CHAPTER 1

INTRODUCTION

1.1 GENERAL

Water is the most important compound of an ecosystem and an elixir of life. It is not only an essential compound for human life but also a precious natural gift for all the plants, animals and other living organisms (National water policy 2002). The availability of water varies with space and it is characterized by hydrological cycle. Water is the only substance which occurs in three form of state as; liquid at standard ambient temperature and pressure, solid state in earth surface as Ice and Gaseous state as steam (Water vapour). Around 75% of the earth surface is covered by water in the form of liquid and solid state as ice. In global water resources around 97.5% is saline water and 2.5% is available as fresh water and 20% of fresh water constituent’s groundwater according to annual report of international maize and wheat improvement centre. The major sources of water are surface water, which occurs in the form of rain water, river water, lake water, sea water and sub-surface water (groundwater), which is generally found in the form of springs, wells, infiltration wells and galleries.

1.1.1 Groundwater

Increasing population and its necessities have led to the deterioration of surface and sub-surface water. Groundwater or sub-surface water is the major source of fresh water which is used for the domestic,
industrial and agricultural purposes in most parts of the world from the municipal well fields and from large number of private bore holes (Janardhana Raju et al 2009), as it has inherent advantages over surface water (Ragunath 1987). At present nearly one – fifth of the water used in the world is obtained from groundwater resources (Ragunath 2007).

The groundwater is located beneath the ground surface in soil pore space and in the fractures of the rocks or lithologic formation (Palanisamy et al 2007). Due to its natural availability and to meet the overall demand, it has been considered as a purest form of the water in both the rural and urban areas. About 95% of population living in India depends on groundwater (Moharir et al 2002).

1.1.2 Global Situation of Groundwater

The part of the sub-surface water which is available in the saturated zone is groundwater. In order to meet the ever increasing water needs, the groundwater resources are over exploited in many regions which in turn lead to the sudden declination in the head level of the groundwater table. Hence the precious resource of the earth (i.e) ground water resources has certain limitations for its potential utilization. Water logging, pollution due to agriculture, industrial activity and human activities, major land use changes and increasing in salinity are the major problems which dominate the usages of groundwater (Datta 2005).

The United nations reveals an estimation that by the year 2025, two- third of human population will face an acute shortage of fresh water across all parts of the world (UN 1995). In recent years, the scientific investigation on the development and management of fresh water resources has gained much importance. The water table levels are declining at an average annual rate of 1.79m/year to 3.3m/year in an agricultural dynamic
region, Guanajuato state, Mexico (Wester et al 1999). Due to increase in population and the economic development activities the usage of freshwater gets increased by 400% by the year 1940 and 1990 (UNEP 2003).

1.1.3 Groundwater scenario in India

The most valuable natural resources on the earth are groundwater which supports the human health, economic development and ecological diversity and in Asia alone about one billion peoples are directly dependent upon this resource (Foster 1995). The dependence of groundwater has tremendously increased in the arid and semi-arid regions in India, due to vagaries of monsoon and the scarcity of the surface water. The groundwater contributes 97% of fresh water and the remaining 3% is the surface water in the form of stream, rivers, etc (Zektser 1998). India supports more than 16% of the world’s population with only 4% of the world’s fresh water resource (Singh 2003), which indicates that the water sector of the nation is under severe stress. In the view of international perspective of “<1700m$^3$/person per year” as water stressed and “<1000m$^3$/person per year” as water scarce. India is water stressed today and is likely to be water scarce by 2050 (Gupta & Deshpande 2004).

1.2 GROUNDWATER QUALITY

The groundwater is the primary source which has been used in many parts of world for drinking and agricultural activities. Some of the geochemical process that occurs in the groundwater system is evaporation, deposition, dissolution and weathering of minerals, ion exchange, etc which are all the responsible for the season and spatial variations in groundwater chemistry. For evaluating the utility of groundwater for agricultural, domestic and industrial purpose, the groundwater quality is very much important. Anthropogenic factors will also affect the quality of groundwater. Excessive
usage of fertilizers and pesticides in agriculture and improper disposal of urban and industrial waste can cause contamination of the groundwater resources (Anjaneyulu 2002). The improper quality of water causes several health problems to human beings and plant growth (Wilcox 1948; WHO 1984; Karnath 1999). In India around 80% of the diseases are directly related to poor drinking water quality and unhygienic conditions. Hence the groundwater quality monitoring tool is used to provide importance of water management.

