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Quantification of the Impact of Land-Use Changes on Ecosystem Services: A Case Study in Pingbian County, China

Abstract

Pingbian Miao Autonomous County is one of the poorest rural areas in China. Land-use changes, mainly driven by agricultural expansion and deforestation, may significantly impact ecosystem services and functions, but such effects are difficult to quantify. In the present study, Landsat image data were combined with the published coefficients about the world and China ecosystem to quantify land-use and ecosystem service changes in the mountainous area. A sensitivity analysis was employed to determine the effect of manipulating these coefficients on the estimated values. Our results show that during the past decades (from 1973 to 2004) forests and grasslands were converted into shrubland and cropland, respectively, resulting in a continuous decrease in ecosystem service (from 124.5 US$ $\times 10^6$ in 1973 to 100.4 US$ $\times 10^6$ in 2004). We found that the decrease of mixed forest in the study area was the largest contributor (i.e., 25.4 US$ $\times 10^6$) to the decline of the ecosystem service. Therefore we propose that future land-use policy should pay more attention to the crucial ecosystem functions of these forests (including tropical forest), and that it is necessary to balance the relationship between the livelihood of local farmers and environmental protection in order to maintain a healthy and stable ecosystem.

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Keywords Agricultural expansion · Deforestation · Ecosystem services · Pingbian County · Remote sensing

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1 Introduction

Ecosystem services are the conditions and processes through which natural ecosystems and the species that make them up sustain and fulfill human life (Daily 1997). They represent the multiple benefits human beings can obtain, either directly or indirectly, from ecosystem functions. Many of these are very crucial to human survival (e.g., food supply, climate regulation, air purification) while others enhance it (e.g., aesthetics) (Guo et al. 2000; Kremen 2005). For example, on the one hand a forest ecosystem may provide direct use values such as timber, fruits, and other forest products; on the other hand it can also provide indirect use values (e.g., carbon sequestration, erosion and flood control, and recreation).

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