



Farmland protection policies and rapid urbanization in China: A case study for Changzhou City



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ABSTRACT

The purpose of this study was to analyze the spatial and temporal patterns of farmland loss and fragmentation and to explore factors that may influence that loss and fragmentation. The study examined changes to farmland in a context of rapid urbanization in Changzhou City, China. It also examined farmland changes in the suburban areas outside the city and in the exurban regions. Time series data from 2004 to 2011 were used to conduct spatial analysis using landscape indices and to perform a redundancy analysis. The results found that farmland was steadily declining during the study period. Farmland also became increasingly fragmented and it moved from low elevation and a gentle slope terrain to higher elevation and a steep slope terrain while its center of gravity generally moved northward. China's farmland protection policy, agricultural production level, and terrain conditions contributed most to farmland loss and fragmentation in the city. Farmland loss and fragmentation in the suburbs and exurbs were influenced mostly by prime farmland area, total population, and per capita net income of rural residents. To control farmland loss and fragmentation, laws regarding its conversion to built-up environments should be enforced. China's overall land-use plan and laws of farmland protection are presently the best ways to effectively protect farmland loss and fragmentation.

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1. Introduction

Farmland is a critical resource for the survival and development of human beings. Over the centuries, farmland has continually increased in response to population growth (Huber et al., 2014). However, with the development of social economies and changes in natural environments, farmland is shrinking in some places (Foley et al., 2005; Deng et al., 2006, 2011; Zhang and Cai, 2011; Antón et al., 2013; Griffiths et al., 2013). Rapid industrialization and urbanization have been the largest contributors to industrial land sprawl and urban land expansions in the developed regions of the world (Thompson and Prokopy, 2009; Liu et al., 2010). Continual demands for residential or commercial land development

has a large influence on farmland loss because farmland is highly suitability property for construction.

China is known for its long agricultural civilization and farmland has traditionally been cherished as a family's most basic property. For centuries, the extent of China's farmland increased in response to its people's needs. However, in the latter part of the 1970s, the Chinese government embarked on a strategy of reforms and openness policies with which it made a major socioeconomic transformation. Industrialization and urbanization developed at an unprecedented rate. During the past three decades (1978–2012), China gradually entered the mid- and post-industrialization phase. Over that period, urbanization increased from 17.6% in 1978 to 46.6% in 2009 (National Bureau of Statistics of China, 2010). China also experienced a population explosion during this period. According to the basic statistics of the national population censuses of 1982, 1990, 2000, and 2010, the urban population increased from 0.21 billion to 0.66 billion and the corresponding urbanization rate climbed from 20.91% to 49.68% (National Bureau of Statistics of China, 2013). As a result, the demand for land for urban housing soared along with demand for business and built-up land

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use. Consequently, much of the farmland was converted into non-agricultural built-up environments (Seto et al., 2000; Long et al., 2009; Li et al., 2014b). Additionally, eco-environmental degeneration endangered the agricultural systems, farmland areas, and production (Huang et al., 2007; Hu et al., 2014). A land alternation survey performed by the Ministry of Land and Resources in 2011 found that about 91.05% of the farmland loss was caused by usurpation for construction. The remaining 8.95% was due to the 1999 Grain for Green conservation program intended to mitigate soil erosion and from damage caused by natural disasters MLR (Ministry of Land and Resource of China), 2011. Statistics indicate that a total of about 8.32 million ha of farmland were lost in China between 1996 and 2008 (National Bureau of Statistics of China, 2010).

Many studies have been conducted to explore the causes of farmland loss and the factors that contribute to it. Alcantara et al. (2012, 2013) studied abandoned farmland, which is one of the causes of farmland decline, using MODIS (Moderate-resolution Imaging Spectroradiometer) time series satellite data. Müller et al. (2013) employed boosted regression trees to study the determinants of cropland abandonment and found that geography (elevation and slope) had a strong effect on the likelihood of abandonment. Griffiths et al. (2013) analyzed the effects of social and political institutions on agricultural land change. Su et al. (2014b) chose four indicators to study the effects of urbanization on farmland change at the eco-regional level of analysis. Lichtenberg and Ding (2008) assessed the influence of China's farmland protection policy and concluded that China does not effectively protect its farmland. However, farmland fragmentation analysis and studies on the transition of farmland from lower to higher elevations or slopes, which is a common phenomenon in China, are scarce. Moreover, most of the studies about causal forces are limited to one type of unit of analysis and a fixed space (Jan Peter Lesschen et al., 2005; Ostwald et al., 2009; Yan et al., 2010). Yet, the factors that influence farmland loss and fragmentation differ by unit of analysis and across space. To fully understand farmland loss, the problem should be examined with respect to different units of analysis and from different spatial perspectives.

