

Land Use Simulation in the North China Plain Under Different Scenarios-An Integrated GIS Approach

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Background

During the last decades, crop production in the North China Plain, one of the most important regions of cereal production in China, has focused on increasing yield to meet growing food demand. This development has caused serious environmental problems, similar to other intensive agricultural systems. A growing population and a rising standard of living make it essential to develop land-use systems with higher productivity, but also better resources protection in the future. A multidisciplinary, collaborative International Research Training Group project (IRTG) “Modeling Material Flows and Production Systems for Sustainable Resource Use in Intensified Crop Production in the North China Plain,” funded by the Deutsche Forschungsgemeinschaft and the Chinese Ministry of Education, has been launched in 2004 to aid in the development of such land-use systems. The mandate of the IRTG is to identify potential improvements to the cropping systems and management practices that achieve sustainable resource protection while maintaining a high-yield level. In addition, the group offers a training program to promote scientific excellence amongst both German and Chinese postgraduate students.

Objective

Within the framework of the IRTG project, one subproject has the task of upscaling and regionalizing plot and farm-level results. The current research within this subproject aims to simulate the environmental effects of different agro-environmental policies, cropping systems and farm practices at the regional level. Furthermore, the project aims to provide suggestions for the adjustment of land-use systems towards sustainable agricultural development in the North China Plain.

Datasets

The central database for the land-use simulation is the Agricultural Environmental Information System (AEIS). This system is composed of Geo Database, Soil, Climate, Land-Use, and Agricultural Management information and was developed specifically to provide the necessary data for regional modeling. Data from field experiments of the IRTG, investigating nitrogen use efficiency, water use efficiency, greenhouse gas emissions and farm management practices under different cropping systems will be incorporated into the central database along with farmer interview data. This information will serve as the basis for regional land-use modeling and policy assessment.

Methods and Selected preliminary results

The AEIS has been and continues to be developed using geographic information systems (GIS), remote sensing and global positioning systems (GPS). The problems encountered in the construction of the AEIS, including data availability, quality and limitation, and resolutions to these difficulties will be introduced.

Different integrated GIS approaches for land use simulation were developed, including the Soil-Land-Use-System-Approach and the Land use-soil type-soil texture based DNDC (Denitrification–Decomposition) MSF (most sensitive factor) modeling approach. Modeling under different scenarios will be performed to give an impression of their impacts on agriculture and the environment in the North China Plain. These scenarios include changes in land use, management practices, and regulation and deregulation resulting from WTO agreements. Preliminary results of the effects of changing land use and farm practices on regional greenhouse gas emissions and soil organic carbon sequestration will be presented. An outlook and suggestions for future sustainable land use in the region will be given for decision makers at the political level.

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