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# Study of Groundwater Quality with GIS Application for Coonoor Taluk in Nilgiri District

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## ABSTRACT

**Water is the basic element of social and economic infrastructure and is essential for healthy society and sustainable development. Due to rapid increase in density of population, fast urbanization, industrialization and agricultural, use the demand of water is increasing day by day. As a result surface water and ground water level is decreasing, pollution and increased demand have made good quality water scarer and more expensive. Groundwater is the favourite alternative is facing threats due to anthoropogenic activities in India, which has lead due to deterioration in ground water quality. The possibility of ground water contamination is due to the mixing up of toxic chemicals, fertilizers, waste disposed site and industrial sites. Hence monitoring of ground water quality has become indispensable. GIS not only facilitates data capture and processing but also serve as powerful computational tools that facilitate multimap integrations. In this project ground water quality analysis was carried out for Coonoor Taluk in Nilgiris District water samples were collected all around the taluk the strategically analysed results are presented in a GIS based water quality mapping.**

**KEYWORDS:** Groundwater, Quality, Gis Application, Coonoor Taluk

## 1. INTRODUCTION

Water is the basic requirements of all life on Earth. The origin of life has been attributed is water along with other basic elements water the source of life is passionate. Too passionate to manage excess of, it leads to flood and lack of its results in drought and famine. It must be remembered that any natural or manmade activity on the surface of the earth will have its for most impact on the quality and quantity of water this will be taken into the biosphere systems and ultimately lead to hydrological extremes.

The increase in population and urbanization and urbanization necessitates growth in the agricultural and industrial sectors which demand for more fresh water. When surface water is the non-available mode the alternative is to depend on ground water.

The dependability on ground water has reached an all time high in recent decades due to reasons such as unreliable supplies from surface water due to vagaries of monsoon, increase in demand for domestic, agricultural and industrial purposes. This has resulted in over exploitation all over the country and in certain places it has reached critical levels like drying up of aquifers.

## 2. PROBLEMS IN STUDY AREA

There are three main sources of groundwater pollution. These includes natural sources, waste disposal activities, spills, leaks and non point source activities such as agricultural management practices. Here in Coonoor area the groundwater could be spoiled due to waste disposal and Improper Agricultural practices.

The groundwater quality in and around Coonoor is potable. All the people used the groundwater for domestic purposes. The Agricultural communities utilized the groundwater for farming in their lands. But today the scenario is completely different. In many part of Coonoor taluk, groundwater usage is obsolete. Therefore water quality monitoring is necessary in Coonoor taluk.

## 3. NEED FOR THE STUDY

Now a days water scarcity increases rapidly due to decrease of ground water. The ground water is also polluted due to various artificial man-made activities. Due to this, quality of the water is reduced. This will produce various adverse impacts on human beings, animals and plants.Therefore, it is necessary to monitor the water quality.

## 4. GEOGRAPHIC INFORMATION SYSTEM

GIS is a power tool for collecting, storing, transforming the spatial information and arriving decision from the real world for particular set of purpose in real time, where the stored information are geo-references (or) geo-coded. In this project the water quality is analyzed using GIS and mapped.

A geographic information system may be defined as an integrated system designed to collect, manage and manipulate information in a spatial context. The geographic component, the various technologies involved and the approach to information modelling set a GIS apart from other types of information systems. A geographic

information system provides an abstract model of the real world, stored and maintained in a computerized system of files and databases in such a way as to facilitate recording, management, analysis and reporting of information. It can be more broadly stated that a geographic information system consists of a set of software, hardware, processes and organization that integrates the value of spatial data.

## 5. OBJECTIVES

The Present study as the following objectives.

- To analysis the various ground water quality
- parameters using GIS.
- To interpreting various ground water quality parameter using GIS.
- To develop an integrated groundwater quality map of Coonoor Taluk using GIS.

## 6. GEOGRAPHICAL INFORMATION SYSTEM

Geographic Information System (GIS) is a computer based information system used to digitally represent and analyse the geographic features present on the Earth surface and the events (non-spatial attributes linked to the geography under study) that taking place on it.