1.3 NEED FOR THE PRESENT STUDY

Water is one of the most useful and abundantly available substances in nature in which groundwater plays an important role in the development of life of mankind, as it is the major source which supports the domestic needs and irrigation purposes. The quality of groundwater is much important for the usages as drinking and irrigational purposes. Hence water quality monitoring system is essential to obtain the information of changes of water quality.

The water available in the surface bodies of Bhavani Taluk regions in the tanks and the reservoirs are not sufficient. Hence the groundwater resources in Bhavani Taluk, Tamil Nadu, India are being continuously exploited to meet the demand of the water supply and irrigation. Due to anthropogenic activities the quality of the groundwater is also affected. Hence it is essential to assess the groundwater quality for the extraction, identification of the potential zones and the recharge sites using Remote Sensing and GIS, which is a emerging as a great public concern in this region. The groundwater in the study area, Bhavani Taluk, is available mainly in the peninsular gneiss rocks. The water table for the groundwater has gone down due to over exploitations for irrigation purposes through the dug well and bore wells. A progressive depletion of the groundwater quality and its potential
with the passage of the time is noticed in the study area due to over exploitation of the groundwater. Hence it is essential to explore the availability of the natural resources by applying modern techniques. So an attempt has been made to demarcate the areas of the groundwater potential zones in the areas of Bhavani Taluk using an integrated approach of the remote sensing with Geographical Information System (GIS).

1.4 OBJECTIVE OF THE STUDY

The objectives of the present study are to understand the hydrogeology and hydrogeochemistry of groundwater in Bhavani Taluk of Erode district, Tamilnadu, India.

The major objectives of the study are,

1. To understand the spatial and the seasonal variation of rainfall and groundwater level fluctuation.
2. To demarcate the groundwater potential zones using GIS techniques.
3. To assess the suitability of groundwater for drinking and irrigational purposes.
4. To find the water quality Index (WQI) by Weighted Arithmetic Index method and to identify the principal pollutants using Nemerow’s Pollution Index (NPI).
5. To develop the Artificial Neural Network (ANN) model for the prediction of groundwater quality parameters.
1.5 STRUCTURE OF THESIS

Chapter 1 deals with the introduction about the groundwater, global situation of the groundwater, groundwater scenario of India, Quality of the groundwater, need for the present study and the objective of the thesis.

Chapter 2 deals with the review of literature relevant to the objective of the thesis in the area of groundwater quality, rainfall analysis, application of remote sensing and GIS and groundwater quality modelling using Artificial Neural Network (ANN).

Chapter 3 presents the overview of the study area, methodology carried out in the work explaining the collection of groundwater samples, the physico-chemical analysis of groundwater and describing the various thematic maps like geology, geomorphology, soil, lineaments, land use/land cover and drainage patterns of the study area obtained by ArcGIS.

Chapter 4 discuss about the spatial variations of the rainfall and the groundwater level in the study area.

Chapter 5 identifies the groundwater potential zones by weighted overlay analysis from the integration of various thematic maps.

Chapter 6 focuses on the quality of water which is suitable for drinking and irrigational purpose and the mechanisms that controls the groundwater chemistry are studied. The spatial distribution of the groundwater quality used for drinking purposes is prepared for the pre and post monsoon seasons.

Chapter 7 highlights about the statistical analysis, correlation analysis, Factor and Cluster analysis, Water quality Index (WQI) and Nemerow’s Pollution Index (NPI).
Chapter 8 details about the ANN model and the prediction of water quality parameters.

Chapter 9 gives the conclusion of the thesis work with respect to the identification of groundwater potential zones, suitability of water for drinking and irrigation purposes, Statistical analysis, ANN modeling and the future scope of the study.