Abstract for 2013 ESA meeting

Spatially explicit assessment of ecosystem service vulnerability in an agricultural landscape under alternative future scenarios

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Background/Question/Methods

Climate and land-use change may alter regional ecosystems and their capacity to sustain the supply of ecosystem services. However, few studies have investigated how ecosystem service supply may vary in magnitude and spatial pattern with alternative future trajectories. There is great uncertainty about what will actually happen, and such analyses could improve understanding about how the future might unfold and how management interventions might enhance sustainability. We evaluated the potential supply of multiple ecosystem services from 2010 to 2060 in the 1330-km^2 Yahara Watershed (Wisconsin, USA) for two plausible scenarios to address two questions: (1) What are the trajectories of ecosystem service production under alternative future scenarios? (2) Where on the landscape are supplies of ecosystem services most vulnerable to future changes? Scenarios were defined based on interviews and workshops with stakeholders. Given the narratives, we used rule-based spatial allocation methods to generate land-use/land-cover maps for each scenario, along with IPCC climate projections. We quantified spatial patterns of six ecosystem services (crop production, pasture production, freshwater supply, surface water quality, carbon storage, and soil retention) using empirical data and spatial models. We compared projected ecosystem service supply to the 2010 baseline and identified locations where each service declined.

Results/Conclusions

In the "Nested Watershed" scenario, characterized by extreme climate change and strict government interventions that prioritized water resources, the extent of cropland declined, and pasture, forest and wetlands increased by 2060. Most ecosystem services (e.g., freshwater supply, surface water quality, carbon storage) were maintained or enhanced (~30% to 290%) compared to the 2010 baseline; only crop production declined substantially. In the "Investment in Innovation" scenario, characterized by significant innovations in green technology and less extreme climate change, the extent of developed land increased sharply at the expense of cropland. Only surface water quality and soil retention increased notably (~20% to 80%). Carbon storage did not change appreciably, and crop production, pasture production and freshwater supply declined slightly (~15% to 25%). Spatially, the locations of greatest change and vulnerability (i.e., decline) were heterogeneous, and patterns differed by service and between scenarios. Results indicated that landscape pattern may be altered to buffer some undesirable consequences of climate changes and to help sustain ecosystem services in this watershed. Technological progress can conserve particular services but might not be the panacea for the future.