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Long-Term Assessment of Nitrogen Pollution Load Potential for Groundwater by Mass Balance Analysis in the Tedori River Alluvial Fan Area, Japan

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ABSTRACT

To evaluate the nitrogen pollution load in an aquifer, a water and nitrogen balance analysis was conducted over a thirty-five year period at five yearly intervals. First, we established a two-horizon model comprising a channel/soil horizon, and an aquifer horizon, with exchange of water between the aquifer and river. The nitrogen balance was estimated from the product of nitrogen concentration and water flow obtained from the water balance analysis. The aquifer nitrogen balance results were as follows: 1) In the aquifer horizon, the total nitrogen pollution load potential (NPLP) peaked in the period 1981-1990 at 1800 $t \cdot yr^{-1}$; following this the NPLP rapidly decreased to about 600 $t \cdot yr^{-1}$ in the period 2006-2010. The largest NPLP input component of 1000 $t \cdot yr^{-1}$ in the period 1976-1990 was from farmland. Subsequently, farmland NPLP decreased to only 400 $t \cdot yr^{-1}$ between 2006 and 2010. The second largest input component, 600 $t \cdot yr^{-1}$, was effluent from wastewater treatment works (WWTWs) in the period 1986-1990; this also decreased markedly to about 100 $t \cdot yr^{-1}$ between 2006 and 2010; 2) The difference between input and output in the aquifer horizon, used as an index of groundwater pollution, peaked in the period 1986-1990 at about 1200 $t \cdot yr^{-1}$. This gradually decreased to about 200 $t \cdot yr^{-1}$ by 2006-2010. 3) The temporal change in NPLP coincided with the nitrogen concentration of the rivers in the study area. In addition, nitrogen concentrations in two test wells were 1.0 $mg \cdot l^{-1}$ at a depth of 150 m and only 0.25 $mg \cdot l^{-1}$ at 50 m, suggesting gradual percolation of the nitrogen polluted water deeper in the aquifer.

KEYWORDS

Water Balance; Nitrogen Balance; Groundwater Pollution; Sewage Treatment Water; Pollution from Farmland; Nitrogen Pollution Load Potential

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