MODELING OF SALT WATER INTRUSION AND ITS INFLUENCE ON THE WATER RESOURCES IN THE ADRIATIC ALBANIAN COASTAL AREA

FATOS HOXHAJ

Institute of Hydrometeorology, Rr. "Durresit", 219, Tirana, Albania.

Abstract

Seawater intrusion into the confined aquifer took place along the Albanian coastal area where is developed mainly gravelly alluvial aquifer. In the this aquifer the sea water intrusion is developed either by natural conditions or by water extraction. About 15 to 55 % of the surface of different coastal gravelly aquifers is affected by seawater intrusion. A severe salt water intrusion is taking place in the groundwater system due to low phreatic water levels in the area.

Albania is situated in the southwestern part of Balkan Peninsula on the eastern coasts of Adriatic and Ionian Seas. Otranto Channel width about 80 km separates Albania by Italy. T h e Albanian coastline has a total length of 476 km, of which two thirds border Adriatic Sea and one third the Ionian Sea.

The Adriatic coastal area is densely populated. Including Tirana City, the capital of Albania which is located about 30 km far from the coast, the population of Adriatic coastal area is more then 1,5 million persons, equal to more than 50 % of country's population. In the Adriatic coastal area is concentrated also more then 80 % of the industry and more then 70 % of agriculture. A massive tourism is under fast development in this area. In the Ionian coastal area there are only small traditional villages or towns. This area represents most valuable tourist resource for Albania, especially because of the many places of unspoilt natural beauty. The groundwater resources of Albania have been found to be abundant, with an uneven geographical and to a lesser extend to a seasonal distribution. Traditionally in Albania appears a clear separation between irrigation, which rely on surface water, and drinking and industrial water, taken from groundwater.

Following a description of water resources of the Albanian coastal area, the research aims to adopt *an improved multi-criteria approach* to water resources under the influence of salt water intrusion using powerful techniques for a spatial analysis like SUTRA model, GIS and SDSS.

The simulation model was based on the transition zone approach, which requires simultaneous solution of the governing water flow and solute transport equations. An irregular grid of a quadrangle was used to discretize the flow domain. Various aquifer parameters were verified with the numerical model in order to obtain satisfactory matches between computed values and observed data from an investigation.

Because increased withdrawal of groundwater in the northern coast is one of the causes of seawater intrusion into the aquifers in the area.

The decrease in groundwater withdrawal has been taken into account to prevent further intrusion of the seawater into the inland aquifers. In order to demonstrate the effect of decrease in groundwater pumpage on seawater intrusion, the pumpage schemes were designed to use the calibrated model for calculations of future changes in water levels and chloride concentrations.

In the course of the predictive scheme simulations, values of hydraulic heads along the southern and eastern boundaries generated from the regional simulation model were used for these arbitrary boundaries, and precipitation for the period was assumed to be identical to those during the predictive period.

Based on the above observation, it is apparent that seawater intrusion would worsen in the confined aquifer along the northern coast if the current scheme of groundwater pumpage continues. This paper has provided a mathematical model based on SUTRA to simultaneously describe groundwater flow and solute transport of the aquifer system in the northern coast of Albania. The dispersion zone between fresh water and salt water was considered in the model. An irregular grid of quadrangle was used in developing the quasi-three-dimensional element model. In the course of the numerical simulation of the seawater intrusion in the area, various aquifer parameters, including boundary conditions, were identified with the model until satisfactory agreements between modeled and observed values of water levels and chloride concentrations were obtained (Fig.4). The numerical model of this site, although based on some simplifying assumptions, proved useful in demonstrating the mechanism of seawater intrusion at this particular site. More importantly, the model could be used to predict the future changes in water levels and chloride concentrations of the groundwater when controlling measurements of seawater intrusion are taken into account.

Results of the predictive scheme simulations showed reasonable calculations of the water levels and chloride concentrations, as well as, the extents of seawater intrusion into the aquifer.

The research performs the simulation and evaluation of proposed development strategies. Once these have been defined, natural· and socio-economic indicators are assessed for each alternative. The multi-criteria approach is performed within SDSS and a conflict analysis can assess the coalition between stakeholders and their role in policy which would determine the best development strategy.

As quantitative data required for many indicators is not available, especially when a large zone must be evaluated, qualitative indicators can be used as an acceptable alternative. The development of indicators is motivated by the need to structure the water resources knowledge of the Albanian coastal area in forms suitable for a logical decision process. In this approach is summarized the negative impacts which may prevail or are likely to occur as a result of development activity.