

Symposium: Understanding exurban landscape change processes: Human preferences, agent behaviors and ecological effects

Paper 3

An agent-based model for studying the landscape effects of exurban development

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This paper presents an agent-based model of land-use dynamics at the urban-rural fringe that links the actions of multiple types of actors with their effects on land-cover. In contrast to predictive models, the principle goals are to understand the linkages between multiple actors and the landscape and to train our intuition about how changes in policy or other actions might affect landscape evolution. We constructed an initial agent-based model that represents the decision making of resident households, developers, and local governments. The model recognizes four different types of residential development, classified according to their appeal to various agents and their resulting spatial landscape patterns. Farmers offer farms for sale with some probability. Townships purchase property for preservation using some strategy. Developers convert farms into one of the development types depending on the landscape characteristics of the farm and on the demand by households for various types of subdivisions. The development of the subdivisions and other dispersed rural development then differentially affects the land-cover patterns on the landscape. We describe the model and present scenarios that are based on conditions within the Detroit Metropolitan Area, Michigan, USA. The scenarios address the question: What are the differential influences of land-use actions implemented at different scales on the ecological landscape patterns that result from the development process? We measure the impact on total tree cover in a township of (1) different strategies for locating preserved areas and (2) inclusion of subdivisions that increase tree cover. For each scenario, the model was run 30 times to evaluate the variability in possible outcomes. The results indicate that, while regrowth on preserved land is the surest way to increase tree cover, regrowth on private lands can contribute significantly to the amount of tree cover in a township. While tree cover varies significantly in the degree to which it serves as wildlife habitat for various species, the results indicate (a) the potential importance of design on private lands for providing habitat in exurban landscapes, (b) directions for future model and scenario development that can serve to improve our understanding of land-cover changes on heterogeneous exurban landscapes, and (c) directions for further data collection to provide empirical grounding for the model.

Keywords: agent-based modeling, landscape dynamics, exurban development, urban sprawl, heterogeneous landscapes