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Vulnerability assessment of an aquifer in an arid environment and comparison of the applied methods: case of the mio-plio-quaternary aquifer

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Abstract

Protecting the quality of water resources has become a priority in Algeria and in several countries around the world, due to droughts and proliferation of pollution sources, such as domestic and industrial wastewater discharges, raw discharges, chemical fertilizers, etc. The valley of Oued Righ, which is one of the oldest cultivated areas and one of the best known of the Algerian northern Sahara, has experienced significant population growth and appreciable agricultural development. The water needs in this region are provided from groundwater resources, contained in the aquifers of the Terminal Complex and Intercalary Continental, and topped by the Quaternary aquifer. The present study focuses on the aquifer in the Mio-Plio-Quaternary of Oued Righ Valley, in order to assess and map its vulnerability to pollution, by applying the DRASTIC and GOD methods. The comparative study, based on Kendall test, showed that the two methods present moderate agreement ($W = 0.703$). The statistical analysis of different vulnerability classes revealed that vulnerability assessment, using the DRASTIC method, may be represented by four classes: "Very low", "Low", "Medium" and "High", with a dominance of class "Medium" (74.30%). The GOD method resulted in vulnerability that sits between two classes, 'Low' and 'Medium', with a noted domination of class "Low" (70%). Comparison of the two vulnerability maps obtained from the DRASTIC and GOD methods shows that the DRASTIC method better represents the distribution of degrees of vulnerability to pollution in the aquifer of the Mio-Plio- Quaternary.

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1. Introduction

Problems related to groundwater pollution are currently a source of serious worry that requires universal vigilance. This pollution, which is generated by human activities can, if it reaches critical levels, present a serious danger to public health and environment as well. To protect these water resources, it is necessary to provide effective protection means, as the decontamination operations are difficult to carry out and are also quite costly. This protection may be ensured by delimitating the areas that are considered to be vulnerable or are exposed to high levels of pollution.

The valley of Oued Righ is one of the oldest cultivated areas; it is the best known region in the Algerian northern Sahara. This valley consists of about fifty oases which produce dates of excellent quality [13]. The water needs for that region are provided from fossil groundwater resources [3], although other authors say that these water resources are poorly refilled [8].

These waters are contained in the aquifers of the Intercalary Continental (IT) and Terminal Complex (TC), and are topped by groundwater. Unfortunately, these water resources are increasingly exposed to overexploitation, mismanagement and pollution.

In order to preserve the quality of groundwater of the Mio-Plio-Quaternary, in Oued Righ Valley, the areas that are vulnerable to pollution in the region were mapped by applying the DRASTIC and GOD methods in order to determine the method that best assesses this vulnerability.

2. Presentation of the study area

The region of Oued Righ is also known as the Lower Sahara due to its low altitude (-30 m in Chott Merouane), especially in the region of chotts, in the northern part [6].

The valley of Oued Righ starts from El Goug in the south and extends over a distance of 150 km to the north, to the village of Oum Thiour, located at a distance of 100 km from the Wilaya (or province) of Biskra [5].

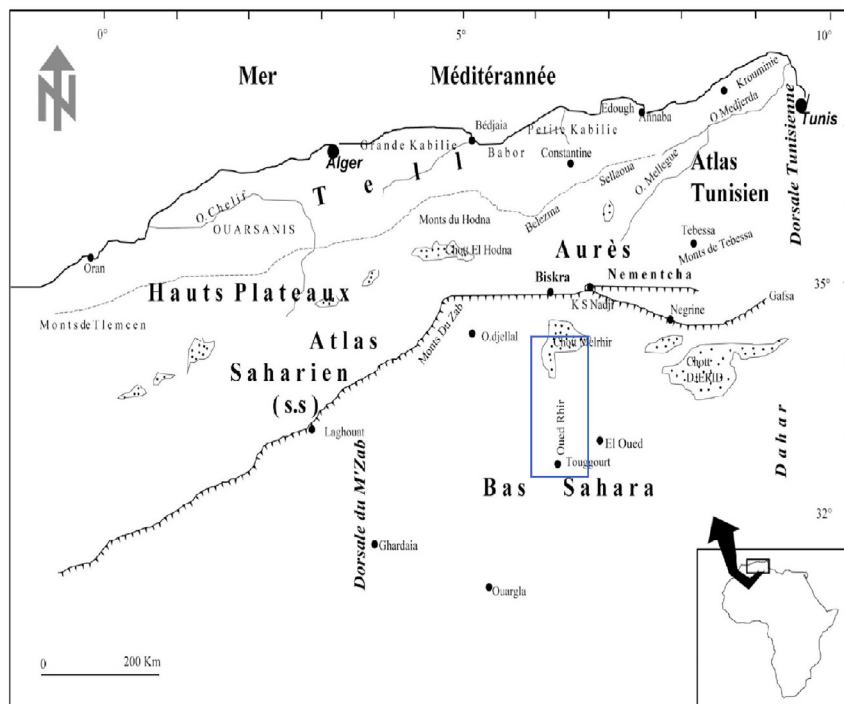


Fig.1. Geographical location of Oued Righ Valley.

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