Spatial parameterisation and uncertainty analysis of a Bayesian crop-economic model

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ABSTRACT

A Bayesian network approach was used to build an integrated GIS crop-economic model. This approach allowed us to quantify the uncertainty of spatially model parameters and crop productivity estimates and to demonstrate how to optimise multiple parameters captured from geographical information in grid-based and vector-based forms. Vector-based land mapping units, defined as homogeneous land areas with respect to key land characteristics, was created by overlaying various vector map layers (e.g. soil, forest zone). Soil properties were used as model parameters, where some properties relate to soil type (e.g. drainage) and others vary according to soil depth (e.g. pH). The spatial database of land mapping units derived from attributes of the overlaid soil and other map layers contained two types of relationships, one-to-one (e.g. drainage) and one-to-many (e.g. pH). Nevertheless land characteristics obtained from summarised grid data also contained a spatial variation. These spatial parameters were presented in the Bayesian net. A Bayesian network was used to link land characteristics and estimate crop yields. Agricultural practice options were modelled as decision nodes and economic returns were estimated using utilities. The model can be used to simulate the probability of achieving a particular crop yield, and economic returns can be estimated for scenarios of crop management and economic situation. The outcomes of model can be displayed using GIS. This study demonstrates how different types of spatial information can be used for Bayesian modelling and Decision Support Systems.

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