Explaining and simulating current patterns of agricultural land use in the Netherlands

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Abstract
Agriculture is currently the most prevalent land use at global level, accounting for more than one third of world's total land area. The spatial patterns of agricultural production and land use have been continuously changing in time as a response to variations in proximate and underlying factors and technological developments. Furthermore, farmers have to compete with other land users in regions where land is scarce: while crop and dairy farmers have roughly similar preferences, urban development and nature conservation may also claim areas that could be suitable for agriculture. Further changes in the spatial patterns of agriculture can be expected in the future as a result of policy reform and changes in the climate and socio-economic systems. Therefore, a good understanding of the determinants of the spatial configuration of land use is necessary to assess possible developments and impacts in the environment, economy and society.

Since experiments in real land use systems are hardly possible, land use models are useful as learning tools to test hypothesis and formalize knowledge. While most economics-based land-use models are able to determine the optimal (agricultural) land-use configuration for different and even divergent objectives through the application of mathematical optimization techniques, their ability to reproduce existing land-use patterns is rarely investigated. Furthermore, theory is often applied according to only one set of prior conditions, criteria and decision variables, without further testing for alternative definitions of land-use suitability. This implies that uncertainties related to model conceptualisation and structure are not fully acknowledged and addressed.

We assess the ability of a land-use modelling approach based on economic theory to explain and reproduce existing agricultural land use patterns, while exploring the importance of underlying uncertainties on model conceptualization and structure. Alternative definitions of suitability are tested through land-use modelling simulation in Land Use Scanner, a modelling tool based on economic theory. The results are then validated by comparing the simulated land-use patterns with existing ones. The Netherlands, a densely populated country with a high pressure on land, a landscape dominated by cropland and pastures, and an advanced agricultural sector with a high value per hectare, is used as a case study.