

李 虎,邱建军,高春雨,王立刚.基于DNDC模型的环渤海典型小流域农田氮素淋失潜力估算[J].农业工程学报,2012,28(13):127-134

基于DNDC模型的环渤海典型小流域农田氮素淋失潜力估算

Simulation of potential nitrate leaching in croplands of typical watershed around Bohai Bay using DNDC model

投稿时间: 2011-10-28 最后修改时间: 2012-03-30

中文关键词: [氮,淋失,模型,小流域,农田](#)

英文关键词: [nitrogen leaching models](#) [small watershed](#) [croplands](#)

基金项目:公益性行业(农业)科研专项(200803036, 201103039)

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中文摘要:

为了定量评价流域尺度氮素污染的可能性并探明氮素污染的主要来源,以期指导农业生产实际保护农田生态环境,该文主要运用农业生态系统生物地球化学模型(DNDC)模拟的方法,以环渤海典型小流域--小清河流域为例,在GIS流域数据库支持下对该流域氮素淋失潜力进行了估算。研究表明,2006年小清河流域年均氮淋失负荷范围为 $10.44 \times 10^3 \sim 36.86 \times 10^3$ t,平均为 23.65×10^3 t。以当年氮肥投入总量 222.2×10^3 t计算,该流域平均氮素流失量占氮肥投入的10.6%。不同地区氮素淋失空间分布差别较大,与氮肥施用量的空间分布规律大体一致。其中,44%和27%的地区氮素潜在淋失量分别集中在 $20 \sim 40$ 和 $>40 \sim 80$ kg/hm²,这些地区主要分布在小清河两侧沿岸及寿光市大部分地区,给流域水环境造成了较大影响。研究结果显示流域氮淋失存在较大的空间区域差异,根据不同地区的实际情况进行水氮管理,减少氮素的无效丢失十分必要。

英文摘要:

Nitrogen (N) leaching from agricultural systems plays a key role in the water contamination. Quantifying potential nitrogen leaching at watershed scale is important for providing mitigation policies or strategies. Taking the typical small watershed-Xiaoqinghe basin around Bohai Bay as an example, this paper selected the denitrification-decomposition model (DNDC), combined with detailed soil hydrological and biogeochemical processes, to predict nitrogen leaching of croplands in the watershed under the support of GIS database. The results showed that simulations of the DNDC model was reasonable and had good agreement with observations of annual amounts of leached water and rates of nitrate leaching from 3 typical cropping systems in Xiaoqing River basin. According to the tested DNDC model, the potential N leaching loads ranged from 10.44×10^3 to 36.86×10^3 t, with an average of 23.65×10^3 t in the watershed in 2006. Taking the amount of total N fertilizer applied 222.2×10^3 t in that year, the average N leaching accounted for 10.6% of the total N fertilizer input. The spatial distribution of N leaching among all the towns in the watershed varied greatly due to the differences in climatic conditions, soil properties, as well as farm management practices, which was similar to the distribution of the fertilizer application rate. The amount of N leaching in most regions mainly varied in a range of 20-80 kg/hm². These regions mainly distributed along the Xiaoqing River and Shouguang city. The study also concluded that it is necessary to reduce potential N leaching rates according the practical conditions in different regions of the watershed.

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