## 7. DEFINNING GIS

A GIS is an information system designed to work with data referenced by spatial / geographical coordinates. In other words, GIS is both a database system with specific capabilities for spatially referenced data as well as a set of operations for working with the data. It may also be considered as a higher order map.

GIS technology integrates common database operations such as query and statistical analysis with the unique visualization and geographic analysis benefits offered by maps. These abilities distinguish GIS from other information systems and make it valuable to a wide range of public and private enterprise for explaining events, predicting outcomes and planning strategies.

A Geographic Information System is a computer based system which is used to digitally reproduce and analyse the feature present on earth surface and the events that take place on it. In the light of the fact that almost 70% of the data has geographical reference as it's denominator, it becomes imperative to underline the importance of a system which can represent the given data geographically.

The four functions of GIS are:

1. Data acquisition and pre-processing
2. Data management, storage and retrieval
3. Manipulation and analysis
4. Product generation

The GIS has the power of organizing effective Social Information System (SIS) towards decision-making or resource management. The spatial information system comprises synthesis of spatial formation and non-spatial data within GIS framework. The GIS aims and works at bringing together, the diverse information, which are gathered from various different sources. Hence, this is also known as integrated analysis.

## 8. APPLICATIONS OF GIS

GIS applicable for many fields

- Environment
- Urban planning
- Natural Hazard Management
- Archaeology
- Agriculture
- Geology

## 9. STUDY AREA

### 9.1 GENERAL

In Tamil Nadu, Nilgiris is one of the famous Tourist Destination which is well known for its Tea Cultivation. It is situated in the western part of Tamil Nadu. Out of total geographical area of 2366.89 sq.km and an elevation of 2280 to 2290 mts hectares. The entire district lies in the western Ghats. Its summer temperature is Max 25'C – Min 10'C. Winter Temperature Max 20'C – Min 0'C. The sources of irrigation are streams, tanks and wells. Ground water plays a major role for Irrigation as well as Domestic uses.

### 9.2 LOCATION AND EXTENT:

Nilgiri Coimbatore District is administratively divided into 4 Taluks

| | | |
|---|---|---|
| Block | - | 4 |
| Town Panchayat | - | 13 |
| Village Panchayat | - | 25 |
| Revenue Village No | - | 54 |

### 9.3 LOCATION OF THE STUDY AREA

And our study area covers Coonoor Taluk which lies between North Latitudes 11˚ and 11˚ 55' East Longitudes 76˚ 13' and 77˚ 2'.

### 9.4 COONOOR TALUK

The total area of this taluk is 227.79 sq.km with a cultivatable area of 12831 Ha. Forest covers about 4107 Ha. The cultivatable area is irrigated by Local streams and also irrigated by ground water.Coonoor taluk comprises of Villages Namely Burliar, Hullical, Hubbathalai, Ketti, Yeddapalli, Mellur, Coonoor Town, Adigaratty and Coonoor Rural.

### 9.5 LAND UTILIZATION PATTERN

Within the Coonoor Taluk, the distribution of rainfall is uneven. The mean annual rainfall in this area is about 1920.80 mm. And a perusal of rainfall data collected over a period of ten years from 2000 reveal that the district receives major portion of its annual rainfall during the North East Monsoon.

### 9.6 SOIL DATA & GEOLOGY

In Coonoor Taluk, various type of soil pattern exists such as Red loams, Laterite soil, Black soil, and sandy coastal alluvium loam and clay loam

**Table 3.1 Coonoor Taluk Land Utilization**

| Land Classification | Area in Ha. |
|---|---|
| Forest | 4107 |
| Barren and uncultivable uses | 562 |
| Non Agricultural uses | 2764 |
| Cultivable waste | 28 |
| Pasture and Grazy Ground | 923 |
| Land under Misc Tree crops | 613 |
| Current fallows | 1017 |
| Other fallow land | 38 |
| Net Area sown | 12831 |
| Geographical area according to | 22884 |
| Total cropped Area | 12831 |

