Access to drinking water and food supply are the utmost priorities of mankind. In India, ever increasing population and economic reforms have led to rapid growth in agriculture and industrial sectors. The pace at which these two sectors are growing has outpaced the measures to control rampant pollution arising out of it. Globally and nationally, ground water pollution from agriculture and industries, is a crisis and currently efforts are directed towards sustainable agriculture and industrialization. Perpetuation of pollution from agriculture and industries coupled with mismanagement of quality and quantity of fresh water will essentially lead to miseries of future generations in terms of famine and water war.

Of all the problems faced in the usage of ground water, pollution of ground water is the most serious one. Because, remedial measures are prohibitively costly, environmental damage is severe and long lasting. Prevention of contamination is the key for effective ground water management than measures for ground water remediation. It is in this context, the present study was proposed to develop methods for assessing specific aquifer vulnerability using Geographic Information System (GIS) and Remote Sensing (RS) as tools, to aid in a better representation of the spatial variability of the parameters used for aquifer vulnerability assessment and to improve upon visualisation of the results in the form of aquifer vulnerability maps.

The study area is a Sub-Watershed in the Ambur minor basin of Palar river comprising Ambur and Vaniyambadi municipalities, situated in the Vellore district of Tamil Nadu, India. The study area is characterized by
intensive agricultural activity in the alluvial plains of Palar river and conglomeration of tannery industries thriving on the ground water resources of Palar aquifer. The alarming levels of pollution from these two activities warrant an evaluation of the quality of ground water resources in the study area.

The primary objective of this study was to develop a methodology for regional scale aquifer vulnerability assessment using DRASTIC model and modifying it to improve its utility in vulnerability assessment. The incorporated modifications to DRASTIC model were intended to reduce the subjectivity in the model application and to aid in better representation of local hydrogeologic settings. Stack unit mapping for sub-characterization of vadose zone was proposed which facilitates assignment of ratings to the impact vadose zone parameter without subjectivity. The stacked surfaces of vadose zone bottom and weathered zone top were used to derive the thickness of the material through which the contaminant has to travel. The travel distance and travel time were reflected using thickness, soil texture and lineament zone density. The second modification was in the form of modifying the ranges of ratings of DRASTIC model parameters using Analytic Hierarchy Process for refined representation of local hydrogeologic settings. Graphical User Interface using Visual Basic software was developed and seamlessly integrated with ArcView GIS software for facilitating modification of ranges and ratings of model parameters.

Incorporating the above two modifications, modified DRASTIC model and AHP-DRASTIC model were developed. Specific aquifer vulnerability assessment was carried out based on the hydrogeologic settings of the study area using DRASTIC model and GIS with regard to the contaminants nitrate (non-point source pollution) and chromium (point source pollution from tanneries). Mapping of the results of the modified DRASTIC and
AHP-DRASTIC models have indicated the spatial patterns of vulnerability categories (i.e. low, moderate and high) in the study area very evidently.

Major portion of the alluvial aquifer is found to be highly vulnerable to contamination with regard to both nitrate and chromium. These high vulnerability areas are identified as zones wherein strict land use regulation policies and ground water protection strategies have to be focussed upon. Results from this study have shown that the sub-surface characterization of vadose zone enables spatial characterization of impact of vadose zone parameter on vulnerability without any subjectivity. Water quality data from field have been used to validate the results of modified DRASTIC and AHP-DRASTIC models. The AHP-DRASTIC model has higher correlation coefficient with both nitrate and chromium concentrations. However, the scatter plot diagrams indicate that the linear relationship between the variables is strong in the case of nitrate than chromium. In the case of chromium, although the correlation is significant, the linear trend is not clearly visible as the points are scattered. The results with regard to both contingency table and correlation analysis have shown that DRASTIC model vulnerability assessment is better in case of non-point source contamination than for point source contamination.

In the hands of a resource manager, these vulnerability maps of social and economic relevance provide a valuable guidance for implementation of land use regulation policies and in planning ground water protection strategies. This enables the resource managers, planners and policy regulators alike, to make environmentally sound decisions regarding enforcement of land use regulation policies and protection of ground water quality.