Spatial Modelling of Land-use Patterns in Forest Frontier Areas — Theory and Empirical Assessment for Indonesia

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Abstract

We develop a spatially explicit land-use model for a forest frontier area in Indonesia. The objective of the study is to describe the socio-economic factors that influence land-use patterns. We aim at understanding farmers’ decision-making process as to where they will cultivate which crops and clear forest. Such a micro-economic focus is crucial for understanding the ongoing human-induced land-use change process and is essential in the land-use change literature — that is dominated by natural scientists focusing on geophysical and agro-climatic processes.

The model is derived from the von Thunen-Ricardo land rent theory that describes land-use patterns as a result of variability in geophysical land attributes and differences in location and transport costs. However, this model is valid only under certain assumptions and is less suited to describe land-use patterns in forest frontier areas characterised by semi-subsistence agriculture and imperfect markets. We refine the model to account for the fact that agricultural prices and wages might be endogenously determined and households cannot be considered as profit maximising agents. The solution to the analytical model defines a spatially explicit multinominal logit model. We estimate the model correcting for endogeneity and spatial dependence and using satellite image interpretation, GIS data and village survey data.

The results demonstrate that differences in Ricardian land rent are important in determining spatial land-use patterns. However, the we do not find evidence in support of the von Thunen idea that land-use patterns are determined by differences in transport costs. Rather the labour intensity of land-use systems, population levels and household characteristics matter. Contrarily to other studies combining GIS and socio-economic data, we do find significant effects of socio-economic factors. This might be imputed to the unique combination of spatially disaggregated data with village survey data, instead of using aggregate socio-economic data that obscure causal effects. Further, the refinement of the von Thunen-Ricardo land rent model is justified by the empirical results and might be a first step in the direction of incorporating more realistic descriptions of economic behaviour into spatial land-use models.

Keywords: Deforestation, Indonesia, land-use change, spatial models

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