Ecosystem Services 10 (2014) 54–60

Contents lists available at ScienceDirect

Ecosystem Services

journal homepage: www.elsevier.com/locate/ecoser

How important are the wetlands in the middle-lower Yangtze River region: An ecosystem service valuation approach

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ARTICLE INFO

Article history:
Received 30 March 2014
Received in revised form
13 August 2014
Accepted 13 September 2014

Keywords:
Wetland ecosystem service
Valuation
Middle-lower Yangtze River region

ABSTRACT

The middle-lower Yangtze River region, with its lake groups and river systems, is one of the important wetland regions in the world. In this study, physical dimension measurement and monetary evaluation were conducted to estimate the value of wetland services in this region. Results revealed that the total value of the wetland ecosystem services in the middle-lower Yangtze River region is US $162.5 billion per year, which reflects the irreplaceable importance of wetlands in this region. The wetland ecosystem service values revealed considerable spatial variability. Poyang Lake, Hong Lake, and Shijiu Lake have the most ecosystem service value. The value of human-made wetlands (2.62×10^4 US $/ha/yr) is 48% lower than that of natural wetlands (5.04×10^4 US $/ha/yr), indicating that the conversion of natural wetlands for aquaculture from the sustainability perspective is not significant. The direct and indirect values of wetland ecosystems are 46.17% and 53.83% of the total values, respectively. Recognizing that the value of wetlands in this region is mainly embodied as indirect use values, conservation of the regulating and supporting services should be prioritized in the design of future wetland ecosystem management plans.

1. Introduction

Wetlands provide valuable ecosystem services that contribute to human well-being, including provisioning (e.g., food, fuel wood and water), regulating (e.g., flood control, water quality and water supply), supporting (e.g., biodiversity), and cultural services (e.g., recreation and esthetic) (TEEB, 2010). Historically, wetlands have been viewed as a waste of valuable land that could only be "improved" by drainage and destruction of the wetland (Mitsch and Gosselink, 1986). While wetlands are known to provide valuable ecological services, the understanding on the value of wetland services has generally led to their omission in public decision making, specifically regarding the conservation of wetlands. In this context, a large and expanding number of studies have estimated the market and non-market benefits of wetland services. The value of some ecosystem services, such as wetland production, water supply, and shipping, can be directly estimated from their market value. Not all ecosystem services are subject to market transactions. Therefore, surrogate market valuation methods, such as the shadow project method, avoided cost method, carbon tax method, and travel cost method, are required to determine a monetary measure of their value. However, when valuation data are unavailable or lacking for some ecosystem services, such as soil formation and protection, climate regulation, habitat and biodiversity, and cultural service, the conduct of original valuation research on these services are expensive and time consuming. Therefore, benefit transfer provides a cost effective method of extending economic analysis (Brouwer, 2000; Groothuis, 2003).

The middle-lower Yangtze River region, with its lake groups and river systems, is one of the important wetland regions in China. This region suffered the most loss of wetlands during the last 50 years (e.g., 41.0% loss in Poyang Lake and 34.2% loss in the Jianghan–Dongting lake group) (CLD, 2005), primarily as an outcome of the reclamation policy by the Chinese government during the staid period (An, 2003). Although research on wetland service valuation has become one of the most significant areas in the last decade or so

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http://dx.doi.org/10.1016/j.ecoser.2014.09.004
2212-0416/

(Zhang et al., 2010), most research results, especially in the middle-lower Yangtze River region, are inaccessible to the global research community because they were not reported in English. A limited number of studies about this region have been published in English (Cui et al., 2012; Guo et al., 2000; Jing and Li, 2012; Su and Zhang, 2007; Yang et al., 2008). However, these studies do not necessarily reflect the overall picture of wetland service valuation in the middle-lower Yangtze River region, although this region has been characterized as one of the main wetland resource distribution areas in China and one of the world's most ecologically and socio-economically critical ecoregion for biodiversity, freshwater, and terrestrial ecosystems (An et al., 2007).

Thus, physical dimension measurement and monetary evaluation were used to reflect the overall picture of wetland service valuation in the middle-lower Yangtze River region, the results of which would help decision makers avoid inefficiencies in wetland management. Market-based valuation, surrogate market valuation, and benefit transfer methods were used as monetary evaluation methods in this study. To validate the value transfer method, the variation in empirical wetland values in this region was identified by combining the value transfer with Geographic Information System tools (GIS) and then published both in English and Chinese as a case study.

