MSc Degree in Environmental Science

ASSESSING THE EXTENT OF SALT WATER INTRUSION AND VULNERABILITY OF FRESHWATER AQUIFERS AT KOGGALA LAGOON AREA

A dissertation submitted

by

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Abstract

Groundwater has been considered as an important source of water supply due to its low susceptibility to pollution compared to the surface water. Groundwater vulnerability assessment has been recognized for its ability to delineate areas which are more easily contaminated than others as a result of anthropogenic and natural activities. The main objectives of the study were to investigate salt affected area at Koggala lagoon and assess the potential level of vulnerability of Koggala groundwater due to the saline and brackish water intrusion. Electrical Conductivity (EC) values (at three different depths as surface, middle and bottom) of selected fifty seven dug wells were measured during the study period from March 2017 to August 2017. Selected dug wells were located within 650m radius from the lagoon bank. Further, Electrical conductivity values of lagoon water samples were also measured. Moreover, Soil samples collected form the lagoon bank were analyzed for soil hydraulic conductivity and soil media. This study involved using a GIS model and the modified DRASTIC method for determining the vulnerability of the groundwater in the Koggala lagoon basin. The aquifer vulnerability map was prepared using depth to water, net recharge, aquifer media, soil media, topography, vadose zone impact, hydraulic conductivity and electrical conductivity of groundwater. The EC of the water sample is an indicator of their salinity. Lagoon salinity level and groundwater salinity level variation were mainly influenced on rainfall pattern during study period from March 2017 to August 2017. Further, lagoon salinity level is increasing due to low rainfall and high temperature with wind velocity. Moreover, during the entire period of sampling average EC levels of whole of the study area except part of upper, inland area of lagoon basin were greater than the 750 µS/cm which is the desirable level of EC according to the Sri Lankan drinking water quality standards of SLS 614 (1983). Thus, it is apparent that ground water in the area could not be recommended for domestic consumptions at least during the dry season. Changing climate resulting less rainfall, high temperature, high wind velocity and extreme evaporation rates will aggravate the problem. Nevertheless some of other dug wells located seaside were exceed the maximum permissible level of EC of 3500 µS/cm in relatively dry months, March, April and August. The study area was divided into three zones according to groundwater vulnerability assessment results: (low risk index <100); moderate (risk index 100–140) and high (risk index >140) groundwater vulnerability risk. Further, when consider the entire study area, average DRASTIC Index (DI) values ranged between 119 ± 21 and 138 ± 19 during the sampling period. Yet, maximum DI value was 159 and minimum value was 84. Furthermore, whole study area's average Modified DRASTIC Index (MDI) values ranged between 125.5 ± 23.2 and 144.6 ± 21.1 meanwhile maximum MDI value was 171 and minimum value was 87. However DRASTIC and modified DRASTIC ground water vulnerability maps favorably exhibited that the lower part of the Koggala lagoon basin is exposed to higher vulnerability while the upper, right bank left bank areas are exposed to low and very low vulnerability. Finally, in this present study there was no significant difference between DI vulnerability levels of sub sites and MDI vulnerability levels of sub sites as per the vulnerability maps.

Keywords: Ground water, Vulnerability, Electrical Conductivity, DRASTIC, Koggala lagoon