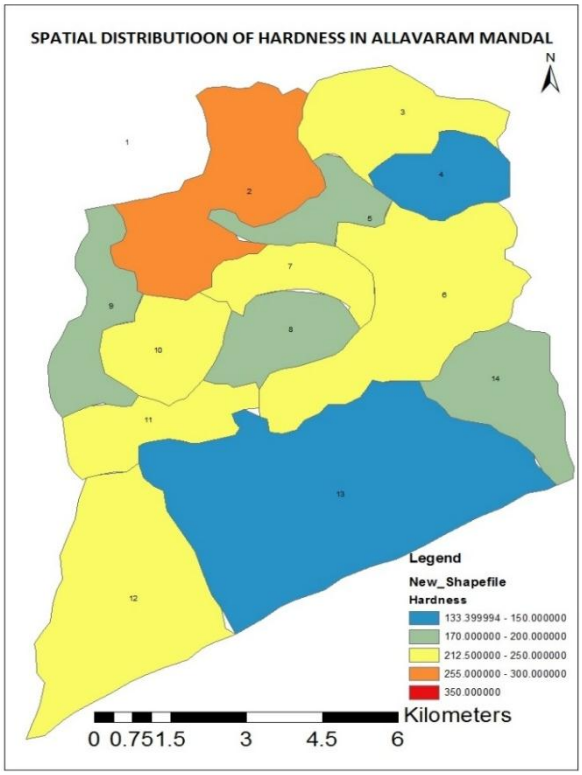

Figure.8: Bar chart showing the Hardness values in different villages

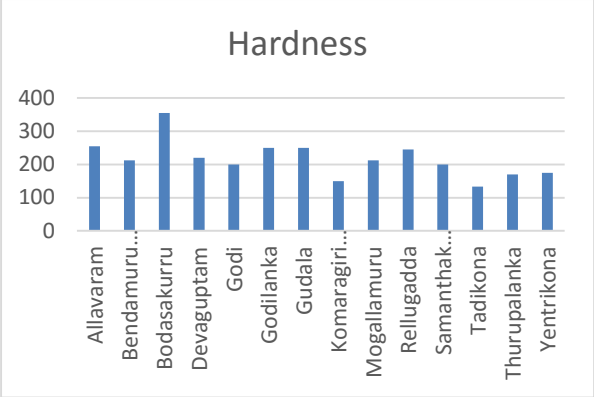

Figure.9:-Spatial distribution of Sulphate in the study area

CONCLUSION

All the above results aim to monitor water quality status in the study area. The information so generated will help regulatory authorities to develop a water management plan. It is necessary that the drinking water should be pure. However the absolute pure water is not found in nature. Even the rain water which absolutely pure at the instant it is formed becomes impure because as it passes through atmosphere it dissolves. Certain gases, traces of minerals, dust, bacteria, and various other substances, It is therefore essential to ascertain the quality of water available from the various sources to whether the water is potable or not. So to know the portability conditions various parameters like Ph, Chloride, Turbidity, Total Hardness, Total Alkalinity, Iron, and fluoride, Nitrate, Total dissolved solids & various parameters were analysed for the study area and tabulated. The final output has given in the pictorial representation of ground water quality suitable or unsuitable for drinking purposes in the area under study. Out of 14 villages some villages contain ground water in 'excellent' category and some villages in 'good' category. In three villages the ground water is unfit for drinking and in remaining villages it is in poor condition as per our results. The analysis reveals that the groundwater of the area needs some degree of treatment before consumption.

The conclusions derived from the project work are summarized below:

PH value of different villages in allavaram mandal is good as per Indian standard. Hardness of different village in allavaram mandal is somewhere high & some where is good. The avalibility of hydrogen sulphide in this mandal is zero. This is good. The availibilty of Iron in this mandal is almost zero, only except in Tadikona village is 0.1 mg\l. The presence of copper in this mandal is almost zero. Only in Devaguptam village shown 2 mg\l of copper. The presence of lead is serious in this mandal. Every village has more than 1 mg\l of lead. The permissible level of lead in drinking water is 0.015 mg/l. The presence of manganese in this mandal is almost zero. Only in three village it shown. The presence of total chloride in this mandal is zero, which is safe side in those village. The presence of Mercury in this mandal is also in safe side. Only in gudala village it is found in some quantity. The presence of nitrite in this mandal is visible in somewhere. Among 14 villages nitrate is found in 5 villages in small quantity which is shown in graph. The presence of nitrate in this mandal is visible in somewhere. The presence of Zinc in this mandal is available in some villages. But it shows its in appropriate quantity. The presence of Fluoride in this mandal is almost zero. In our drinking water we need The permissible level of fluoride in drinking water is 1.5 mg/l. Because of nearly place of sea area the Sodium chloride quantity is very high in this mandal, which is shown in our results. The presence of Alkalinity in this mandal is very high, which is shown in our results. Water with high levels can cause scaling. The permissible limit for alkalinity in drinking water is 200 mg/l. Bacteria is present in all villages except Tadikona and Bodasakurru. The presence of Lead more than the prescribed limit is attributed to the excess aqua cultural practices adopted in this mandal.

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