2. Methods

2.1. Study area

In this paper, the ecosystem services of wetlands in the middle-lower Yangtze River region were valuated (Fig. 1). This region, with its lake groups and river systems, is one of the eight important wetland regions in China (An, 2003). As the third longest in the world and the longest and largest river in China, the 6300 km long Yangtze River flows from west to east and drains into the eastern China Sea in Shanghai. The Yangtze River is divided into several reaches. The middle reach runs between Yichang and Hukou (Poyang Lake mouth), while the lower reach runs between Hukou and Datong. All sections downriver from Datong are considered as estuary. The middle-lower Yangtze River region, with its many bends, is connected with many lakes. This region is referred to as the “Water Realm” is China's major wetland district. The top five largest freshwater lakes in China (10800 km^2; dominated by species of *Potamogeton*, *Prgamites*, *Acorus*, *Juncus*, *Ranalisma*, *Brasenia*, *Miscanthus*, *Vallisneria*, and *Cyperus*) are all distributed in the middle-lower Yangtze River region (e.g., Poyang Lake and Dongting Lake), while the tidal wetlands are found near the estuaries of this river. These wetlands provide the most important ecosystem service for the middle-lower Yangtze River region, which has high densities of industry and population. Despite the provision of multiple valuable services, wetlands in this region encounter a number of anthropogenic threats, including destructive and non-sustainable fishing practices, pollution and waste, mining and dredging, and non-sustainable tourism practices.

2.2. Data description

The data used to estimate the size of wetland ecosystems were extracted from twelve cloud-free LANDSAT Thematic Mapper (TM)/Enhanced Thematic Mapper (ETM) images obtained in 2009/2010 (data source: http://glovis.usgs.gov/) and DEM data

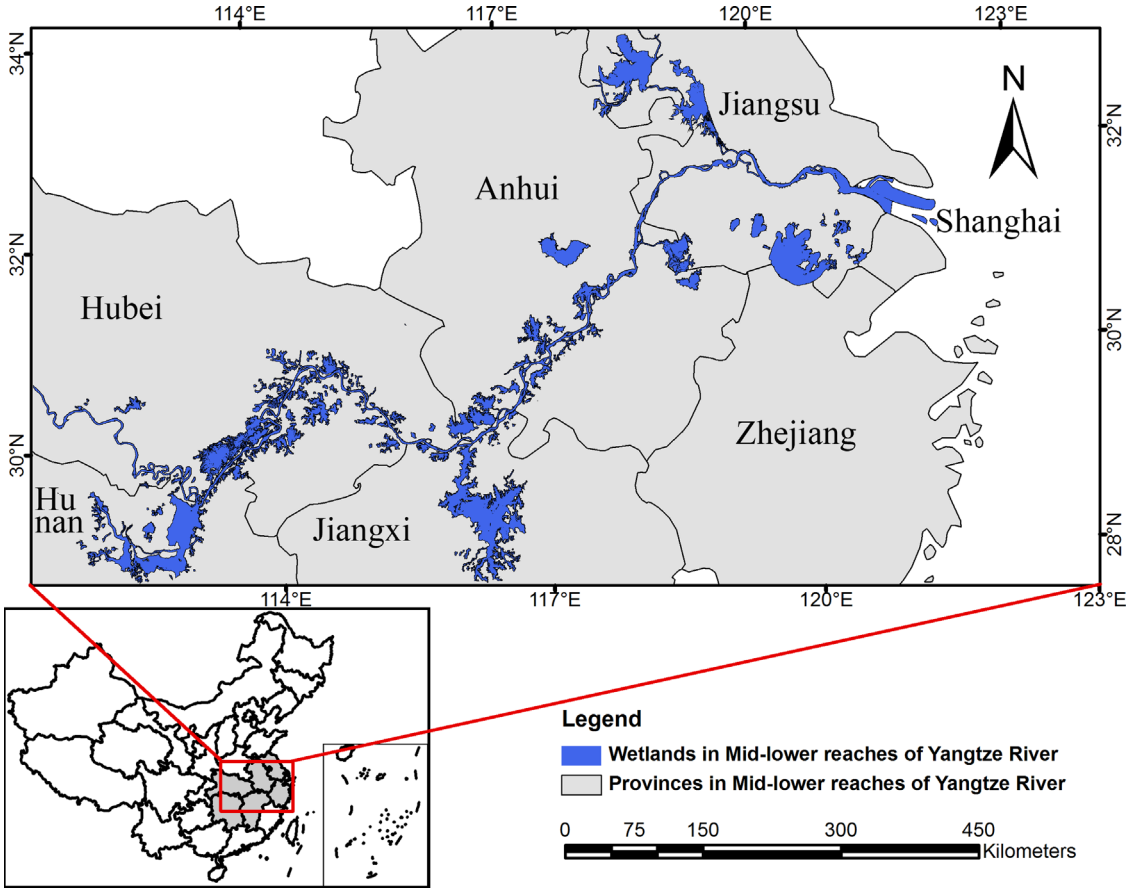

Fig. 1. Location of the study area and distribution of wetlands in the middle-lower Yangtze River region.