



Spatial distribution pattern analysis of groundwater nitrate nitrogen pollution in Shandong intensive farming regions of China using neural network method

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ABSTRACT

Nitrate nitrogen (NO_3^- -N) from agricultural activities has become the main source of groundwater pollution. A spatial distribution pattern of groundwater NO_3^- -N pollution is vital for agricultural ecological and environmental management. The objective of this paper is to investigate the potential of artificial neural network to explore the spatial distribution of groundwater NO_3^- -N pollution in Shandong intensive farming regions of China. A detailed field campaign has been carried out to obtain the 216 sample site data focusing on the intensive farming regions in Shandong province. Considering the practical difficulty of the complex nonlinear relationship between multi-factors and groundwater nitrate, a Back Propagation Neural Network (BPNN) was developed for modeling groundwater NO_3^- -N concentration. In order to perform the analysis, both natural and anthropogenic factors have been studied, such as soil characteristics, fertilizer usage and terrain factors and so on. Finally, soil organic matter content, total nitrogen content and nitrogen fertilizer data were chosen as input features of the BPNN for having the best correlation with groundwater NO_3^- -N concentration. The results indicated that areas with higher NO_3^- -N concentration in groundwater are mainly located in the region of excessive use of nitrogen fertilizer and low groundwater runoff modulus. The application results suggested that the BPNN provide a promising approach for analyzing the spatial variability of the groundwater NO_3^- -N concentration.

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1. Introduction

In recent years, groundwater, one of the main sources of water is being subjected to an increasingly serious pollution [1]. Several studies have shown that nitrate nitrogen (NO_3^- -N) is the most frequently entering groundwater pollutant [2]. NO_3^- -N in drinking water can cause “blue baby” syndrome and increase the incidence rates of stomach cancer, colorectal cancer, lymphoma and other kinds of cancers [3]. Therefore the maximum admissible concentration permitted for drinking water was determined below 10 mg L^{-1} of NO_3^- -N in USA and Japan, or 11.3 mg L^{-1} in European countries according to the recommendation of the World Health Organization [4]. In China, due to the presence of NO_3^- -N in groundwater, groundwater has severely deteriorated, especially in North China and Yangtze River Delta region [5–7].

Several previous researches works on NO_3^- -N pollution in groundwater mainly focused on the investigation of groundwater NO_3^- -N pollution and general statistics [8–11], as well as NO_3^- -N concentration of groundwater in local

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