The study area is mainly covered by wide range of metamorphic rocks of unclassified Genesis. Some minor area is covered by Granite and Syenite type of rock

## 10. METHODS AND METHODOLOGY

### 10.1 CONVENTIONAL DATA BASE

1. Layout Map of Coonoor Taluk
2. Groundwater quality parameters

### 10.2 INSTRUMENTS USED

1. GPS – Garmin
2. Water Quality Field Kit

### 10.3 SOFTWARE USED

1. Surfer - 8
2. ARC GIS 9.3

### 10.4 CREATION OF A DATABASE

A collection of information in such a way that a computer program can quickly select desired pieces of data. Traditional database are organized by field, records and fields. A field is a single piece of information a record is one complete that of fields and a file is a collection of records. Here data base was created using ground water quality parameters.

### 10.5 SCANNING OF TOPOSHEETS

Scanning results in the conversion of the image into an array of pixels thereby producing an image in raster format. A raster file is an image created by a series of dots called "Pixels" that are arranged in rows and columns. A scanner captures the image by assigning a row in a column and a colour value each dot. The Coonoor Taluk Map was scanned.

### 10.6 DIGITIZATION

A Raster image is a type of computerized image that consists of row after row of pixels. There are many different raster image file format. Digitization is the process which converts raster to vector format. Most of the GIS technologies are vector formats are more common, so the raster format is converted into a vector format. In the vector format the position of the line is determined by the co-ordinate which are present at the starting and ending points of the line. Digitization was done by Surfer - 8.

### 10.7 QUERY ANALYSIS

Data query retrieves a data subset from a map by working with its attribute data. The selected data subset may be visually inspected or saved for further processing. Attribute data query requires the one of expressions which must be interpretable by a GIS. These expressions are often different from one system to another.

### 10.8 SPATIAL INTERPOLATION

Spatial interpolation is a process of using points with known values to estimate values at other points. Spatial Interpolation is a means of converting point data to surface data.

### 10.9 SUMMARY

The water quality parameters were tested in the laboratory. The Lab Test Procedure was done as per Indian standard code of Practice. The water quality parameters are given in the data base to GIS. The Coonoor map was scanned and digitized. Digitization was done by Surfer – 8. The spatial variation was done. Finally, integrated ground water quality map was created using ARC GIS 9.3.

## 11. ANALYSIS

### 11.1 GROUND WATER QUALITY PARAMETERS

The major ground water quality parameters such as,

1. pH
2. Total dissolved solids
3. Total hardness
4. Sulphate
5. Chloride
6. Calcium
7. Turbidity
8. Temperature.

have been estimated in 13 observation wells throughout the Coonoor Taluk. The ground water quality data of the study area as shown in table 5.1 and locations in study area map 5.2. Finally, integrated ground water quality map was created using ARC GIS 9.3.

### 11.2 ARC VIEW GIS 9.3

Using ARC VIEW 9.3 the spatial interpolation was done on the basis of attribute values. Like pH, TDS, TH, sulphate, chloride, calcium, Turbidity and Temperature, etc.

For each parameter the spatial analysis was done and map was created except for turbidity as there is less variation in turbidity values.

### 11.3 INTEGRATED GROUNDWATER QUALITY MAPPING

Spatial variation of ground water quality parameter map were integrated and integrated ground water quality map was created. After integration, the map shows groundwater quality in Coonoor Taluk.

## 12. RESULTS AND DISCUSSION

### 12.1 GENERAL

In the present study, ground water quality parameters were analyzed and integrated water quality map of Coonoor Taluk was prepared considering the ground water quality data using GIS.

### 12.2 RESULTS

Integrated ground water quality map of Coonoor Taluk was prepared from the ground water quality data and shown in figure The land use map of Coonoor Taluk was digitized using Surfer - 8 then exported to ARC GIS 9.3. The spatial analysis was done using ARC VIEW 9.3.

