CHAPTER III
STUDY AREA

3.0 Study Area

The study area, ie the Ambalappuzha taluk is one among the six taluks of Alappuzha district of Kerala. It lies between latitudes $9^\circ 19' 14''$ and $9^\circ 36' 04''$ N and $76^\circ 19' 44''$ and $76^\circ 24' 22''$ E longitude. The present study was undertaken to evaluate the geo environmental status and hydrological scenario of the taluk and to carry out special studies on fluoride contamination and to suggest measures to be taken to maintain and protect a healthy environment. The study area has many unique features. This coastal taluk is one among the most populated taluks of Kerala bounded on the West by the Arabian Sea and on the East by Kuttanad, a region situated below sea level. Sand and Clay formations, with the bedrock at an approximate depth of 600 m, constitute the general geologic setup. The Vembanad, which is the largest lake of Kerala is situated on the north eastern side of the taluk. Three major rivers viz. Pamba, Manimala and Achankovil drain into this lake on the north eastern side of the taluk. The study area is criss-crossed by number of canals; many of them are connected to the sea on the western side and yet another set to the Vembanad lake. The presence and proximity of these canals have a controlling effect on the quality of water. The inhabitants of the taluk depend mainly on groundwater sources of Warkallai formation for all purposes. Of the three major aquifers of Warkallai formation one is phreatic and the other two are of confined nature.

The taluk, being situated on the western coastal low land, is in the ‘discharge’ area of the groundwater from the eastern hilly tracts of the Western Ghats and the midlands. The major rivers draining in to the lake has considerable influence on the quality of groundwater. Another important factor contributing significantly to the quality of groundwater is the practice of widespread application of fertilizers and pesticides to the paddy and other agricultural fields. The major industry in the taluk is coir industry. This also has its unhealthy influences on the hydrological and environmental scenario due to the retting of coconut husks and dumping of waste materials of the coir industry. The wastage from fish industry and other chemical industries also has significant impact on the deterioration of water quality and the environment. The present investigation includes a systematic study and critical analysis of a wide range of collected data on various aspects including geology, hydrogeology, hydro geochemistry,
and pollution aspects. Type of agriculture, crop pattern, rainfall, etc also helps to reveal the environmental status and hydrological scenario of the taluk. The taluk comprises of thirteen villages and one municipality. (Fig. 3.1) (Census of India, 2001)

3.1 Population

Ambalappuzha taluk has the second largest population in the district with a rural – urban ratio of 1:2. The density among the different taluks of Alappuzha District ranges from 768 persons per Sq. Km. in Kuttanad taluk to 2465 persons per Sq.Km. in Ambalappuzha taluk. The highest urban density is in Alappuzha. Of the total number of households of 94615, 71.6% ie 67259 have access to drinking water supply. The urban – rural divide is 62% and 76.4% respectively. Only 84.2% have toilet facilities whereas 14.1% have drainage facilities. (Panchayat Level Statistics, 2006)

3.2 Geomorphology

The terrain of the study area falls under depositional surfaces of marine, fluvio marine and fluvial environment and is broadly referred to as coastal plains. (Fig. 3.2) In general, elevation of the area is less than 5 mts above mean sea level. Some of the areas like the Kuttanad region is below mean sea level. Typical coastal geomorphic features such as beaches, shore platforms, spits and bars, beach ridges, estuaries, mud flats, tidal flats etc. are present. Beach ridges are suggestive of marine regression. Absence of extensive tidal plain and intensive coastal erosion may be indicative of the neo tectonic activity, the area is subjected to. The beach between Purakkad and Thottappally in the south and Chettikad and Mararikulam in the north are subjected to erosion.
3.3 Geology

The major portion of Alappuzha District (Fig. 3.3) is occupied by coastal sediments of tertiary period, which is overlain by the Recent and Sub Recent sediments of Holocene age. The crystallines appear on the eastern and south-eastern part of the district. The geological map of Ambalappuzha taluk is shown in Fig. 3.4., where sand and silt occupy the top portion.

3.4 Lithostratigraphy of the Study Area

Different formations of the study area at Kattoor, Kalarcode, Neerkunnam and Thottappally are represented in the Fig.3.5.

The hydrogeological cross section between Cheppad in the southern part of Alappuzha district and Pattanakkad in the Northern part clearly describes the disposition of Recent sediments. The thickness of the formation gradually increases from...
North to South and reaches the maximum value at Kattoor, a place in the Ambalappuzha taluk of the study area. The Warkallai formation and Quilon formations also attains maximum thickness within the study area. (CGWB, 2003). The lithological data of certain tubewells are given in Table 3.1, which denotes the various lithostatigraphical units present in the study area.
The Vaikom formation, that yields good quality water, also has good thickness within the study area. The deepest part of the Tertiary basin, where the Alleppey formations is met with and have maximum thickness is found at Kalarcode, in Ambalappuzha Taluk. (Soman, 2002) Deep drilling up to a depth of 600 mts at Kalarcode within the study area shows that the base rock is still at higher depth.

3.5. Groundwater conditions in different formations

Of different formations, water from the Quilon formations is poor in quality due to its brackish nature. The tertiary formations of Kerala, occupying the Ambalappuzha taluk, provide the water bearing zones (aquifers) with a total thickness of sediments ranging from 90 m to more than 600 m.

