Integrating principles of nitrogen dynamics in a method to estimate leachable nitrogen under agricultural systems

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Abstract
Surplus nitrogen (N) in ground and surface water is of concern in intensive agricultural regions. Surplus N leaches during lengthy periods where annual crop systems are used in temperate regions. This paper presents a model to estimate the surplus N available for leaching to ground water beneath agricultural systems and applies the model to watersheds in an intensive maize and soybean production system. The model utilizes commonly available georeferenced data on soils, crops, and livestock, making it applicable to watersheds in many regions. The model links stocks of N in soil, crops, livestock, fertilizer and the atmosphere. Nitrogen flow centers on exchange between the soil N stocks. Nitrogen mineralization rates are defined for three soil organic matter pools, crop residue, and manure based on carbon:N ratios. Nitrogen exports from the system are harvested crops, livestock and losses to the atmosphere. Application of the model in 26 Iowa watersheds finds surpluses of 18 to 43 kg-N/ha. Surpluses exceeded measured annual nitrate-N loads in regional streams by amounts equivalent to denitrification rates in groundwater. Deficits in soil N were sufficiently small to suggest that the system is in equilibrium with soils of the region.