Landscape consequences of bioenergy and exurban development scenarios in the Southern Appalachian Mountains

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Background/Question/Methods

Anticipating the consequences of competing land-use trends remains challenging. Exurban development has increased in many rural landscapes, often at the expense of agricultural lands. Increased demand for bioenergy has introduced a new potential pathway for land-use/land-cover change. Bioenergy crops may provide an alternative for agricultural lands at risk of development and sustain grassland habitat in forest-dominated regions. We explored alternative future bioenergy and development scenarios in the southern Appalachian Mountains to address two questions: (1) What is the potential for bioenergy crop production? (2) How do alternative future scenarios of bioenergy production and exurban development affect landscape structure and grassland habitats? We developed seven spatially explicit land-use scenarios for the French Broad River Basin (North Carolina, USA) by integrating a crop suitability model for hybrid poplar (*Populus* sp.) and an existing empirical yield model for switchgrass (*Panicum virgatum* L.) with an existing parcel-based regional growth model. The 2012 USDA Crop Data Layer (30-m resolution) was reclassified using simple rules in ArcGIS™ software to create scenarios that differed in the prioritization and spatial allocation of bioenergy crops. Finally, we determined how potential bioenergy production, landscape structure, and the extent and connectivity of grassland habitats varied among scenarios.

Results/Conclusions

Results indicated that bioenergy crop production is feasible on 2.5 to 9% of the landscape, which represents up to 44% of current agricultural lands. Row crop production declined and developed land increased in all scenarios; forest cover remained dominant and varied relatively little (< 5%) among scenarios. Relative to the 2012 landscape, the “Business-as-Usual” scenario, which assumed a growth trajectory extrapolating current trends to 2040, resulted in the greatest increase (21%) in developed lands. Scenarios that prioritized switchgrass production resulted in a 5% decline in forest cover and a 25% increase in grassland habitat. Scenarios that prioritized poplar production resulted in less total area in bioenergy production and were accompanied by greater increases in developed land and substantial declines (25%) in grassland habitat; connectivity of grassland habitat was also reduced. However, scenarios that included both switchgrass and hybrid poplar increased grassland habitat area and connectivity. A mixture of perennial grasses and woody bioenergy crops in this landscape may balance tradeoffs among bioenergy production goals, development, grassland habitat and large uncertainties in future bioenergy markets.