The Quaternary sediments are bifurcated from the tertiaries by an unconformity of laterite and the end of the sedimentaries is marked by the crystallines. A large number of tube wells, constructed by various agencies are present in the study area.

3.5.1 Groundwater conditions in unconsolidated formations

Among the various lithostratigraphic units, the Recent unconsolidated formations along the coastal tracts and flood plain deposits of the interior areas of Ambalappuzha Taluk, are the major potential phreatic aquifer. The water table is generally shallow having a depth of 1.5 m only. The depth of filter point wells range between 6 to 15 m. Dug wells are used mainly for domestic purposes. Yield test conducted by Central Groundwater Board shows that the open well discharge is in the range of 11.76 to 12.90 m$^3$ per hour for a draw down ranging from 0.7 to 5.58 m. The filter point wells are usually fitted with pumps ranging from one to two Horsepower and can be pumped for four to five hours continuously.

Chemical analysis of water from dug wells and filter point wells shows that they are contaminated with high iron content at certain places but is generally potable. In general the water is suitable for irrigation and majority of people depend on this for irrigation.

3.5.2 Groundwater in Warkallai bed

The Warkallai bed are the top most and the most extensively developed aquifer of the study area. Here the granular thickness of the zone is 6 to 44 mts. Most of the tube wells of the study area, tap water from the Warkallai aquifer. The specific capacity is in the range of 98.01 to 168 litres per minute and transmissivity ranges between 221 and 712 m$^3$/day.
3.5.3 Ground water conditions in Quilon bed

The Quilon beds which overlies the Vaikom beds yield water of low quality or slightly brackish water compared to Warkallai beds. The thickness of this granular zone is less compared to Warkallai and Vaikom beds.

3.5.4 Groundwater conditions in Vaikom bed

Vaikom bed overlies Alappuzha bed and has thickness varying between 25 m to 238 m in the tertiary sequence. It consists of gravel, coarse sand, clay and seams of lignite and is the most potential aquifer of the Tertiaries. The water from the Vaikom aquifer is found to be more mineralized at some places. Some of the tubewells tapping the Vaikom bed shows artesian conditions. It is observed that the general groundwater flow in the aquifer is from south to north (CGWB, 1985) The total groundwater potential available in this aquifer is worked out to be 10 MCM (CGWB, 2003)

3.5.5 Groundwater conditions in Alleppey bed

Alleppey bed is the bottom most of the Tertiary formations. It is represented by highly carbonaceous clay with intercalations of sand. Drilling of a tube well at Kalarcode, of Ambalappuzha taluk up to a depth of more than 600m revealed that the basement rock is still at a greater depth. The groundwater from this formations is brackish in nature.

3.6 Soil types

Soils of the study area are classified as to sandy, loam, alluvial and laterite (Fig. 3.6). Sandy soils vary in texture from sandy loam to pure sand and are highly porous having very little water retention capacity, and are highly acidic. Peaty or Kari soils are found in a small belt on the eastern region of Cherthala, Ambalappuzha taluk and western region of Kuttanad taluk, and is highly acidic, having high content of organic matters. It contains nitrogen and potash and is deficient in phosphate and lime. Alluvial soils occurs in Kuttanad taluk, North Eastern portion of the Karthikappally taluk, Western portion of

Fig. 3.6.. Soil Map of study area
Chengannur taluk and Western portion of Mavelikkara taluk, and is subject to the annual inundation with saline water. The lateritic soil formed by the weathering of acidic rocks under alternate wet and dry conditions is found in Chengannur and Mavelikkara taluks. On the basis of morphological and physico – chemical properties, the soils of the taluk have been classified into: (1) Coastal alluvium (Entisols) 2. Riverine Alluvium (Inceptisols) 3. Brown hypidimorphic soils (Alfisols) 4. Lateritic soil (Oxisols).

3.6.1 Coastal alluvium (Entisols)

These soils are seen along the western parts of the district all along the coast and have been developed from recent marine and estuarine deposits. Its texture is dominated by sand fraction and is extensively drained with very high permeability. These soils have low content of organic matter and hence are of low fertility level. (Pratt et al. 1972)

3.6.2 Riverine alluvium (Inceptisols)

These soils occur in the central Pediplains and eastern region of the study area along the banks of Pamba River and its tributaries. They show wide variation in their physico-chemical properties depending on the nature and characteristics of alluvium that is deposited. They are typical of the catchment area through which the river flows and are very deep soils with surface textures ranging from sandy loam to clayey loam. They are moderately supplied with organic matter like Nitrogen and Potassium. (Jackson, 1958)

3.6.3 Brown hypidimorphic soil (Alfisols)

These are mostly confined in the western low-lying areas of the district along the coast. They have been formed as a result of transportation and sedimentation of material from the adjoining hill slopes and also through deposition by rivers. They exhibit wide variation in their physical and chemical properties. They are poor in drainage condition (Fig. 3.7) and are moderately supplied with organic matters like Nitrogen,
Potassium, etc. but deficient in lime and phosphate. (Norrish, 1983).

3.7 Rainfall

Ambalappuzha taluk has a tropical climate. The period from March to the end of May is the summer season, which is followed by the south-west monsoon till the end of September. North-east monsoon usually starts during October and continues till December. There are two rain gauge stations in the Taluk which are located at Alappuzha and Ambalappuzha. In addition to this, data collected from the nearby rain gauge stations were also used. The average annual rainfall for the year 2006 was 3034 mm whereas the normal was 3025 mm.