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Hierarchical analysis of landscape urbanization and its impacts on regional sustainability: A case study of the Yangtze River Economic Belt of China

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ABSTRACT

Landscape urbanization has profound influences in the structure, function, and dynamics of the coupled human-environmental systems (CHESs). However, due to the spatial heterogeneity of urban landscape and its socioeconomic attributes, there are many limitations in our understanding of how to render urban systems more sustainable across different administrative levels and geospatial scales. Place-based and cross-level research must be conducted to provide realistic and context-specific pathways to regional sustainability. Thus, the main objectives of this study were to investigate the multiscale spatiotemporal patterns, divers, and sustainability impacts of landscape urbanization at the levels of nation, economic development zones, urban agglomerations (UAs), and cities, with a focus on the Yangtze River Economic Belt (YREB). We explored the linkages among the landscape urbanization, national development plans, and regional sustainability from the hierarchical landscape perspective, using landscape metrics and bivariate regressions. Our main findings include: (1) the YREB's built-up area expanded from 9000 to 40,000 km^2 during 1990–2015, and the general spatiotemporal patterns of landscape urbanization were similar to those in other major urban regions worldwide; (2) influenced by national development plans, the east-west disparities of landscape urbanization continued to widen in the YREB and China as a whole during 1990–2015; (3) the overall landscape urbanization pattern of the YREB was characterized by an east-west gradient interwoven with hierarchies of UAs and cities that were influenced mainly by geography, demography, and top-down governmental policies; (4) positive feedbacks between landscape urbanization and socioeconomic development underpinned rapid urbanization, resulting in insufficient public green space, deteriorated air quality, freshwater shortages and pollution, and inadequate infrastructure development, especially in the coastal urban agglomerations (UAs), megacities and super megacities. To achieve sustainability of the YREB region, future policies need to address the geospatial disparities and minimize the gradients of socioeconomic development. The hierarchical landscape approach provides new insights for improving regional landscape planning and management for sustainability.

1. Introduction

Since the Industrial Revolution, global land surfaces have been rapidly transformed from rural and natural lands to urban areas at an ever-expanding scale and pace (Liu et al., 2005; Seto et al., 2011). Urban agglomerations (UAs) and cities are not only the engines of a region's socioeconomic development but also hot spots of environmental problems (Wu, 2014). Growing evidence has demonstrated that the worsening environmental problems in urban areas have pushed urban systems onto unsustainable trajectories (DeFries et al., 2012). Recent studies have proposed the concepts of "planetary boundaries" and "social boundaries" and have estimated

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