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Original research article

A consistent ecosystem services valuation method based on Total Economic Value and Equivalent Value Factors: A case study in the Sanjiang Plain, Northeast China

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ABSTRACT

In this study, a regional revision coefficient is proposed for the Equivalent Value Factors to better valuate the Sanjiang Plain (in China) ecosystem services. An index system suitable for the valuation of the ecosystem services in the Sanjiang Plain is established. The proposed method can realize the rapid valuation of nine ecosystem service types of six different terrestrial ecosystems. Through the preliminary application of the method, the calculated total value of ecosystem services of the Sanjiang Plain in 2010 was 510.89 billion yuan, of which the forest ecosystem contributed to 37.85%, followed by water bodies and wetland ecosystems. The variations among the contributions of the different ecosystem services are considerable. The contribution attributed to regulation function was the highest, especially the value from the hydrological regulation (36.17%) and climate regulation (16.04%). The Total Economic Value (TEV) method and the Equivalent Value Factors (EVF) method are compared in this study. Results show that Equivalent Value Factors derived value of the Sanjiang Plain ecosystem services is slightly lower than the value obtained by the Total Economic Value method, i.e., 537.84 billion yuan, of which the total value of the Feature Services has reached as high as 38.35 billion yuan.

1. Introduction

Ecosystem services valuation has become the focus of many ecological economists (Daily, 1997; Costanza et al., 1997; Groot et al., 2002). Stephen (1984) and Loomis (1987) applied the profit-loss method to estimate wild animals and environmental resources. Since the 1990s, an increasing number of studies on the valuation of ecosystem services have been published, and some relevant theories have emerged. In 1991, the method of expense payment to estimate the recreation value of 63 forests in Japan (Chen, 1996). Gren et al. (1995) estimated the value of ecosystem services of the Danube in Europe. Jakobsson and Dragun, 1996 estimated the value of all endangered species in the state of Victoria in Australia. Xue and Bao (1999) used the travel cost method and contingent value method to analyze the indirect value and non-use value of the biodiversity in Changbai Mountain Nature Reserve. Ouyang et al. (1999) applied the market value method to value the terrestrial ecosystem services in China. Gram (2001) discussed the disadvantages of the economic valuation of special forest products and proposed a new comprehensive valuation method. Mendoca et al. (2003) determined the monetary value of three kinds of species by the methods of willingness to pay and population viability analysis and predicted the survival probability of each species in the future. Turner et al. (2010) divided the estimation methods for wetland ecosystems into three categories: direct market, stated preference, and revealed preference.

Total Economic Value (TEV) is the method to tackle such a challenge of how to make the optimum conversion of ecological services to economic value. It is defined as the sum of the value of all services that natural capital generates. TEV encompasses all components of (dis)utility derived from ecosystem services using a common unit of account: monitory or any market-based unit of measurement that allows comparisons of the benefits of various goods. Since, in most societies, people are already familiar with

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monitory account, expressing relative preferences in terms of monitory values may give useful information to policy-makers. Recent studies have used the TEV method (Pascual et al., 2010). This method has certain disadvantages, including numerous input parameters and complex calculation process. Determining which valuation methods and parameters to use for a particular service is difficult (Zhang et al., 2010; Yu and Bi, 2011a, 2011b; Sun, 2011). Xie et al. (2015a, 2015b) proposed the EVF method. The EVF of a standard ecosystem services is determined by how much money the farmland ecosystem can generate from the food produced per hectare per year, representing the contribution of the ecosystem to the ecological services (Xie et al., 2008). This method can achieve the rapid valuation of ecosystem services. However, it cannot be applied universally to different geographic regions. Therefore, these researchers (Xie et al., 2008; Pascual et al., 2010) mainly devoted to themselves to assessing ecosystem common services, but paid little attention to Feature Services. Ecosystem services, such as climate regulation, material products, are common and shared by different ecosystem types. However, because of differences in inner structure, services offered by different ecosystems have certain heterogeneity with typical functions. Feature Services are described as a unique environmental benefit provided by a certain ecosystem rather than by other ecosystems, thereby making a unique contribution to the total ecosystem services value. Feature Services valuation based on the TEV method is the process of assessing the contributions of special services to sustainable scale, fair distribution, and efficient allocation. Valuation that ignores Feature Services fails to exactly reflect the actual value for the ecosystem services and underestimates total value of the whole ecosystem.

