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Research article

How to balance ecosystem services and economic benefits? – A case study in the Pearl River Delta, China

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ABSTRACT

There is a significant challenge in resource management: the perceived trade-off between economic growth and ecosystem conservation. In this study, we integrate a variety of quantitative research methods and models, such as the ecosystem service value (ESV), interval parameter planning (IPP), Dyna-CLUE, and Monte Carlo methods, in an attempt to balance the ESV and economic benefits. The highest system benefits can be obtained, and uncertainty in the ecosystem assessment is considered. Taking the Pearl River Delta as the study area, the results show that when the GDP growth rate is less than 6%, the ESV in 2025 will be higher than the ESV in 2017. An interval approach (upper and lower bounds) is used. For a scenario with a 5% GDP growth rate, the ESV is RMB¥ $[1.85, 20.79] \times 10^9$, which is more than the ESV of the scenario with a 9% GDP growth rate. When the GDP growth rates are 5% and 9%, the proportions of forestland are [61.5%, 61.7%] and [58%, 58.2%], respectively. Furthermore, spatialization was performed using the Dyna-CLUE model. In 2025, the simulated area of farmland is larger in some small regions with 9% GDP growth rate than it is in regions with 5% GDP growth rate, thus achieving a balance between occupation and compensation of regional farmland. By comparing ecosystem planning under different GDP growth rates, an optimized land-use allocation method can help decision makers balance system benefits and ecological risks, which can provide multiple options and specific locations for decision.

1. Introduction

Rapid development of the global economy and acceleration of urbanization have resulted in the constraining role of resources and environment in human production. The world faces serious resource depletion and environmental degradation problems. Balancing economic development and ecosystem conservation has become an important problem for administrative management (Costanza et al., 2017; Goldstein et al., 2012). As an important indicator for assessing economic development, gross domestic product (GDP) is a general measure of the overall economic performance of a country or district (Kubiszewski et al., 2013). In this process, ecological environmental damage and ecosystem well-being for human beings in economic production activities are not considered (Boyd and Banzhaf, 2007); thus, research on ecosystem services (ES) has become one of the hot topics in related fields, such as ecological economics and environmental economics.

Since the introduction of the concept of ES and its calculation methods developed by Daily (1997) and Costanza et al. (1997) in 1997, scholars have carried out extensive research on ES and achieved rich results on different scales around the world (Cruz-Garcia et al., 2017; Zhang et al., 2018). ES are the benefits that humans derive directly or indirectly from ecosystems, including support services, provision services, regulation services, and cultural services (Millennium Ecosystem Assessment, 2005). At present, research on the valuation of ES focuses on the evaluation methods of ecosystem services value (ESV) (De Groot et al., 2012; Vo et al., 2012), the relationship between biodiversity and ES (Cimon-Morin et al., 2013), simulation studies of ecosystem processes (Grêt-Regamey et al., 2008; Vidal-Legaz et al., 2013), and ES evaluation results of separate land types (Chazdon, 2008; Gordon et al., 2010). Taking the ES assessment as an example, traditional assessments focus on the economic value of ecosystems (Costanza et al., 2014; Hein et al., 2006). Because the ecosystem is a complex system with a regional and random structure (Allesina and Tang, 2012), there is no mature and unified evaluation system that can be used for all purposes (Sun et al.,

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