CHAPTER VII

RESULTS AND DISCUSSION

The electrical resistivity survey was carried out near Abishekappatti (E77° 39' 18" and N 8° 45' 58"), ten Kilometers NW of Tirunelveli Town and Thuthukudi (78° 7' 30" E and 8° 48' 45" N), a coastal town of Southern Tamilnadu, India to understand the subsurface structure and groundwater aquifer characteristic studies in this region. While geological studies can provide information on the surface manifestation of the formation, only geoelectrical investigations can provide significant depth information, especially regarding the nature and extension of geological contacts and groundwater aquifer of the study area.

No specific or detailed geoelectrical survey was carried out at Abisekapatti area for the subsurface structural studies and to locate the potential aquifer resources earlier. In view of this, the geoelectrical studies have been attempted in the study area to understand the geological condition by electrical method. Here, by electrical resistivity, Wenner profile method was applied at an interval of 25m and 50m in the study area. With this field data, apparent resistivity contour map was prepared using surfer software. This map reflected the lateral resistivity variation roughly in the study area. The prepared contour map reveals the contact between the two formations viz gneiss and calcareous limestone was traced based on the trend of resistivity of contours. Here, the limestone formation exhibited a uniform resistivity of 20 ohm-m to 90 ohm-m whereas the gneissic rocks have the apparent resistivity of 120 ohm-m to 220 ohm-m. The resistivity variation showed a pattern of high to low from south - west to north - east observed in the study area. High resistivity may be due to gneissic formations and low resistivity may be due to limestone formation overlain by black cotton soil. The spatial contact between gneiss and limestone
was identified along the profiles at the station interval between 25m – 30m in the study area.

In addition to this, analysis of apparent resistivity data acquired from geoelectrical techniques was used for the assessment of subsurface condition of the study area by Geographic Information System (GIS). The GIS based analysis of spatiotemporal behavior of the subsurface structure in the study area was done using the spatial analytic module of ArcGIS 9.2. The interpolation technique used in the analysis is Inverse Distance Weighted (IDW) method. This concept is used to demarcate the subsurface apparent resistivity variation of the study area.

The interpreted results from Vertical Electrical Soundings (VES) were used to delineate the ground water potential aquifers. The interpretation of the VES data indicates the presence of three subsurface layers in the processed study area. The top layer is a thin soil cover and the second layer is weathered or semi-weathered hard rock and the third layer is high resistive bedrock. A fracture zone is interpreted at a depth of about 10m from the VES data and confirmed with available geological and hydrological information including bore well lithology. One-dimensional and two dimensional inversion of the VES data was carried out using an interactive inversion code IP12Win. The depth variations are further highlighted in the geoelectrical section obtained from individual one-dimensional inversion of the sounding data carried out in the study area. The sections are shown to the maximum depth of 100m. The computed pseudo section shows the apparent resistivity variation with respect to the half current electrode separation (AB/2) and vital information on its lateral extent, though not to the actual scale.
Some of the VES data at the Abisekapatti area discussed in this thesis are the VES data which can be explained by three layer model in this, the top layer having resistivity of 36.1 ohm-m and thickness of 2.55 m, this is followed by the layers having resistivity 100 ohm-m and thickness of 10.7 m followed by basement. In VES 12 data, the first layer having the resistivity of 15.7 ohm-m and a thickness of 2.27 m is underlain by second layer having a resistivity of 55.8 ohm-m and thickness of 10.6 m. Beyond this layer is the basement having the resistivity of 396 ohm-m. Similarly the VES 23 data can be explained by four layer model and the top layer having resistivity of 1.81 ohm-m and thickness of 0.885 m and this is followed by the layers having resistivity 4.01 ohm-m and 1.18 m and also having the resistivity of 26.8 ohm-m thickness of 9.53 followed by basement. In VES 24 data, the first layer having the resistivity of 2.76 ohm-m and a thickness of 0.762 m, which underlain by second layer having a resistivity of 7.07 ohm-m and thickness of 1.19 m. Beyond this layer is the third layer having the resistivity of 47.6 ohm-m and thickness of 8.8 m followed by high resistance basement. The inverted resistivity cross section depicts high resistivity rocks at a deeper depth. In groundwater prospecting, large scale linear features/faults and fissures are assumed to have great significance as they enhance the occurrence and the movement of ground water in abundant quantity to wells in such structural zones. In limestone areas, ground water occurs seemingly in pore space called channels formed by the circulation of ground water at fracture and joint planes. In the study area, the spatial contact between gneiss and limestone along the profiles has more potential source.

