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ORIGINAL PAPER

Vulnerability mapping of groundwater aquifer using SINTACS in Wadi Al-Waleh Catchment, Jordan

Atallah M. Al-Shatnawi[1] · Mohammad Said El-Bashir[2] · Refaat M. Bani Khalaf[3] · Nabeel M. Gazzaz[4]

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Abstract This paper aims at evaluating the level of groundwater vulnerability to pollution in Wadi Al-Waleh wells and South Amman area based on SINTACS model. The Wadi Al-Waleh Catchment (WWC) is considered to be one of the most important sub-basins in the middle part of Jordan. This study creates a map of groundwater vulnerability that shows areas with potential pollution. Areas are then classified into units with different levels of vulnerability based on anthropogenic and hydrogeological factors. The parameters of the SINTACS model are rated and evaluated by weight numerical indices. The vulnerability parameter is set upon fixed percentage interval of the sub-basin's area. SINTACS index values have been categorized into four groups of pollution: very low (green), low (yellow), medium (orange), and medium to high (red). The results reveal that the units with very low levels of vulnerability to pollution cover an area of 0.17 km^2. In addition, units with low, medium, and medium to high levels of vulnerability to pollution cover areas of 44.13, 1102.37, and 654.97 km^2, respectively. The vulnerability maps show that most of the sub-surface area of WWC is characterized by medium to high levels of vulnerability to pollution, while units with very low and low vulnerability to pollution cover small areas of the western part of WWC. As well, the vulnerability maps show that there is moderate–high risk of pollution in the middle to eastern parts of WWC sub-basin. The risk of pollution in WWC mainly stems from intensive agricultural activities in the area.

Keywords Aquifer vulnerability · Pollution · SINTACS model · Imaging map · Wadi Al-Waleh Catchment · Wadi Mujib

✉ Atallah M. Al-Shatnawi
atallah@aabu.edu.jo

Mohammad Said El-Bashir
mohdelb@aabu.edu.jo

Refaat M. Bani Khalaf
refaat_waj@hotmail.com

Nabeel M. Gazzaz
NabeelMGazzaz@yahoo.com

[1] Department of Information Systems, Al al-Bayt University, Mafraq, Jordan

[2] Department of Computer Science, Al al-Bayt University, Mafraq, Jordan

[3] Water Authority of Jordan, Amman, Jordan

[4] Faculty of Environmental Studies, Universiti Putra Malaysia, Selangor, Malaysia

Introduction

Water shortage is a severe problem in Jordan and is a serious challenge for the incoming generations. Jordan is a country that suffers from severe droughts, contains few available water resources, and experiences increasing demands on water every year with the growth in population. Jordan therefore relies mainly on groundwater resources to meet these demands. These resources are under the threat of pollution due to human activities, non-sound management of aquifers, the excessive use of pesticides and fertilizers, and the discharge of chemical substances and waste into water (Al-Rawabdeh et al. 2013; Al-Shatnawi et al. 2014).

Wadi Al-Waleh and Wadi Heedan are considered important valleys in the center of Jordan as these two valleys are located in the course of the valley which is crossed by the Waleh Dam. Both valleys are important sources of water for Madaba and its villages for domestic purposes. However, the basin is sensitive to pollution, and a number of residential, service, industrial, and commercial activities are practiced therein, which

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