This study analyzed farmland loss and fragmentation with respect to slope, elevation, landscape, and change to the center of gravity. Furthermore, factors that may influence the farmland changes are discussed with respect to different units of analysis (i.e. urban, suburban, and exurban) and from different perspectives (i.e. socioeconomic development, policy, and terrain conditions). The effects of specific factors on farmland change are statistically assessed to determine the correlations of farmland change. The objectives of the study are to: (1) analyze the trend of farmland change in China's developed areas that have experienced rapid urbanization and (2) combine socioeconomic factors with natural indicators to quantify influential factors related to farmland change in the study area from different perspectives and for different units of analysis.

2. Related context of Chinese farmland protection

2.1. The evolution of land management system

China's land management system has undergone four stages since the founding of the People's Republic of China in 1949 (Fig. 1). The first stage (1949–1956) was the centralization of management of the land resources intended to abolish the feudal and semi-feudal land system and institute a system of land to the tillers. The Land Bureau was created to be responsible for the administration and supervision of all of the land in the country.

However, the centralization of land resources' management was changed because land management was divided into different

administrative departments in the three decades after 1956 (Fig. 1). The Ministry of State Farms and Land Reclamation was responsible for developing the wasteland, whereas the Ministry of Agriculture, Livestock, and Fishery was in charge of agricultural land management. Several functional departments, such as the Ministry of Civil Affairs, Communications, Railways, and Construction, were created to be responsible for construction. Thus, at that point, land management was in a stage of decentralized management characterized by land resources under the administration of a variety of government ministries.

The Chinese society and economy developed because of the implementation of reforms and openness, and construction requests rapidly increased. Illegal land-use behaviors, such as unauthorized occupation of farmland (squatting), farmland contamination, and disorderly urbanization, manifested under the decentralized management system. Even the "Enclosure Movement," which originated in the British Isles, occurred in China in 1984. With the goal of standardizing the land-use management system, the Chinese government issued the strengthening management to land use and prohibited squatting on farmland in March of 1986 (The State Council of the People's Republic of China, 1986). Then, the National Land Administration was created to be responsible for the centralization of land-use management.

However, in 1993, the "Enclosure Movement" was continuing and different types of unlawful and unauthorized land-use behaviors intensified. In response, the Chinese government issued an order on vertical management of institutes of land and resource in provinces in April of 2004 (The State Council of the People's Republic of China, 2004). The order expressly pointed out that the land administrative departments in the provinces must relinquish their authority over the land resources and their power of appointments and removals to the provincial governments. Furthermore, the State Council created the state land supervision system in 2006 to further strengthen land administration. At that point, although vertical administration with respect to China's land-use management was in place, the land supervision system did not function well due to its poor operational efficiency. Currently, unlawful land occupation and harmful land conversion from agricultural to non-agricultural uses continue to endanger the farmland resources.

2.2. Farmland protection policy system change of China

Awareness of farmland protection in China by different groups began with the rural reform in 1978. The government's work report in 1978 proposed to increase the farmland area by enlarging the extent of land reclamation (GOSC, 1978). However, the actual beginning of the farmland protection policy was between 1986 and 1997 (Fig. 1). "Farmland protection is a basic state policy for China" was proposed by the Central Committee of the Chinese Communist Party (CCP), documented for the first time in 1986 (The State Council of the People's Republic of China, 1986). All levels of government began to pay more attention to farmland protection.

Subsequently, the Sixth National People's Congress Standing Committee approved the Law on Land Management of the People's Republic of China (PRC) in June of 1986, at which time land management obtained laws. Furthermore, the "people who occupy the farmland must undertake the obligation to develop the farmland" was also proposed in the government's work report in 1990 (GOSC, 1990). However, the specific measures of farmland protection were not introduced until the "Regulations on the Protection of Prime Farmland" was proposed by the State Council of China in 1994 (The State Council of the People's Republic of China, 1994). The construction of prime farmland has played a key part in farmland protection for a long time. The disadvantage of the farmland protection system was that there were no specific laws to support implementation of the policy.

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