

Evaluation of Ground Water Quality in Poultry Farms in Namakkal Taluk by Using GIS & Remote Sensing

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ABSTRACT-Groundwater quality in Namakkal taluk has special significance and needs great attention of all concerned since it is the major alternate source of domestic, industrial and drinking water supply. The present study monitors the ground water quality, relates it to the land use / land cover and maps such quality using Remote sensing and GIS techniques for a part of Namakkal taluks. Thematic maps for the study are prepared by visual interpretation of SOI Toposheets and linearly enhanced fused data using ARC-GIS software. Physico-chemical analysis data of the groundwater samples collected at predetermined locations forms the attribute database for the study, based on which, spatial distribution maps of major water quality parameters are prepared using curve fitting method in Arc View GIS software. Water Quality Index (WQI) was then calculated to find the suitability of water for drinking purpose. The overall view of the water quality index of the present study area revealed that most of the study area with >50 standard rating of water quality index exhibited poor, very poor and unfit water quality.

I. INTRODUCTION

Water is the basic necessity of life. In the recent decades, many countries are facing serious issues of water quantity and quality. The global community acknowledges a water crisis: the UN has declared 2005-2015 as the decade of water (Glendenning 2009). More than 2000 million people would live under conditions of high water stress by the year 2050. Water could prove to be a limiting factor for development in a number of regions in the world. About one-fifth of the world's population lacks access to safe drinking water. With the present consumption patterns, two out of every three persons on the earth would live in water-stressed conditions by 2025 (Arjun Bhattacharya and O'Neil Rane 2003).

Contamination of groundwater by domestic, industrial effluents and agricultural activity is a serious problem faced by developing countries. The industrial waste water, sewage sludge and solid waste materials are currently being discharged into the environment indiscriminately. These materials enter subsurface aquifers resulting in the pollution of irrigation and drinking water (Forstner and Witman, 1981). High rates of mortality and morbidity due to water borne diseases are well known in India. Access to safe drinking water remains an urgent necessity, as 30% of urban

and 90% of rural households still depend completely on untreated surface or groundwater (Rakesh Kumar *et al.*, 2005). While access to drinking water in India has increased over the past decade, the tremendous adverse impact of unsafe water on health continues (WHO,2004). It is estimated that about 21% of communicable diseases in India is water related (Brandon *et al.*, 1995).

II. LITERATURE REVIEW

The hydrochemical characteristics and groundwater quality assessment were carried out by Arumugam and Elangovan (2008) in Tirupur Region of Tamil Nadu, India. Groundwater samples from 62 locations have been collected. The extensive agricultural, industrial activities and urbanization resulted in the contamination of the aquifer. Most of the locations were contaminated by higher concentration of EC, TDS, K and NO₃. Majority of the samples were not suitable for domestic purposes and far from drinking water standards.

Robertson (1977) found that higher NO₃-N levels were commonly detected in areas with poultry operations when compared with areas that had no operations. Ritter and Chirnside (1984) found that 32% of the wells sampled in coastal Sussex County in an intensive ground water study had average NO₃-N concentrations above 10 mg/L. The highest NO₃-N concentrations occurred in areas with intensive broiler production or intensive crop production with excessively drained soils. The authors also found that in several areas, NO₃-N concentrations in the ground water decreased as the distance from poultry houses increased.

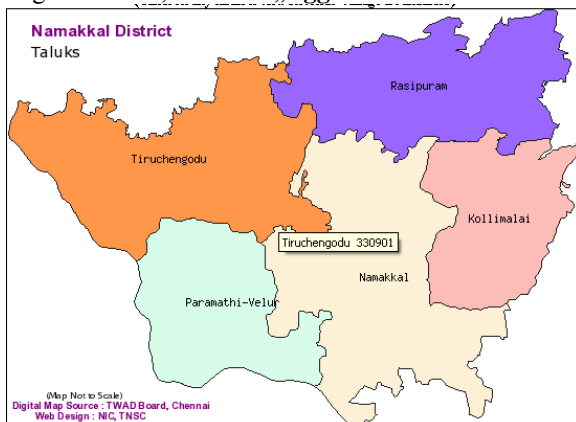
A. Scope of the Project- Water quality issues have received a lot of press coverage in recent years as contamination of ground and surface water sources have been brought before the US public. The importance of these issues will continue to escalate as our nation looks more critically at its natural resource base. Water quality is an issue that will continue to be magnified and will not disappear or be played down in the near future. Water quality is a health issue in many parts of the US and world, and it is just as important to poultry production and processing, since water quality can affect poultry health and performance. This new regional research