In this study, a revised version based on that developed by Xie et al. (2015a, 2015b) is used to estimate the total value of ecosystem services and various ecosystems in Northeast China's Sanjing Plain in 2010. The EVF method is also compared with the TEV method to assess their differences. The main aim of this study was to investigate if the two methods can reach a consensus, for understanding the mechanisms of ecosystem services and economic benefits. Some insights into Feature Services, as well as valuation methods, were also proposed.

2. Materials and methods

2.1. Study area

The Sanjiang Plain is a low floodplain located in the northeast of Heilong Jiang Province between 43°49′55″–48°27′40″N and 129°11′20″–135°05′26″E. It has an area of 10.89×10^4 km^2 and is drained by the Heilong Jiang, the Songhua Jiang and the Ussuri River. The Sanjiang Plain has a cold temperate with annual mean temperature of–18 °C and its ice period lasts for about seven

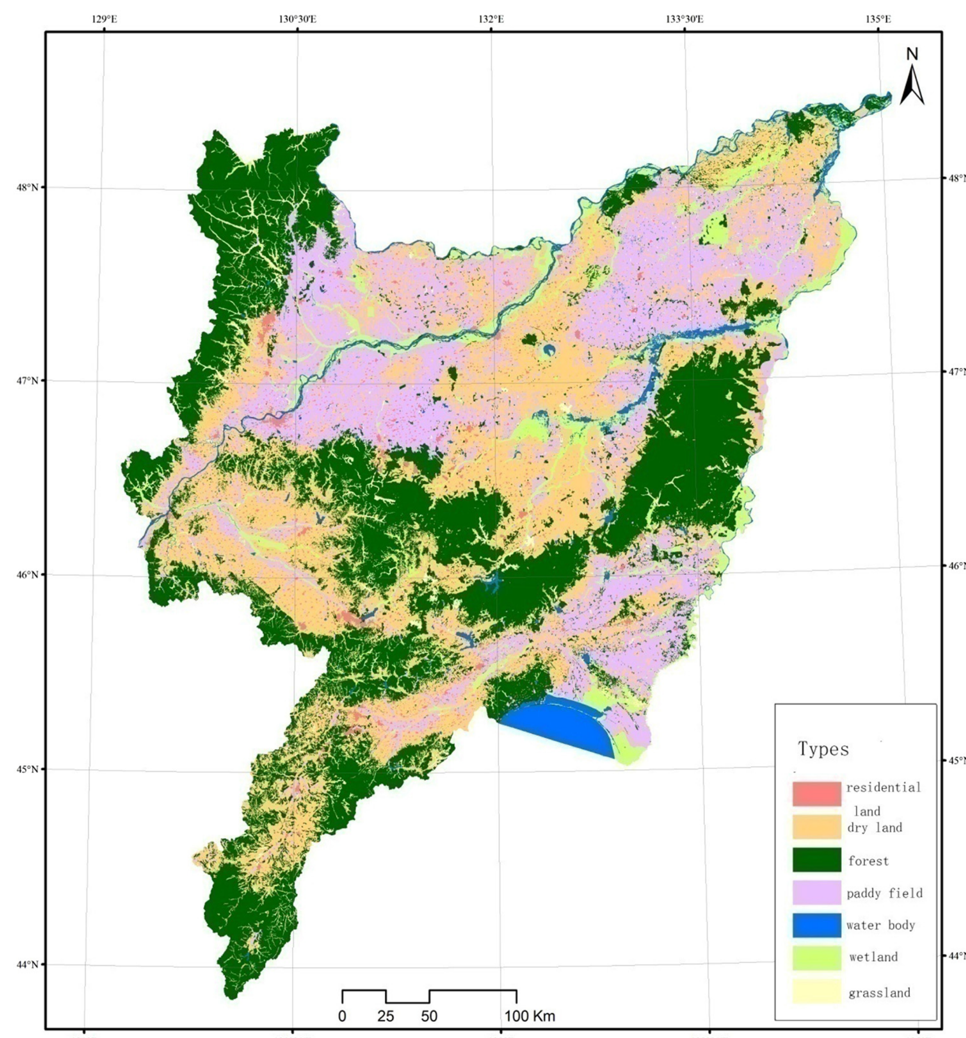

Fig. 1. Spatial distribution of land use types in the Sanjiang Plain (2010).