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Trade-offs and Synergies of Ecosystem Services in Karst Area of China Driven by Grain-for-Green Program

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As an important means regulating the relationship between human and natural ecosystem, ecological restoration program plays a key role in restoring ecosystem functions. The Grain-for-Green Program (GFGP, One of the world's most ambitious ecosystem conservation set-aside programs aims to transfer farmland on steep slopes to forestland or grassland to increase vegetation coverage) has been widely implemented from 1999 to 2015 and exerted significant influence on land use and ecosystem services (ESs). In this study, three ecological models (InVEST, RUSLE, and CASA) were used to accurately calculate the three key types of ESs, water yield (WY), soil conservation (SC), and net primary production (NPP) in Karst area of southwestern China from 1982 to 2015. The impact of GFGP on ESs and trade-offs was analyzed. It provides practical guidance in carrying out ecological regulation in Karst area of China under global climate change. Results showed that ESs and trade-offs had changed dramatically driven by GFGP . In detail, temporally, SC and NPP exhibited an increasing trend, while WY exhibited a decreasing trend. Spatially, SC basically decreased from west to east; NPP basically increased from north to south; WY basically increased from west to east; NPP and SC, SC and WY developed in the direction of trade-offs driven by the GFGP, while NPP and WY developed in the direction of synergy. Therefore, future ecosystem management and restoration policy-making should consider trade-offs of ESs so as to achieve sustainable provision of ESs.