

Joint spatial analysis of water policies and hydrologic ecosystem services in an urbanizing agricultural landscape

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Managing hydrologic ecosystem services (freshwater benefits generated by terrestrial ecosystems) in regional watersheds is challenged by a complex network of multi-level policies. However, the effectiveness of water-related policies is seldom assessed spatially, and few studies have investigated the spatial concordance between water-related policies and delivery of hydrologic services. In an urbanizing agricultural landscape, we asked whether water-related interventions coincided spatially with hydrologic services and whether their spatial concordance varied by government level (federal, state, county and municipal) and intervention type (land acquisition, direct management, incentive and regulation). We merged spatial analyses of 35 interventions with mapping of four hydrologic services (freshwater supply, ground- and surface-water quality, and flood regulation) in the 1,336-km² Yahara Watershed (Wisconsin, USA). Spatial concordance between areas of intervention and hydrologic services varied widely among interventions, reflecting different priorities or constraints of each intervention. Cumulative areas of interventions showed positive correlations with surface- and groundwater quality and negative correlations with freshwater supply and flood mitigation (all $p < 0.01$), reflecting a strong policy emphasis on water quality. Spatial overlap also varied by level of government and type of intervention: acquisition aligned with areas of water-quality concern, enhanced water supply and flood mitigation, whereas other interventions showed opposite alignment. Our results demonstrate that joint spatial analysis of governance and ecosystem services would help evaluate and enhance targeting of interventions at the landscape level.