Quantifying trade-offs of land multifunctionality evaluated by set pair analysis in ecologically vulnerable areas of northwestern China: Implications for sustainable land use

Ziyan Han¹, Jijun Meng¹, Likai Zhu², Haoran Cheng¹, Yingdi Wu¹, and Chanjuan Wei¹

¹Peking University ²Linyi University

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Abstract

Abstract: Land systems in drylands have been experiencing increasing conflicts among different land functions due to ecological vulnerability and growing demands. The improvement of one function is often at the cost of other functions, which causes trade-offs of functions. Understanding land multifunctionality and its trade-offs are prerequisites to alleviate land use conflicts and achieve land sustainability. But research often cannot well address the fuzziness and uncertainty within assessments, and neglect the nonlinear feature when quantifying the trade-offs. Taking the Heihe River Basin (HRB), a typical arid ecologically vulnerable area in China, as the study area, we applied the set pair analysis (SPA) to develop a novel framework for assessing land multifunctionality at a fine scale from the production-living-ecological angle. We then utilized the constraint line fitted with segmented quantile regression to identify the trade-offs among land functions and understand the bidirectional interaction between land systems. The results showed that the overall land multifunctionality in HRB showed an upward trend during 2000-2015, and especially the production and living functions had a larger magnitude. We used the coupling coordination degree to comprehensively indicate the interaction and found that the degree was high in the south and low in the north, which was mainly controlled by ecological function. The effects of different drivers on land functions showed nonlinear characteristics, and thresholds existed for some influencing factors. Our research provides reliable and detailed information to coordinated the development of land systems, which is helpful for sustainable land use and territorial spatial planning.

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