

Simulation of Nitrogen Balance in Xiaoqinghe Watershed Consisting of Cropland and Livestock Farms Using Manure-DNDC Model

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Abstract: Nitrogen (N) loss in agricultural system has become a significant issue over the past several decades, which has caused serious environmental problems all over the world. Excessive N from chemical fertilizer and livestock manure has played an important role in water eutrophication and environment degradation. In this study, a newly biogeochemical model named Manure-DNDC was introduced for the modeling of nitrogen balance in agricultural ecosystem including cropland and livestock. A typical watershed, Xiaoqinghe Watershed, was selected in the study to test the modeling approach for quantifying N loading at regional scale. Database of climate, soil, livestock and cropping system management at town level were built up to support the model upscaling to the watershed scale. Based on the baseline simulations for 2008, 237.9 million kg N was added to the agricultural soils in the Xiaoqinghe watershed, including 184.2 million kg N from synthetic fertilizer application and 44.6 million kg N from livestock manure. At the end of year, there was 33.2 million kg N manure left in the livestock operation systems, mainly in form of compost. 126.9 million kg N of ammonia and 34.9 million kg N of other gases including nitrous oxide (N₂O), nitric oxide (NO) and N₂ were released to the atmosphere. Driven by the rainfall and irrigation events, 11.8 million kg N was leached from the cropping systems in the year of 2008. Driven by surface runoff, 38 and 6.4 million kg N were lost from livestock operation and cropping system, respectively. Validation test was conducted at site and regional scale to verify the applicability of Manure-DNDC for the watershed scale.

Keywords: Nitrogen balance, Agricultural Non-Point Source pollution, Manure-DNDC, Xiaoqinghe, Livestock and poultry production.