Problem of groundwater quality can be solved either by simulation or by optimisation. Both the techniques have limitations. The optimisation techniques necessitate more assumptions or suffer from dimensionality problem. The simulation models need a very large number of trials and thus consume more time. So there have been attempts to combine simulation - optimisation methodology to solve the problem in an efficient manner. Hence in this study the simulation model is linked with optimisation model. The developed methodology is demonstrated through a case study with the Minjur-Mouthambedu Aquifer System which is intruded by seawater and requires an efficient way to clean up the aquifer.

MMAS situated north of the city of Chennai in Tamil Nadu state, India, is one such system with an upper water table aquifer having lower hydraulic conductivity, a potential lower artesian aquifer and an aquitard separating the aquifers. A study of groundwater hydrographs and quality reveal that the aquifer has been overstressed and contaminated by seawater. As the MMAS is hydraulically connected to sea and overstressed, it has been subjected to seawater intrusion since 1969. The objective of this study is to develop a planning model for the optimal control on pumping and optimal recharge to arrest and to reclaim the contaminated confined aquifer.
This study is focussed on the development of a conceptual model, application of the solute transport to the MMAS and development of combined simulation - optimisation model. After conceptualising the MMAS with certain assumptions and appropriate boundary conditions, the solute transport model involves two parts. The predicted head distribution computed from the flow model is utilised in the solute transport model to estimate the chloride concentration distribution. There are three steps involved when a theoretical model is applied to field problem. They are:

i. Establishment of initial conditions and model calibration

ii. Testing the calibration

iii. Future projection

Establishment of initial conditions are to develop an initial distribution of piezometric head or concentration prior to simulation period. Calibration is the process by which parameters of the model are adjusted to produce a good match between the simulated and observed records. The calibration period is 1976 - 82. To know the accuracy of the calibration, it is tested for the known period (1983-96). If the simulated heads and concentrations are closely matched with observed heads and concentrations during the testing period, then the model can be used for application. Otherwise it will be once again calibrated and tested.

In the optimisation formulation a simulation model is linked explicitly to the management model as an independent module. Once a
simulation model for a particular system has been developed, implementation of the management model is relatively easier. The proposed management model is formulated as a multivariable, constrained, nonlinear optimisation problem and penalty is applied to convert the constrained optimisation problem into an unconstrained problem. To simulate the physical and chemical processes occurring within a confined aquifer system, MODFLOW and MT3D are used separately. The pattern search algorithm proposed by Hooke and Jeeves is used to solve the unconstrained optimisation problem.

The Hooke and Jeeves model acts as a driver model wherein it calls a simulation model by passing the management decision variables and gets back the corresponding objective function value. The nonlinear programming model then adjust the management decision variable. This process repeats till there is no further improvement in the objective function by altering the decision variables. In this study two optimisation strategies are formulated and analysed in detail. The two strategies are reducing the pumping and recharging the aquifer. After finding the optimal point, the detailed results are obtained from the simulation model.