Land Use Policy 69 (2017) 25–40

Contents lists available at ScienceDirect

Land Use Policy

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

Monitoring cropland transition and its impact on ecosystem services value in developed regions of China: A case study of Jiangsu Province

Xiao Lu[a,b,*], Yangyang Shi[a,b], Changling Chen[b,c], Miao Yu[a]

[a] School of Geography and Tourism, Qufu Normal University, Rizhao City, Yantan Road, No.80, Shandong Province, China
[b] The Key Laboratory of the Coastal Zone Exploitation and Protection, Ministry of Land and Resources, Nanjing City, Beijingxi Road, No.43-8, Jiangsu Province, China
[c] College of Land Management, Nanjing Agricultural University, Nanjing City, Weigang, No.1, Jiangsu Province, China

ARTICLE INFO

Keywords:
Land use transition
Cropland transition (CLT)
Ecosystem services value (ESV)
Geo-information Tupu
Jiangsu Province
China

ABSTRACT

Cropland use is experiencing an intense transition in both depth and breadth with rapid development of the Chinese economy. Unwarranted land use transitions can affect the ecosystem services value (ESV) and ecosystem functions significantly. This paper reports the dynamic patterns of cropland transition (CLT) and its impact on ESV in Jiangsu Province based on land-use data from 1990, 2000, 2010, and 2013, crop yield data, empirical data related to ESV, some revisions adapted to the situation of Jiangsu, and Geo-information Tupu methods. Jiangsu has experienced rapid economic growth and urbanization, which can be seen as a microcosm of China's development. Results showed that the total area of cropland decreased markedly from 1990 to 2013. This loss of cropland took place mainly through the expansion of construction land and water area, accounting for 83.78% and 13.71%, respectively. The gain in cropland came mainly from construction land, water area, grassland, and woodland, accounting for 58.92%, 19.92%, 11.46%, and 10.22%. The transitions from 2000 to 2010 were much more significant than during 1990–2000 and 2010–2013. CLTs were accompanied by relatively concentrated distributions near towns and cities and the distributions in southern and central Jiangsu were more than in northern Jiangsu. Between 1990 and 2013, CLTs gave rise to a decrease of 6.78 million US$ ESV that was mostly caused by the transition from cropland to construction land and water area to cropland. Based on this information, some of the major implications for improving the land use policy and ecological protection policy in China were discussed. These include increased emphasis on land quality and ecological environment in balance between cropland addition and conversion, introducing ESV measures to evaluate the ecological effect of land-use planning, and establish an all-around ecological compensation mechanism.

1. Introduction

Urbanization and industrialization have accelerated rapidly in China since the economic reforms and open-door policy of the late 1970s. China's industrialization and urbanization are characterized by a significant rate of economic growth and people's income, but, at the same time, it also produced serious challenges, including regional economic disparity, aggravation of environmental pollution, and excessive consumption of the resources (Lichtenberg and Ding, 2008; You, 2015; Xu et al., 2013; Paul and Anthony, 2017). This progress in urbanization and industrialization has posed great challenges to sustainable development, especially the sustainable utilization of land resources. From 1997 to 2009, approximately 8.2 million ha of arable land were lost in China (Xu et al., 2013). However, the global loss estimated per year was about 20,000 km^2 (Huang et al., 2015). Evidence accumulated by scholars throughout the world has shown that, with socio-economic development, cropland reduction is inescapable (Kolb et al., 2013; Thompson and Prokopy, 2009). This argument is validated by the changes observed in China's cropland resources (Deng et al., 2015; Song, 2014).