**GROUND WATER QUALITY ANALYSIS FOR COONOOR TALUK.**

| Sample No | Village | Hamlet | Latitude | Longitude | Altitude | Temp (Oc) | Ph value | Hardness ppm | Turbidity | TDS | Sulphate | Chlorides | Calcium |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Ketti | Shantur | 11?22' 29.72 | 76?43' 22.40 | 1852 | 11.6 | 6.51 | 73 | 3 | 540 | 250 | 234 | 62 |
| 2 | Ketti | Shantur | 11?22' 34.68 | 76?43' 23.48 | 1862 | 10.8 | 6.73 | 88 | 4 | 542 | 241 | 245 | 73 |
| 3 | Ketti | Palada | 11?21' 29.61 | 76?43' 56.73 | 1835 | 11.7 | 6.89 | 117 | 4 | 418 | 244 | 241 | 92 |
| 4 | Adigaratty | Kattery Dam | 11?20' 24.36 | 76?43' 58.58 | 1847 | 11 | 7.26 | 126 | 4 | 475 | 163 | 197 | 104 |
| 5 | Mellur | Thaimalai | 11?16' 18.22 | 76?43' 52.11 | 1596 | 11.3 | 6.78 | 109 | 3 | 410 | 213 | 194 | 98 |
| 6 | Mellur | Thaimalai | 11?15' 52.82 | 76?43' 12 | 1565 | 11.6 | 6.32 | 103 | 1 | 575 | 221 | 169 | 96 |
| 7 | Hullical | Selas | 11?19' 42 | 76?45' 06 | 1697 | 11.2 | 7.07 | 86 | 2 | 415 | 203 | 194 | 74 |
| 8 | Hullical | Karrumpalam | 11?20' 02 | 76?46' 23 | 1625 | 11.8 | 7.29 | 84 | 0 | 540 | 229 | 187 | 52 |
| 9 | Hullical | | 11?19' 13 | 76?47' 26 | 1743 | 11.9 | 7.06 | 97 | 4 | 418 | 236 | 209 | 71 |
| 10 | Coonoor Town | Brooklands | 11?21' 11 | 76?48' 33 | 1810 | 11.9 | 7.06 | 127 | 4 | 572 | 227 | 228 | 106 |
| 11 | Coonoor Town | Sims Park | 11?21' 29 | 76?48' 08 | 1846 | 10.9 | 7.27 | 119 | 3 | 518 | 246 | 247 | 97 |
| 12 | Yedapalli | Yedapalli | 11?22' 39 | 76?48' 53 | 2026 | 11.7 | 6.83 | 69 | 2 | 423 | 213 | 194 | 48 |
| 13 | Burliar | Kodamalai | 11?22' 16 | 76?49' 37 | 1941 | 12.3 | 6.9 | 127 | 4 | 495 | 242 | 197 | 116 |

### 12.3 GROUND WATER QUALITY MAPPING

In order to assess the ground water quality 13 sampling points are identified throughout the Coonoor Taluk and water samples have been collected. The major water quality parameters such as pH, TDS, TH, Sulphate, Chloride, Calcium, Temperature and Turbidity have been estimated. The tested data of 13 locations for each parameters have been converted into spatial variation using GIS. (Fig.1)

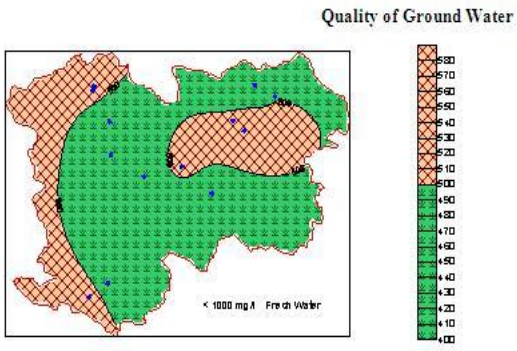


**Figure.1. Ground water quality mapping**

## 13. INTEGRATED GROUND WATER QUALITY MAP OF COONOOR TALUK

### 13.1 DISCUSSION

GIS is used to evaluate the quality of ground water in Coonoor Taluk. Spatial variation map of major water quality parameters like pH, TDS, TH, Sulphate, Cloride, Calcium, Temperature, were prepared for Coonoor Taluk based on these spatial variation maps of major water quality parameters and integrated ground water quality map of Coonoor Taluk was prepared using GIS. This integrated ground water quality map help us to know the existing ground water condition of the study area.

