CHAPTER I
INTRODUCTION

1.0 General

A healthy environment is the most critical component for the well being of a society and is the foundation for a sustainable and strong economy. The term ‘environment’ refers to a definable place where an organism or organisms live, including both the physical and biological features of the place. Organisms and environment are in constant change and environmental awareness has grown enormously all over the world. Hence measures are to be taken to protect the environment from further degradation.

This work is spread over into nine chapters. The first chapter provides a brief account of the scope, significance, objectives, methodology, and review of earlier works. The second chapter deals with the structure and geomorphic evolution of the coastal tract of Kerala and its stratigraphic and general set up with special reference to Alappuzha district. A general description about the study area, its population statistics, geomorphology, soil types, drainage characteristics etc. are discussed in Chapter III. Chapter IV deals with the analysis of the water level data. The water level data collected were compared with the historical data and the correlation between them was established. Chapter V deals with the hydrogeochemistry of the area. Different concentrations of chemical parameters were compared with the water quality standards and the areas with abnormal values were marked. In chapter VI the quality assessment of the water was carried out and various indexes and ratios were prepared to compare it with general standards. Chapter VII deals with the fluoride occurrence and its concentration level in the tubewells and openwells. The data were compared with historical data. Chapter VIII deals with the hydrogeochemistry of fluoride along with of X-ray diffraction studies. The defluoridation techniques were also dealt with in this chapter. Chapter IX provides the conclusions and recommendations.

1.1 Scope

The study area belongs to the Ambalappuzha Taluk of Alappuzha district, characterized by a terrain having coastal structure that extends from Mararikkulam to Thottapally, covering 12 villages. The present study focuses on the geo environmental aspects of the Taluk and its present status. It also
involves critical evaluation of the hazard due to fluoride contamination and suggests remedial measures for it.

The data was collected for a period of 22 months from April 2005 to January 2007.

1.2 Significance

The present investigation aims to get a holistic idea about hydrological setup and geo environmental status of the Ambalappuzha Taluk. It will also give us a clear picture about the level of hazard due to fluoride contamination of the groundwater. The result of the study, if properly correlated and remedial measures taken, will definitely bring lot of improvement in the health status of the residents of the Ambalappuzha Taluk. The study will also enable us to clearly demarcate areas most affected and the source of the pollution. As such no serious studies were carried out so far. The outcome of the study can be utilized to bring necessary changes in the planning and developmental activities of the area by the local administration.

1.3 Objectives

The objectives of the present study are the following:

a) To evaluate the general conditions of ground water occurrence, its quality, flow direction and ground water movement.

b) To assess the factors contributing to the geo environmental status of the study area including the soil and geomorphic conditions, the influence of rivers, canals etc. on the ground water occurrence.

c) To assess various groundwater pollution sources within the taluk and the agents promoting it.

d) To assess the water quality of the entire study area, by taking samples from different well sites to obtain the general water quality conditions.

e) To identify chemical parameters that affects the quality of water and to find out the possible sources of the contamination.

f) To suggest methods to improve the drinking water quality.

g) To prepare ground water zonation map that depicts zones of variation in groundwater quality.

h) To find out and critically analyse the fluoride contamination present in the groundwater of the taluk and its possible sources.

i) To suggest suitable remedial measures to reduce the fluoride content.
To understand the groundwater fluctuation conditions within the study area.

1.4 Methodology

Collection of water samples during pre monsoon- monsoon and post monsoon periods from selected wells of the study area, its chemical analysis, collection of lithologs from tube wells, its X-ray diffraction analysis, measurement of water level at fixed intervals during different seasons, correlation of this data with the rainfall data etc. form the main part of the study. Information were collected in the following manner:

1. Rapid reconnaissance field survey for getting a preliminary understanding about the terrain characteristics and its peculiarities.
2. Collection of maps and various secondary data such as data pertaining to tube well and open well depth, terrain characteristics etc.
3. Preparation of the map of the study area, with well sites for collection of water samples and water levels.
4. Collection of rainfall data of the area under investigation for the study period as well as secondary data for the past few years to establish the correlation between rainfall and ground water recharge conditions and thereby to predict the variation in ground water level in accordance with the intensity and duration of rain for a particular period.
5. Collection of litholog of varying depths from tubewells.
6. Critical analysis, evaluation and interpretation of the chemical data on water samples collected from different wells during the period of study.
7. Chemical analysis of aquifer sample and X-ray diffraction analysis to establish the source and genesis of the fluoride contamination.
8. Graphical representation and interpretation of the data collected in a GIS environment and its evaluation.

