Optimizing Land Use Allocation to Balance Urban Expansion, Cropland Protection, and Conservation of Ecosystem Services

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SUMMARY

Dealing with the conflicts among urban expansion, cropland protection, and conservation of ecosystem services becomes the subject of increased attention in the sustainable land use planning. Previous studies explored the optimized land allocation to mitigate the trade-offs between urbanization and protection of cropland quantity, or between urbanization and protection of ecological environment, but few studies explored the optimized land use allocation which could achieve the synergy among urban expansion, cropland protection (not only protecting its quantity but quality), and conservation of ecosystem services. Taking Hubei of China as the study area, this study aims to optimize land use allocation which can meet the demand for both urban land and cropland in quantity, while maximizing the productivity of cropland and minimizing the loss of ecosystem service value (ESV) during 2010–2030. Based on cropland productivity estimated by Global Agro-ecological zone (GAEZ) model and the spatial differences of ESV assessed by unit value-based approach, we optimized the land use allocation by applying the LAND System Cellular Automata model for Potential Effect (LANDSCAPE). Specifically, the spatial difference of cropland productivity was expressed as parameter of asynchronous rate of transition, while the spatial difference of ESV was represented by the parameter of resistance. Results show that, the optimized land use allocation will meet the demand for both urban land and cropland in quantity, meanwhile, the cropland productivity will increase by 361 kg/km2 (which can make cropland economic value increase 12 million US$), and the loss of ESV will decrease by 20 million US$. The results indicated that it is feasible to allocate land resources to achieve the synergy among urban development, protection of cropland in quantity and quality, and conservation of ecosystem services. This study highlights the importance to take the spatial difference of both cropland productivity and ESV into consideration in land use planning.