GIS Based DRASTIC Model for Assessment of Groundwater Vulnerability in Puri City, India

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Groundwater pollution is mainly caused due to the domestic and industrial activities which pollute the shallow aquifers. Puri city is such an important and pilgrim place where groundwater is getting contaminated by various anthropogenic activities. The vulnerability assessment of groundwater is mainly carried out to define the areas critical for the groundwater contamination. For this, GIS based DRASTIC model was used to assess the groundwater vulnerability considering groundwater level, hydro-geological parameters, land use pattern and topographic condition. It was found that most of the city area is highly vulnerable to groundwater contamination due to sandy aquifer property. The output of DRASTIC model helps in suggesting measures for protecting the groundwater from further contamination and management.

Key words: DRASTIC, aquifer, GIS, vulnerability, groundwater quality

Introduction

The quality and quantity of groundwater are both equally important because groundwater is the only source of drinking water in most of the urban areas of India1. Due to high growth of population, unplanned growth of cities, mixed land-use patterns, lack of proper sewage system and poor disposal of wastewater both from domestic and industrial activities are deteriorating the groundwater quality in several Indian cities in recent years2. The assumption in the assessment of groundwater vulnerability is that the geological environment ensures a sufficient degree of protection against the anthropogenic impact. Almost 70% of the surface water resources and most of the groundwater reserves are already contaminated by biological, organic and inorganic pollutants3. The vulnerability of groundwater to pollution can be articulated as the sensitivity of its quality to anthropogenic activities for assessing their effects upon groundwater4.

The accuracy of aquifer vulnerability assessment depends on the availability of complete and reliable hydrodynamic and hydro-chemical information, data on the location of potential pollution sources and the type and physico-chemical properties of pollutants5-4. A number of models are available for assessing the aquifer vulnerability to contamination. Among these models, the most comprehensive and frequently used model in assessing groundwater vulnerability is the DRASTIC model7. Further, Geographical Information System (GIS) technique has provided an efficient tool for assessing and analyzing the vulnerability to groundwater pollution8. Therefore, the aim of the present study was to develop a GIS based DRASTIC model for the assessment of aquifer vulnerability to groundwater contamination in Puri city.

Study area

Puri city is situated on the shoreline of Bay of Bengal and lies between 19° 47’2 and 19° 50’2 N latitudes and 85° 48’2 and 85° 52’2 E longitudes (Fig 1). The city area is around 16.84km2. The climate of Puri is warm-humid with the maximum and minimum temperature 37.5°C and 27°C in the summer while 28.2°C and 15.2°C in winter, respectively9. River water is not sufficient and suitable for water supply due to non-perennial nature and salinity due to backwater of sea. Therefore, the city receives water supply of about 20.44 million liters per day (mld) from groundwater resources namely Chakrartirtha water field (CTWF) on the eastern side and Balia Panda water field (BWF) on the western side of the city10.

The major hydrogeological units occurring in this area are unconsolidated and porous formations. The sand gravel layers are the main repositories of groundwater in the area. The groundwater at shallow depths occurs under phreatic conditions, and thickness of individual aquifers varies from 6 to 79m12. There is a high water table fluctuation in the Puri city. The depth of water table is very less in the post-monsoon season which indicates that those areas are very high vulnerable to contamination13. The groundwater quality of Puri city was deteriorated due to the discharge of effluent from septic tanks; soak pits, pit latrines, discharges of domestic wastewater in leaky drains, and leachate from solid waste dumpsite14. The groundwater is getting contaminated in city area as compared to Chakratirtha and Balia Panda water fields.

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