1.5 Review of Earlier Works

Different aspects pertaining to the geology and hydrogeology of the area were studied in detail by various scientists. The inhabitants of the study area, mainly depend on groundwater for their day to day requirements. Various studies have shown that geology and hydrogeology have great influence on the occurrences and quality of the water. A brief account of the earlier studies carried out by different researchers are given below.
The 'Hydro geochemistry and Groundwater quality studies around Devak and Rui Watersheds of Jammu Region, Jammu and Kashmir’ by Jasrotia A.S and Rajinder Singh (2007) provides information of groundwater resources in developing rural as well as urban area of Jammu region. The occurrence of fluoride and its geographical and depth wise distribution was studied by Gupta and Deshpande (2005). Sudhakar Reddy et al. (2003) studied the incidence of fluoride occurrence in groundwater of Kocheria Vegu and Anumula Vegu sub basins of Dindi River basin Mahaboonagar (Dt) Andhra Pradesh. Their studies has shown that high fluoride content occurs in dug wells and bore wells of these area which results in endemic fluorosis. Samson (1952) carried out studies on absorption of Fluoride by clay minerals and hydrated alumina. Dipanker Saha and Sharma (2003) studied the variation in fluoride content with time for a specific period and found evidence of rise in fluoride concentration in the alluvial area of Mid Ganga basin. Studies carried out by CGWB (2003) reveal that the deeper aquifers in Alappuzha District does not show a regular spectral pattern in the distribution of fluoride ions and that in the phreatic aquifer, the fluoride concentrations are very low. The concentration of fluoride in the groundwater, the hydrochemical processes involved and also the defluoradation techniques were studied by them. Raha et al. (1983) studied the lithostatrigraphy of the Kerala coast and correlated the Warkallai Group in to Mayyanad, Quilon and Ambalappuzha formations.

A detailed study of the quaternary geology of south Kerala sedimentary basin and its division to southern block, central depression and northern block were carried out by Nair et al. (1988). Further, they have also given a broad picture on the structural frame work, stratigraphy, palynology and depositional environments.

Pandian and Shankar (2007) carried out a detailed study of the hydrogeochemistry and ground water quality in the Vaippar river basin, Tamilnadu using GIS techniques. Assessment of the groundwater quality of the shallow aquifer of the Chennai city area, using GIS were carried out by Satheesh et al. (2007).

1.6 Alappuzha District

With a coastline of 82 kms, Alappuzha District, is one among the 9 coastal districts of Kerala. It occupies 9th position in population among the various districts of Kerala. (Census of India, 2001) Alappuzha has 3rd position in the State in literacy rate. It is unique in two aspects (1) it has no reserve forest
area and (2) The Kuttanad area, the rice bowl of the State, lying below the mean sea level falls within the district.

1.7 Brief History:

The early ‘cheras’ who were living in the present Kuttanad area were called the ‘Kuttuvans’. Later the place was transformed as Kuttanad. The famous travellers Pliny and Ptolemy of the first and second centuries had mentioned about places like Purakkad, port of Ambalappuzha taluk (Sarvavinjnakosham, 1983).

During 16th century Portugese came into prominence of the political scene of the District and Christianity became popular in several parts of the district. During the period of Pooradom Thirunal Devanarayana, King of Chempakasseri, the famous Sreekrishna Swami temple at Ambalappuzha was constructed. (Sarvavijnakosham, 1983).

During 17th century Portuguese power declined and the Dutch occupied the area and built various factories and warehouses for storing pepper, ginger etc. Maharaja Marthandavarma annexed the kingdoms and gave the Dutch a setback, and played a remarkable role in the progress of the District (Sreedhara Menon, 1978). Raja Kesavadas, the Diwan of Travancore known as the maker of Modern Alleppey” built the premier port, several roads and canals. Veluthampi Dalava took keen interest in the development and began coconut and paddy cultivation in several areas. Subsequently the first post office of the state and first telegraph office of the Travancore state was set up in the district. The first modern coir factory was set up in 1859 (Aiya, 1906). The historic struggles of Punnapra and Vayalar in 1946, resulted in the exit of the Diwan Sir C.P Ramaswamy Iyer. After the formation of Kerala State, ie on 1st November 1956, the Alappuzha district was formed. It came in to existence on the 17th of August 1957 with seven taluks and was renamed as Alappuzha district on 7th February 1990. It is said that the land between the sea and the network of rivers flowing in to it had earned the area the name Alappuzha, which means ‘between sea and rivers’ (Aiya, 1906) The present Alappuzha district has 6 taluks namely Cherthala, Ambalappuzha, Kuttanad, Karthikappally, Chengannur and Mavelikkara.
1.8 Location and Topography

Alappuzha district lies between North latitudes 9° 05’ and 9° 54’ and East longitudes 76° 17’ 30” and 76° 40’ . The total area of the district is 1414 Sq.Kms, which comes to 3.64% of the total geographical area of the state and is the smallest district. The coastal taluks of Alappuzha district are represented by a sandy strip of low land. Towards the eastern portion small isolated hillocks can be seen. There are many lagoons, rivers and canals. General topography is characterized by crisscross rivers and lakes (Fig.1.2). Physiographically Alappuzha district can be broadly divided into Alleppey coast, Kuttanad low lying plain, and Chengannur rolling plain.