Fast social-economic development has resulted in considerable land-use change. These changes were characterized by reduction in the amount of cropland and rapid expansion of urban-rural construction land in China (Long et al., 2009; Long and Li, 2012). As is known, the dynamic modifications of cropland and the level of land-use intensity are the key factors that can influence regional sustainable development and food security (Xie et al., 2014), which has become a focus of the Chinese central government. The Chinese central government has enacted numerous laws and regulations to curb indiscriminate occupancy of cropland and encourage the cultivation of new cropland. These instruments of government mainly include general land use planning, balance between cropland addition and conversion, and land-use policy

* Corresponding author at: School of Geography and Tourism, Qufu Normal University, 80 Yantai Road, Rizhao, Shandong Province 276826, China.
E-mail addresses: xl1030@foxmail.com, lvxiao@qfnu.edu.cn (X. Lu).

http://dx.doi.org/10.1016/j.landusepol.2017.08.035
Received 26 May 2017; Received in revised form 20 August 2017; Accepted 26 August 2017
Available online 12 September 2017

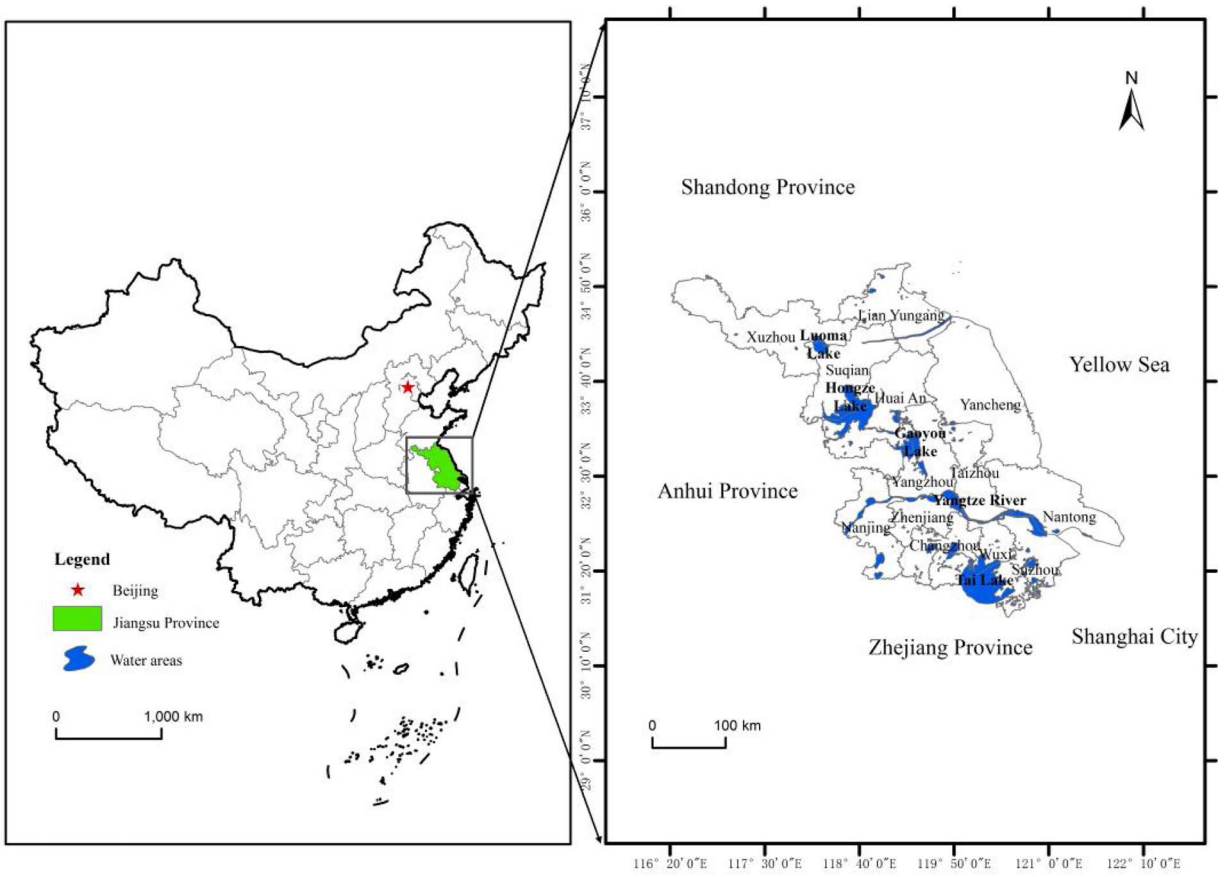

Fig. 1. Location of Jiangsu Province.