project will be the only regional project dedicated to the role of water quality issues in poultry production. Water quality issues include the environmental, food safety, growth performance, and profitability of poultry and poultry products. The objective of this new project is to study the role of water used in poultry production and product processing and their effect on the environment, and food safety.

B. Objectives-The Primary objective of this study is:

- Identifying the Chicken forms in Namakkal Taluk.
- Preparing various Thematic maps like Geology, Geomorphology, Soil, Drainage, Land use/ land cover etc...
- Geochemical Analysis of Groundwater samples
- Integrating All the layers in GIS Environment
- Identifying the Chicken forms and its waste related Environmental changes

C. Study Area: Namakkal District is situated at 11o 00' and 12o 00' of the North latitude and 77o 40' and 78o 05' of the East longitude (Figure 3.1). The altitude of the district is 300 metres above MSL. Namakkal District comes under the North Western Agro climatic zone (Excluding Thiruchengode Taluk) of Tamil Nadu. It is situated in the dividing portion of two watersheds between Cauvery and the Vellar System with the Taluks of Attur, Rasipuram and Namakkal on the East and Salem, Omalur and Mettur on the West. Thiruchengode taluk alone is placed under Western Agro -climatic zone. Namakkal finds a place of importance in the map of India because of its Lorry body building industry, a unique feature of the town. More than 150 Lorry body building work shops and with a number of subsidiary industries of auto body works are operating since 1960's. There are Lorries, Trailers and L.P.G. Tanker Lorries in Namakkal district. Therefore it is called as "**Transport City**". Namakkal is the major producer of Egg in Southern Region. Hence, called as "**Egg**".



D. Physiography and Drainage- The Northern portions of Namakkal there are mountains and the Southern areas are

plains. The plain area of the district can be divided into 3 elevating stages. The lower elevation (below 150 m) has Namakkal and Paramathy taluks which are being benefitted by Cauvery river. The mid elevation (150-300 m above M.S.L.) occupies the major area in all Taluks. The high elevation area (between 300-600 m) spreads over mainly in Rasipuram and Namakkal Taluks. The chief rivers run through in the district are Cauvery Aaru, Karipottamaru and Thirumanimuthar.

E. RAINFALL AND TEMPERATURE - The district receives the rain under the influence of both southwest and northeast monsoons. The northeast monsoon chiefly contributes to the rainfall in the district. Most of the precipitation occurs in the form of cyclonic storms caused due to the depressions in Bay of Bengal. The southwest monsoon rainfall is highly erratic and summer rains are negligible. Rainfall data from six stations over the period 1901-2000 were utilized and a perusal of the analysis shows that the normal annual rainfall over the district varies from about 640 mm to 880 mm. It is the minimum around Paramathi (640.50 mm) in the southwestern part of the district. It gradually increases towards north, northeast and east and attains a maximum around Rasipuram (880.5 mm) in the northern part. The district enjoys a tropical climate. The weather is pleasant during the period from November to January.

III. MATERIALS & METHODOLOGY

A. Data Used- In the study, a variety of data including Satellite images, digital elevation model, geological map, soil map, standard 1:50:000 scale Topographic maps and various thematic maps obtained from various sources have been used as data sources together with ground truth studies that have also been carried out.

B. Satellite Data- Landsat -8 Operational Land Imager (OLI) were used in this study. The Landsat ETM+ image (Path141, Row 51) 25-08-1992, 28-10-2001 & 07-02-2006 (Figure.4) was downloaded from earthexplorer (<http://www.earthexplorer.org/data/>). The Landsat Program is a series of Earth-observing satellite missions jointly managed by NASA and the U.S. Geological Survey. Since 1972, Landsat satellites have collected information about Earth from space. This science, known as remote sensing, has matured with the Landsat Program.