### 13.2 pH

The pH values of the analysed samples ranges from 6.32 to 7.29. The ranges are classified in the spatial variation map shown in figure in 2.

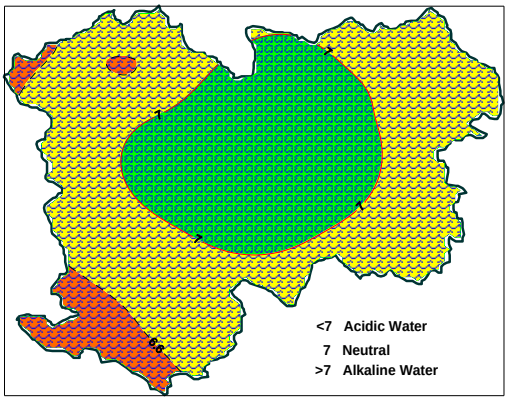


**Figure.2. Spatial variation map of pH values**

### 13.3 Total Dissolved Solids

To ascertain the suitability of ground water for any purposes, it is essential to classify the ground water depending upon their hydrochemical properties based on their TDS Values. The TDS values ranges from 410 – 540mg/l from the spatial variation map it is observed that Maximum area of the TDS Value cover <600mg/l as shown in figure.3.

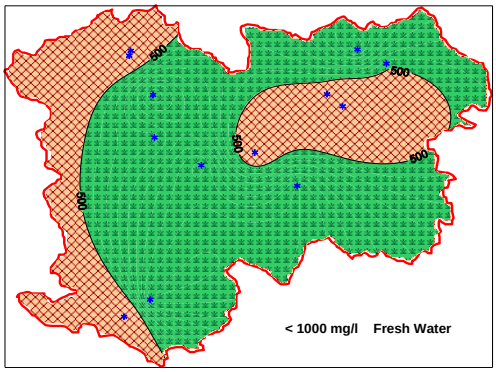


**Figure.3. Spatial variation map of TDS values**

### 13.4 Total Hardness

The classification of ground water based on total hardness (TH) shown that a majority of the most desirable limit is 100mg/l as per the sho international standard. The tested values of TH of the samples ranges from 73 to 127. From the map it is observed that most of the area cover <1000mg/l as shown in figure.4

### 13.5 Sulphate

Sulphate is unstable if it exceeds the maximum allowable limit of 400mg/l. The sulphate concentration various from 163 to 250mg/l

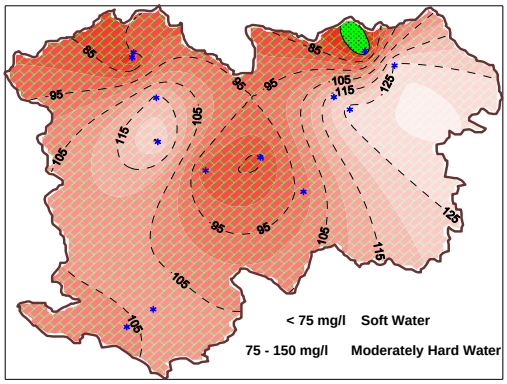


**Figure.4. Spatial variation map of hardness**

and illustrated in the spatial variation map shown in figure.5.

