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Systematic conservation approach in assessment of climate change impacts on Ecosystem services

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Ecosystem services are closely linked to land use and climate change. Integrating ecosystem services approaches to Systematic Landscape conservation planning (SLCP) facilitate the strategic planning for land-use conservation more effectively. This study evaluates the impacts of different zoning policies and climate change on ecosystem services in the Chen You Lan River watershed in Taiwan. The study focuses on six types of ecosystem services including water yield, sediment retention, nitrogen retention, phosphorus retention, carbon storage, as well as biodiversity, and further, to identify the appropriate area conservation scenario as a reference for decision makers. This study firstly quantifies those ecosystem services present in 1999 based on meteorological data and land use maps of the same year by Integrated Valuations of Ecosystem Tradeoff (InVEST) model. Second, we use Local Indicators of Spatial Association (LISA) to perform a cluster analysis on the 1999 ecosystem services spatial data and identify these areas as hotspots. Third, we use Zonation to produce priority rank maps that reflect four land use scenarios: 1) Yushan National Park Reserve; 2) Top 10% Zonation conservation prioritization output for Chen You Lan River watershed with Yushan National Park Reserve; 3) Top 20% Zonation conservation prioritization output for Chen You Lan River watershed with Yushan National Park Reserve; and 4) Top 30% Zonation conservation prioritization output for Chen You Lan River watershed with Yushan National Park Reserve. The Conversion of Land Use and its Effects at Small regional extent (CLUE-s) model utilizes these four land use scenarios to simulate the land use in 2023. Accordingly, five Global Climate Models (GCM) with two Intergovernmental Panel on Climate Change Fifth Assessment Report (IPCC AR5) projection scenarios: a RCP8.5 scenario for high emissions and a RCP2.6 scenario for low emissions, are integrated to the developed 2023 land use map created, to further, quantify the 2023 ecosystem services. Finally, 2023 ecosystem services for four land use scenarios under different climate change conditions are analyzed, the recommendations are raised based on kappa statistics and the study area's actual total amount values.

A comparison of kappa statistical values for 1999 and 2023 hotspots indicate that when using Zonation, it is more efficient to prioritize conservation areas that are ecosystem services hotspots. Study findings further indicate that for ecosystem services in 2023, scenarios 2, 3 and 4 works better than scenario 1 in nitrogen retention, phosphorous retention, and sediment retention if we use the study area's actual total amount values to compare results. Regardless of which GCM is employed, scenarios 2, 3 and 4 are able to conserve ecosystem services hotspots and the study area's actual total amount values. Furthermore, since scenario 2 also requires less land use than other scenarios and so has the highest efficiency, it is recommended for strategic land use conservation planning considerations for the study area.

Keywords:Climate change, SLCP, LISA, Zonation, CLUE-s, InVEST model, Land use change, ecosystem services.