CHAPTER 1

INTRODUCTION

1.1 GENERAL

Water sources have always been a precious commodity for human life. The available source of surface water is limited; moreover, it is under tremendous pressure due to pollution in many parts of the world. In many parts of India, therefore, groundwater is the major source for domestic, agricultural and industrial purposes. Groundwater is under considerable stress to fulfill all these needs, which would ultimately lead to deterioration of groundwater quality. Natural processes such as flooding, earthquakes, tsunami, sea water intrusion and rock-water interaction processes will all result in deterioration of groundwater quality. One such natural catastrophic event, in the form of a massive tsunami occurred on December 26, 2004, triggered by a 9.2 magnitude earthquake off the west coast of Sumatra, killed more than 2,50,000 people and displaced thousands in countries around the Indian Ocean. Tsunami waves entered inland up to 0.2-1 km, causing extensive damage to life and property to all coastal districts along the east coast of Tamil Nadu, India. There were major impacts of the tsunami on infrastructure and human life; it also resulted in deterioration of groundwater quality in the coastal regions. Study of processes of salinization of groundwater by tsunami and the time that it might take for the natural recharge processes to flush this salinity is of great importance.

Also, a number of groundwater modeling studies have been carried out around the world for effective groundwater management and solute transport model (Prickett et al 1981; Linda and Bredehoeft 1987; Storm and Mallory 1995; Gomboso et al 1996; Koskinen et al 1996; Holzbecher 1998; Storm 1998; Gnanasundar and Elango 2000; Zhou et al 2000; Faidi et al 2002; Senthil Kumar and Elango 2002; and Eiswirth et al 2004). None of these studies, however, attempted to study the salinization of groundwater by tsunami.

Thus, there are no systematic, long-term studies on the salinization of the groundwater system by the tsunami. Such a study is not only very essential to understand the processes of salinization, and the time that it will take for the natural recharge to clean up the system, but will also assist in taking up suitable remedial measures to flush out the tsunami-induced groundwater, salinity as the rural community living in coastal regions depends heavily on the groundwater reserve. Hence, the present work was carried out to study the impact of tsunami on groundwater by systematic monitoring of
groundwater quality and solute transport modeling in the Kalpakkam region, Tamil Nadu, India (Figure 1.1).

1.2 NEED FOR THE STUDY

Kalpakkam is located 75 km south of Chennai in Tamil Nadu, India. The villages namely Sadras, Meyyur and Kalpakkam Township are located near this area. Groundwater from this coastal aquifer is used for drinking as well as for agricultural purposes. Agricultural activity is practised in some parts of the villages of Sadras and Meyyur. The tsunami of December 26, 2004, inundated coastal parts of this area deteriorating the groundwater

Figure 1.1 Location of the study area
quality. Hence, it became imperative to study the quality of groundwater and investigate the time that it might take to flush out the tsunami-induced salinity in this coastal aquifer. The purpose of this research was to know about the deterioration of groundwater quality due to tsunami, process for improvement of groundwater quality in the affected region, and to develop a mass transport model of chloride ions that has been increased due to the tsunami in the study area.

No such studies have been carried out in this area. So, it was necessary to study the deterioration of quality on groundwater in detail for this area. The present study has been carried out by investigating the hydrogeochemistry of groundwater, including major and minor ions, nutrients, trace elements and stable isotopes studies. Hydrogeochemical processes taking place in this aquifer after the possible recharge of tsunami water can enlighten about the post-tsunami deterioration of groundwater quality. This would help to evaluate the different factors that increase groundwater pollution by natural processes like tsunami in the coastal aquifers.

1.3 OBJECTIVES

The present study in the Kalpakkam region, southern India was conducted with the following objectives in mind:

1. To determine the impact of tsunami on major and minor ions, trace elements, nutrients and isotopic concentrations in the coastal aquifer.
2. To understand the processes of improvement in the quality of tsunami-affected groundwater by solute transport modeling.
1.4 STRUCTURE OF THE THESIS

The thesis is comprised of nine chapters, including this one as follows:

Review of the work carried out in hydrochemistry and hydrogeochemistry, groundwater quality, minor ions, stable isotopes and solute transport modeling are presented in Chapter 2. Chapter 3 explains the methodology and techniques adopted in this study, while Chapter 4 gives the detailed description of the study area. The hydrogeology and hydrochemistry of the study area are described in Chapter 5. Hydrogeochemical changes and salinization process due to tsunami are presented in Chapter 6. Inferences based on minor ions and environmental isotopes are presented in Chapter 7. Groundwater flow and solute transport modeling studies are discussed in Chapter 8. Conclusions of this study are presented in Chapter 9.