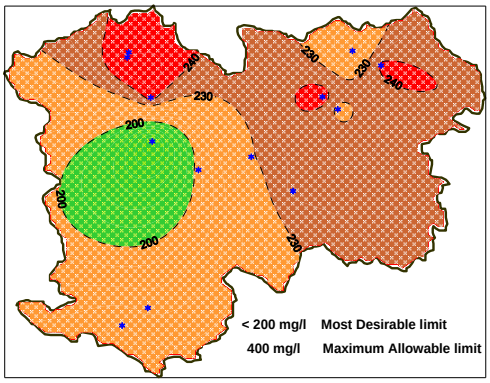


**Figure.5. Spatial variation map of sulphate**

### 13.6 Chloride

The chloride ion concentration various between 194 to 247 mg/l. The spatial distribution of chloride concentration in ground water of the study area is illustrated in figure.6. which in <600mg/l

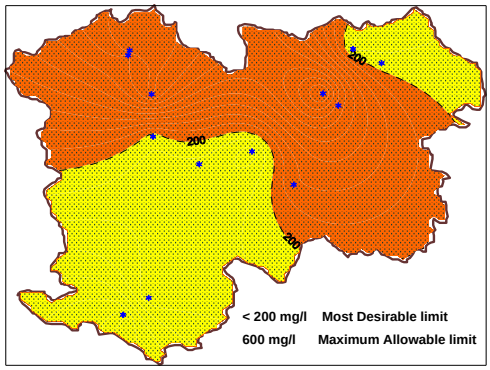


**Figure.6. Spatial variation map of chloride**

### 13.7 Calcium

Calcium the analysed samples various from 62 to 116. Which is illustrated in the spatial variation Map shown in figure.7.

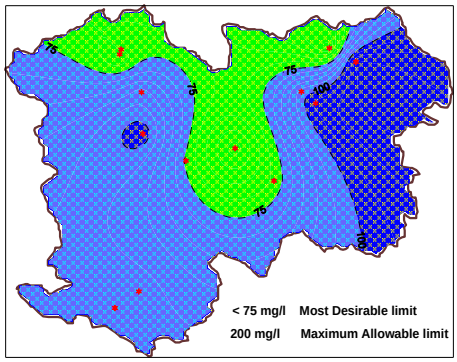


**Figure.7. Spatial variation map of calcium**

### 13.8 Temperature

Water Temperature is an important property that determines water suitability for human use, Industrial applications and aquatic ecosystem functioning. The Temperature varied from 10.80'c to 12.3'c which is also illustrated in the spatial variation Map shown in figure.8.

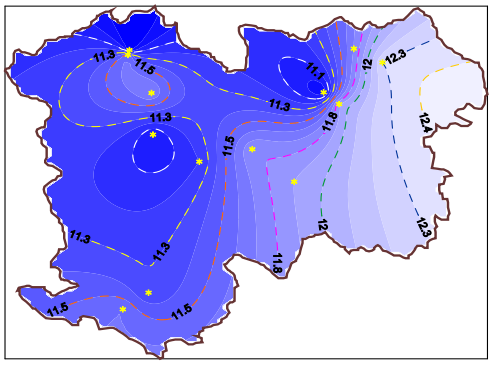


**Figure.8. Spatial variation map of temperature**

### 13.9 Turbidity

The quality of water is ascertained based on the turbidity value. The Turbidity values ranges from 0 -4. Which is well within the permissible limit. The integrated map illustrated the good and excellent quality of water in Coonoor Taluk.

## 14. CONCLUSION

Water is the prime requirement for the existence of life groundwater is a precious resource of finite extent. Over the years increasing population urbanization and expansion in agriculture has head in the scientific exploitation of ground water creating a water stress condition. Coonoor area is under threat due to the critical issues of environmental pollution and water scarcity problems. The groundwater quality in Coonoor Taluk has been reduced due to pollution. Hence monitoring the groundwater quality is indispensable. The study was carried out in entire Coonoor Taluk. GIS technologies can provide appropriate platform for convergent analysis of large volume of multi-disciplinary data and decision making for ground water studies can be effectively done. The GIS bare zoning of groundwater quality map may be used as a guideline for predicting the groundwater quality to new areas. The present study provides a guideline for solving water quality problem in Coonoor Taluk.

### 14.1 Scope of future study

This groundwater quality analysis can be extended to ground water modeling and the present study can be kept as basic data for future investigation for analyzing various parameters of Ground water studies.

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