of 'urban construction land increasing vs. rural construction land decreasing balance' (Chengxiang Jiansheyongdi Zengjian Guagou Zhengce), etc (Huang et al., 2015; Yan et al., 2006; Long et al., 2012). So, the high-speed and large number of cropland occupancy and supplement become the significant showing of land use transition.

Land use transition was put forward by Grainger (1986, 1995) based on his study on the land use in forested countries (Long and Li, 2012; Grainger, 1986; Grainger, 1995). From then on, the research concerning land use transitions has been carried out vigorously, but which mainly focused on forest transition (Satake and Rudel, 2007; Barbier et al., 2010; Yeo and Huang, 2013; Mather, 2004, 2000; Dan, 2010). With the consideration of land use transitions by the academics of China, related studies have been extensively carried out, especially on cropland transitions (Song, 2017). Recently, issues related to CLT in China have been of interest to many researchers. Some favor theoretical hypotheses and verification (Song, 2017; Song et al., 2014; Long and Li, 2002; Li, 2008), the morphological evolution of cropland (Liu et al., 2015a; Xiang et al., 2016), functional transition of cropland (Song et al., 2015a), and others aim to understand the driving forces and coupling mechanisms of CLT (Xu et al., 2013; Long and Li, 2012; Liu and Long, 2016). Since there are obvious human-land conflicts, CLT has a significant effect on China's sustainable development, and even global food security. With the rapid economic development and urbanization, the substantial occupation of cropland for non-agricultural purposes since the 1980s has become widespread phenomenon in developed regions of China. The concern over the threat of China's incapacity to meet its domestic food needs (Brown, 1995). induced some major policy changes in the late 1990s (Zhang et al., 2014), which requires replenishment of cropland with an equivalent amount and quality to that of cropland lost to non-agricultural use (balance between cropland addition and conversion) (Zhong et al., 2017). So, the dramatic CLT took place and leads to complex effects. The research on CLT in China just focusing on land itself and food security are incomplete, to some extent, their dual process of occupancy and supplement due to land use policy, and their effects on ecosystem need to be paid more attentions. While there have been some studies that analyzed the effects of land use transition on eco-environment quality and ecosystem services (Satake and Rudel, 2007; Lv et al., 2013; Liu et al., 2015b; Long et al., 2014; Tsai et al., 2015), the effects of CLT on ecosystem services in developed regions of China has received much less attention.

The most evident requirement of information is the area affected by land use change, but some characterization of its geographical patterns is also necessary (Pinto and Nelson, 2007). In particular, the study of spatial patterns and their control is valuable to understanding the proximate causes of change (Müller et al., 2012; Gasparri et al., 2015). In the existing studies, the methods integrated into spatial pattern and temporal processes of CLT need more in-depth research. To fully understand CLT spatio-temporal process, the new methods should be introduced and examined. Geo- information Tupu is a methodology for spatial and temporal graphical analysis. It synthesizes the succinctness of comprehensive landscape maps and the abstractness of mathematical models, and can visually display the essential attributes of complicated problems and construct graphics modes of corresponding phenomena (Ren et al., 2007; Ye et al., 2004a).

In recognition of the above, the objective of this paper was to identify dynamic patterns of CLT and its impact on ESV in a developed region of China. Specifically, the paper investigates: (1) to assess the dynamic patterns of CLT in Jiangsu province using the geo-information Tupu method; (2) to evaluate the changes in ESV by connecting the observed CLT and the evaluations of ESV considering the research of Costanza et al. (1997), Xie et al. (2008) and some revisions adapted to the situation of Jiangsu; and (3) to discuss the major implications for land use policy in China.