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Nitrate contamination of groundwater: A conceptual management framework

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Abstract

In many countries, public concern over the deterioration of groundwater quality from nitrate contamination has grown significantly in recent years. This concern has focused increasingly on anthropogenic sources as the potential cause of the problem. Evidence indicates that the nitrate (NO_3) levels routinely exceed the maximum contaminant level (MCL) of 10 mg/l NO_3-N in many aquifer systems that underlie agriculture-dominated watersheds. Degradation of groundwater quality due to nitrate pollution along with the increasing demand for potable water has motivated the adoption of restoration actions of the contaminated aquifers. Restoration efforts have intensified the dire need for developing protection alternatives and management options such that the ultimate nitrate concentrations at the critical receptors are below the MCL. This paper presents a general conceptual framework for the management of groundwater contamination from nitrate. The management framework utilizes models of nitrate fate and transport in the unsaturated and saturated zones to simulate nitrate concentration at the critical receptors. To study the impact of different management options considering both environmental and economic aspects, the proposed framework incorporates a component of a multi-criteria decision analysis. To enhance spatiality in model development along with the management options, the utilization of a land use map is depicted for the allocation and computation of on-ground nitrogen loadings from the different sources.

Keywords: Groundwater; Nitrate; Contamination; Management; Decision analysis; Conceptual; Fertilizer; Modeling

1. Introduction

Nitrogen (N) is an essential input for the sustainability of agriculture (Delgado, 2002; Shrestha and Ladha, 2002; Lake et al., 2003; Schröder et al., 2004). However, nitrate contamination of

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