The interpretation of sounding data reveals the minor fracture at a depth of approximately 10 m. Then the continuous rise in the sounding curve indicates a massive hard rock. Overall, the water table in the study area varies from 5 m to 15 m depth. The
correlation of the geophysical data with known geology indicates the favorable zone for the exploration and exploitation of ground water resource.

In this thesis, geoelectrical and geochemical studies were carried out at Thuthukudi, coastal Tamilnadu for aquifer characteristic studies. Here, the geoelectrical method consisting of Vertical Electrical Soundings (VES) was carried out and analyzed by qualitative and quantitative methods (which showed) with the two layer and three layer cases which reveals that, the third layer is the bedrock or weathered bedrock having high resistivity of more than 500 ohm-m. The second layer is having low resistivity in the range of 20 ohm-m and the depth to the basement is around 20m. The significant reduction in the resistivity value even less than 10 ohm-m is also observed at a depth in some locations in inland areas also. This may be due to the discharge of effluents which may be contaminating the ground water at these locations. The creation of 2D model with apparent resistivity data represents the subsurface electrical properties utilized from field study. Here, 2D electrical resistivity pseudocross section shows vertical information about the ground water aquifer pollution by discharge of industrial effluents and also by salt water intrusion. Further, geochemical analysis of the ground water samples collected from wells or bore wells in the study area as near as possible the geoelectrical data points was done.

A correlation was made between some of the chemical analysis of water samples like Electrical Conductivity (EC) having maximum and minimum value of (8400 µS/cm - 1110 µS/cm), Total Dissolved Solid (TDS) having maximum and minimum value of (5376 mg/l - 691.2 mg/l), Chloride (Cl) with maximum and minimum of (791mg/l - 25mg/l). Further, the values are correlated with World Health Organization (WHO) standards. The GIS based analysis of spatiotemporal behavior of the chemical analysis is also incorporated. The correlation study shows that the aquifer quality at many areas has
been contaminated either by salt water intrusion or by discharge of industrial effluent. As a result the integration of geoelectrical and geochemical method has distinguished different types of hydro geologic behavior of the groundwater. It also shows a high saline coastal aquifer, water contaminated with effluents and freshwater areas.

The inversion of electrical data is carried out by conventional method followed by Artificial Neural Network (ANN). The study of 1D resistivity inversion procedure using the ANN system was carried out in addition to the conventional method because the procedure works well for the observed data. Best training performance can be achieved after the iterations had successfully completed the goal, using the number of epochs for the synthetic data. This inversion thus represents the subsurface layer model viz., thickness and resistivity. The results for interpreting the near surface features by means of ANN technique is satisfactory and are more efficient than the conventional methods and the error percentage before and after training is less than 6% for most of the VES data and less than 11% for some of the VES data.

It is found that the groundwater aquifer is still in a safe stage at Abishekpati in Tirunelveli district Tamilnadu, India. In future further development of additional irrigation potential has to be carried out. Wasteland development programs and micro irrigation system have to be implemented for increasing the ground water aquifer in the study area. Furthermore, proper care has to be taken in the coastal area towards the quality of aquifer characteristics and all industries have to undertake waste water treatment system to prevent further degradation of coastal aquifer.