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What are the relationships among ecosystem services in Qinghai-Tibetan Plateau of China

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The Qinghai-Tibetan Plateau (QTP) is a “sensor” and “sensitive area” for climate change in Asia and even the northern hemisphere, and its soil ecosystem services are vital components to all aspects of life in the region and support ecosystem functions and services. Understanding the distribution of regional ecosystem services, the relationship among ecosystem services and the influencing factors is an important prerequisite for the protection and optimization of the ecosystem on the QTP. This study quantitatively analyzed the spatio-temporal distribution and interrelationship of multiple ecosystem services such as soil retention (SR) service, water yield (WY) service, habitat quality (HQ) service, crop supply (CS) and livestock supply (LS) services in the Qinghai-Tibet Plateau (QTP) based on InVEST model, statistical and NPP data. Besides, we explored the influences of temperature, elevation, population density, land use and land cover on the relationship of ecosystem services and put forward the corresponding optimization strategy based on ecosystem services perspective. We found that SR, WY and HQ decreased from the southeast to the northwest, regulating services-supporting services are mainly identified as synergies and CS-HQ and CS-LS are manifested as trade-offs. In addition, natural factors (temperature, elevation) influence the distribution of CS and the level of significance of LS, natural factors and the land-use/land-cove affect the shift in the trade-offs and synergies between regulating services and supporting services, and population density mainly affects the relationship between supporting services and other types of services. Providing that the scale effect of ecosystem service relationships in the QTP, we divided the livestock supply collaborative promotion area, the crop-livestock tradeoff optimization area and the multi-ecosystem service optimization area, then put forward specific suggestions at the city scale. This study could be a step forward to optimizing the balance between provisioning services and supporting services or regulating services in the QTP and implementing ecosystem protection policies effectively.