Modelling Land Use Changes Using Cellular Automata: An Example From the North China Plain

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Within the context of the 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" http://rtgchina.uni-hohenheim.de, funded by the Deutsche Forschungsgemeinschaft and the Chinese Ministry of Education land use modeling is one important task. The project is running at the University of Hohenheim, Stuttgart and the China Agricultural University, Beijing and has been launched in 2004 to aid in the development sustainable land-use systems in North China. Therefore it is necessary to get an idea of the regional extent of specific land use systems, their development and possible changes in the future.
The decision, how land use is managed, is influenced by determining factors like natural conditions, land ownership or local and national policies respectively. Land use types themselves influence the yields and therefore also the income of the farmers. In respect to a sustainable land use the impact of fertiliser or water use efficiency and other environmental features should be taken in account.

While typical GIS approaches in land use modelling are widespread in the meanwhile, another concept of regional representation is tested. Describing and simulating the land use applying cellular automata offers the opportunity to recognise the dependencies between neighbouring spatial entities more accurate.
Cellular automata (CA) are one approach to model changes in land use. In contrast to a raster GIS CA are able to simulate land cover changes in a more dynamic way. Each cell can interact with neighbouring cells to calculate next stages in cell status. In each cell, for example representing a land use unit, the current land use depending on users decisions and influences from regional and national policies is simulated. In scenarios different assumptions for policy adjustment may be run through. Thus dealing with data of different origins and scale is one major task.
One major opportunity in working with cellular automata is to include analysis made in the different subprojects. The subprojects are dealing with matter flow in soil, water and air and with cropping systems and farm systems optimisation. Within the whole framework of the IRTG these data can be used to create transition rules for the cell stages. The possibility to create cells in hierarchical order opens up the opportunity to regionalise data. The base for the regionalisation are data gained from field experimental sites and farm surveys in the North China Plain.

The hierarchies of cells may be structured in spatial as well as temporal order. So the impact of different spatio-temporal scales can be simulated to detect the effect and circumstances of changing land use within the scenarios.
The supposed paper will describe the background situation, stress the data base and the methodological approach in detail, present selected results and draw conclusions.