1.8.1 Alappuzha coast; Comprises whole of Cherthala taluk, part of Ambalappuzha, Karthikappally and Mavelikkara taluk. The elevation of some places are below MSL and in many areas almost same as that of MSL and are marshy in nature.

1.8.2 Kuttanad; This region is a basin between western coastal area and the eastern plain. At many places, the elevation is lower than that of the sea level.

1.8.3 Chengannur rolling plain; Comprises the Chengannur and Mavelikkara taluks of the eastern side of the district and is characterised by gentle slope towards west. The elevation ranges between 80 and 90 m.

1.9 Fluvial Control of the Terrain

1.9.1 Manimala River: It has a length of 91.73 Km and a drainage area of 802.90 Sq Km. (Fig. 1.3) The river enters the district at Thalavady in Kuttanad taluk and passes through Edathua and Champakulam village and joins Pampa River at Muttar. (Water Atlas of Kerala, 1995)
1.9.2 Pamba River: is the third longest river of Kerala. It enters the Alappuzha district at Chengannur and flows through Pandanad, Veeypuram, Thakazhy and Champakulam. Manimala river joins with Pamba at Muttar. Another branch of Pamba is joined by Achenkovil river at Parumala. Pamba river empties into Vembanad Lake through branches such as Pallathuruthi, Nedumudi and Muttar. It has a length of 117 Km and has a drainage area of 1976 Sq.Km. The annual run off of the drainage area is estimated at 6309 MCM. (Fig. 1.4)

1.9.3 Achenkovil River: enters the district at Venmony and passes through Cheriyanad, Puliyoor and Chengannur villages and enters Mavelikkara taluk at Chennithala. (Fig. 1.5) It passes through Pallipad village and joins the Pamba river at Veeypuram. It has a length of 128 Km and a catchment area of 1158 Sq.Km with an estimated run off of 2152 MCM.

1.9.4 Meenachil River: Meenachil river originates at Araikunnunmudi region of Kottayam District, at an elevation of 1097m with a catchment area of 1272 Sq.km. (Fig. 1.6) Main tributaries are Kadapuzha, Minadamar, Kalathukadavu, Trikovil, Kurusumalai and Punjar. Total length of the main river is only 78 km.
Average annual stream flow of the basin is 1059 MCM and has navigable length of about 41 Km. Average annual rainfall of the basin is 3000mm.

1.9.5 Muvattupuzha River: Muvattupuzha river originates at Thangamankanam region of Kottayam District, at an elevation of 1094m with a catchment area of 1554 Sq. km and it empties into Vembanad lake. (Fig. 1.7) The river traverses
through Kottayam and Ernakulam districts of Kerala State. Main tributaries are Kaliyar, Thodupuzha and Kothamangalam. Total length of the main river is 121km. Average annual stream flow of the basin is 3560 MCM and has navigable length of about 25 Km. Average annual rainfall of the basin is 3100mm.

1.9.6 Backwaters.

Vembanad Lake and Kayamkulam Lake are the important backwaters of the District. Vembanad Lake has a length of 84 Km with an average breadth of 3.1 Km, and covers an area of 204 Sq.Km. Every year the whole of the Vembanad lake area attract migratory birds. 4 rivers namely Pamba, Achankovil, Manimala and Muvattupuzha drains in to this lake (Fig. 1.8).

The largest mud regulator in India, the ‘Thannermukkom regulator’ intended to prevent saline intrusion into the lake is built in this district. Kayamkulam lake is a shallow one having an area of 59.57 Sq.Km with a length of 30.5 Km and an average breadth of 2.4 Km.

1.9.7 Canals

A number of canals are found in this district, the important ones being vadai canal, commercial canal and the link canal. The district has flat unbroken sea coast having 82 Km length, which is 13.9% of the total coastal line of the State. Just like other districts of Kerala, Alappuzha District too has ‘Mangrove’ vegetation along the coastal belt which plays an important role in the wetland ecosystem. Mangrove areas are generally marshy surrounded entirely or partially by saline water.

1.10 Climate

The entire geographic areas of the district is characterized by two monsoon periods’ namely South West monsoon (June to September) and North Eastern monsoon (October and November). The average annual rainfall in the district during 2006 was 2638mm.