World Academy of Science, Engineering and Technology
International Journal of Environmental and Ecological Engineering
Vol:11, No:10, 2017

Evaluation of Groundwater Quality and Contamination Sources Using Geostatistical Methods and GIS in Miryang City, Korea

Authors : H. E. Elzain, S. Y. Chung, V. Senapathi, Kye-Hun Park

Abstract : Groundwater is considered a significant source for drinking and irrigation purposes in Miryang city, and it is attributed to a limited number of a surface water reservoirs and high seasonal variations in precipitation. Population growth in addition to the expansion of agricultural land uses and industrial development may affect the quality and management of groundwater. This research utilized multidisciplinary approaches of geostatistics such as multivariate statistics, factor analysis, cluster analysis and kriging technique in order to identify the hydrogeochemical process and characterizing the control factors of the groundwater geochemistry distribution for developing risk maps, exploiting data obtained from chemical investigation of groundwater samples under the area of study. A total of 79 samples have been collected and analyzed using atomic absorption spectrometer (AAS) for major and trace elements. Chemical maps using 2-D spatial Geographic Information System (GIS) of groundwater provided a powerful tool for detecting the possible potential sites of groundwater that involve the threat of contamination. GIS computer based map exhibited that the higher rate of contamination observed in the central and southern area with relatively less extent in the northern and southwestern parts. It could be attributed to the effect of irrigation, residual saline water, municipal sewage and livestock wastes. At wells elevation over than 85m, the scatter diagram represents that the groundwater of the research area was mainly influenced by saline water and NO3. Level of pH measurement revealed low acidic condition due to dissolved atmospheric CO2 in the soil, while the saline water had a major impact on the higher values of TDS and EC. Based on the cluster analysis results, the groundwater has been categorized into three group includes the CaHCO3 type of the fresh water, NaHCO3 type slightly influenced by sea water and Ca-Cl, Na-Cl types which are heavily affected by saline water. The most predominant water type was CaHCO3 in the study area. Contamination sources and chemical characteristics were identified from factor analysis interrelationship and cluster analysis. The chemical elements that belong to factor 1 analysis were related to the effect of sea water while the elements of factor 2 associated with agricultural fertilizers. The degree level, distribution, and location of groundwater contamination have been generated by using Kriging methods. Thus, geostatistics model provided more accurate results for identifying the source of contamination and evaluating the groundwater quality. GIS was also a creative tool to visualize and analyze the issues affecting water quality in the Miryang city.

Keywords : groundwater characteristics, GIS chemical maps, factor analysis, cluster analysis, Kriging techniques
Conference Title : ICMGR 2017 : International Conference on Management of Groundwater Resources
Conference Location : Bangkok, Thailand
Conference Dates : October 26-27, 2017