C. Digital Elevation Model- Currently, the use of Digital Elevation Models (DEM) has found widespread applications in several geomorphologic and hydrological purposes; especially that this technique allows the extraction of topographic features of the earth surface making possible the display of all Drainage Systems natural features for the both vertical and horizontal resolutions. However, DEM extraction requires elevation data for topographic features with geographic coordinates of each elevation. SRTDEM downloads from <http://srtm.csi.cgiar.org/>

D. Collateral Data

1. Survey of India Toposheet
2. District Geology and mineral resources map
3. Tamilnadu soil Atlas map

E. Water Quality Data

Water quality data for Namakkal district in the year of 2007 was collected from PWD Chennai. The water samples were collected from four wells and tested for physico-chemical parameters are compared with the permissible limits.



F. Software Used

- ImageProcessing Software: ERDAS imagine 9.2
- GIS Software: Arc GIS 9.3
- Hydrology software: Rockware Aqua

G. Thematic Map Preparation

1) Geology

Namakkal District is mostly underlain by the archaean crystalline and metamorphic complex. The geology of the district is complicated due to recurring tectonic and magmatic activities occurred during pre cambrian period. The famous Sithampoondi complex which is known for its complex geology is situated in this district. Gneisses are the oldest rocks in four taluks of the district. It is present widely in plains. The gneisses are highly weathered upto 30 m at some places. The Charnockites are coarse grained and their colour is bluish dark to grey. They are the second largest rock type present in the district. They are massive and less weathered than the gneisses. They exhibit 2 to 3 distinct set of joints and most of them are vertical with steep dips. Iron ore deposits associated with quartz felspathic gneiss and garnetiferous quartz gneisses are present in some areas. These rocks are highly folded and jointed and less weathered (PWD 2001) Calcite.

2) Geomorphology

Namakkal district forms part of the upland plateau region of Tamil Nadu with many hill ranges, hillocks and undulating

terrain with a gentle slope towards east. The prominent geomorphic units identified in the district through interpretation of Satellite imagery are 1) Structural hills, 2) Bazada zone, 3) Valley fill, 4) Pediments, 5) Shallow Pediments and 6) Deep Pediments.

3) Land Use And Land Cover

Anthropogenic changes in land use and land cover are being increasingly recognized as critical factors influencing the global change (Nagendra et al 2004). Land use / land cover changes alter the climate also. As the groundwater recharge is the result of infiltration after rainfall, the land cover pattern influences the surface area available for the rain waterpercolation. And hence the quantity of infiltrating water is altered. Solid wastes disposed on open land become major source for groundwater pollution. A landfill may be defined as any land area serving as a depository of urban or municipal solid wastes. Most of the landfills are simply refuse dumps. Leachate from a landfill can pollute groundwater if water moves through the fill material. (Todd 2001). Land is a non-renewable resource. Mapping of land use land cover is essential for planning and development of land and water resources (Ashwani et al 2006).

IV. RESULT & CONCLUSION

Groundwater quality maps are useful in assessing the usability of the water for different purposes. The spatial and the attribute database generated are integrated for the generation of spatial variation maps of major water quality parameters like pH, Electrical Conductivity (EC), Total Dissolved Sol-ids, Total hardness, Sulphates, Fluorides and Calcium. Based on these spatial variation maps of major water quality para-meters, an Integrated Groundwater quality map of the study area was prepared using GIS. This integrated groundwater quality map helps us to know the existing groundwater condition of the study area.

A. *Water Quality Index* House and Newsome, 1989, stated that the Water Quality Index (WQI) allows „good“ and „bad“ water quality to be quantified by reducing a large quantity of data on a range of physicochemical and biological variables to be a single number in a simple, objective and reproducible manner (Liou sm et al., 2004). The WQI concept is based on the comparison of the water quality parameter with respective regulatory standards (Khan F, et al., 2003) and provides a single number that express overall water quality at certain location based on several water quality parameters (Yogendra and Puttaiah, 2008). WQI improves understanding of water quality issues by integrating complex data and generating a score that describes water quality status and evaluates water quality trends (Boyacioglu, 2007).

