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Recharge characterization of a Plio-Quaternary aquifer in Central Haouz by geoelectrical imagining survey and GIS (Marrakesh – Morocco)

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The central Haouz in the Marrakech plain is not spared by the phenomenon of water scarcity. Indeed, its climate is semi-arid and its groundwater and surface water resources are overexploited as a result of accelerated population growth and the implications of economic development. Especially since the successive dry seasons in the region since the early 1980s have led to excessive groundwater mobilization as two-thirds of the local population operate mainly in the agricultural sector.
Facing this problem, a good knowledge of water potentials should be conducted in order to require the development of an appropriate exploitation plan for this region. This knowledge will only be possible with a reliable characterization of the hydrogeology of this area and its potential for groundwater resources.
The Haouz Plio-Quaternary aquifer has been the subject of several studies, but its characterization has so far been traditionally carried out on the basis of geological, piezometric, geochemical and test pumping studies. These study techniques have certain limitations. However, they can be reduced by the use of complementary methods such as certain geophysical methods.
Our study is a step in this direction to show the importance of the contribution of GIS and Electrical Resistivity Tomography. The first method was for the determination of the runoff coefficient to determine the recharge areas that are designated by areas of low runoff coefficient. These areas were the subject of geophysical surveys. The second method is Electrical Resistivity Tomography, using for the 2D imaging technique of the subsoil to identify its geological heterogeneities. The use of a multi-electrode device has made it possible to acquire a large number of measurements corresponding to the different combinations of four electrodes, which makes it more appropriate in this complex geological region. Five Electrical Resistivity Tomography surveys were conducted on the Wadi Ourika, corresponding to a recharge area according to the GIS results, in order to show the effect of the recharge of the groundwater by the Wadi. The location of the geophysical surveys was supported by the existence of a dike dedicated to artificial groundwater recharge.
According to the results of the pseudosections of apparent resistivity, two underground layers have been identified. A superficial resistant ground of variable thickness of about 15 meters with a resistivity ranging from 200 Ω.m to 900 Ω.m, which belongs according to existing reconnaissance drillings to the upper Pleistocene. The second is a conductive ground with a resistivity of 7-150 Ω.m belongs to the Mio-Pliocene formation corresponding specifically to the silt and conglomerate. As well as a lateral contrast of resistivity on the same level was observed on the upstream and downstream sides of the dike due to the variation in the water content. This hydraulic installation shows the usefulness of building artificial recharge dikes all along the Wadis as well as considering another alternative to apply in areas of high infiltration outside the Wadis.
Keywords: Electrical Resistivity Tomography (ERT), GIS, Haouz central, Plio-Quaternary aquifer, Hydrogeological characterization.