All units except pH and conductivity are in mg/l

B. *Water Quality Based On Durov Diagram* The principle of the Durov plot is to permit the cation and anion compositions of many samples to be represented on a single

graph, in which major groupings or trends in the data can be discerned visually.

For the Durov plot, the cation and anion composition is considered in conjunction with a central rectangle. In addition, the Durov plot allows for the direct comparison of two other groundwater parameters, typically pH and the total dissolved solids (TDS).

The following principle ions are used in the calculations:

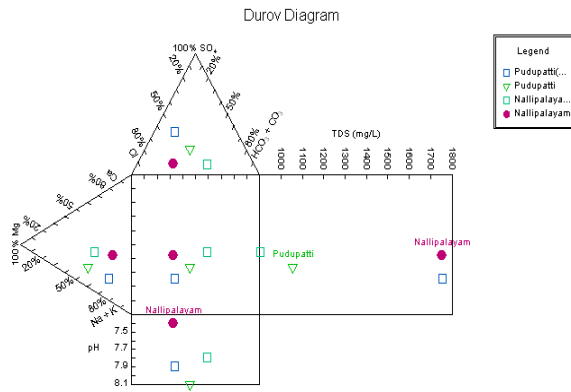
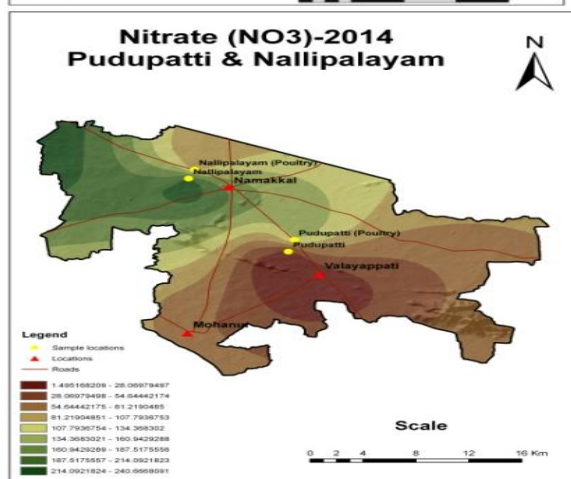
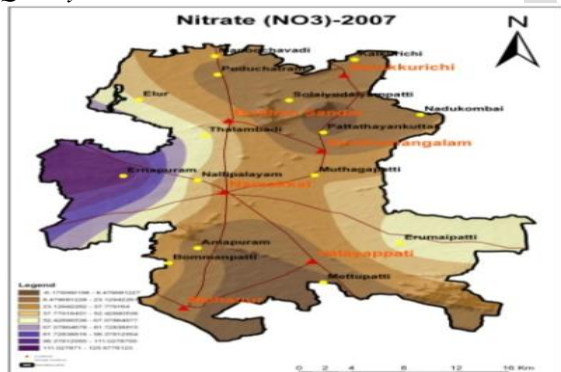


Fig : Durov Diagram Diagram showing the various water quality parameter levels in Puthupatti and Nallipalayam area

1)Gis Spatial Modelling Spatial Distribution of Water Quality Parameters Conclusion:



C. Conclusion

This study has demonstrated the utility of GIS combined with laboratory analysis to assess and mapping of groundwater quality. Variations in major ions help to identify the chemical processes and interaction between soil and water that are responsible for the changes in groundwater quality with respect to space and time. In conclusion, the concentrations of the investigated major ions like chloride, sodium and potassium in the ground water samples from the namakkal taluk area were within the permissible to less permissible limits for drinking water recommended by BIS (1991) and WHO (1984). the present study indicate that the groundwater quality in the study area is poor as it is polluted with high amount of TDS, TH, chloride, alkalinity, Most of the parameters were either more than permissible limit or excessive limit. Therefore, the groundwater in the study area is not potable. To maintain quality of groundwater, the continuous monitoring of physicochemical parameters should be done. On the basis of the present study, it is recommended that the groundwater in the study area should be suitably treated before it is used for drinking and other domestic purposes. Above cited results shows that the overall water quality of Namakkal taluk region is unsuitable for drinking purpose as well as domestic purpose in absence of other sources.

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