



Land-use changes and land policies evolution in China's urbanization processes



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ABSTRACT

Ensuring food security and sustainable development in China has been threatened by the dilemma of the rapidly growing consumption of the country's land resources. Research on the linkage between land-use changes and land policies in the process of industrialization and urbanization has received increased attention in recent years. The present study was conducted to analyze the underlying dynamics for Chinese land policies and land-use changes based on reliable land-use data and to develop a thorough understanding of the historical drivers and pathways of land-use changes and China's deep-seated land issues, as well as the social, political and economic factors involved. The results showed that land-use changes were linked closely to shifts in government land policies and socio-economic development in China. The evolution of land policies in China was the result of a path-dependent process, which included the reform of land use system, the economic development environment as well as a policy-making process that responded to short-term land development. The results also indicated that there have been considerable achievements regarding the land use system and land management in China. However, Chinese economic growth overly depended on investments as well as land finance, which were uncoordinated and unsustainable. The changes in land use were also the outcomes of the land policy failure. There is still a pressing need to reform land policies for more efficient and effective utilization of limited land resources; develop a trade-off and synergy among urban development, agricultural production and ecosystem preservation; differentiate land-use policies; allocate market-oriented land resource; and establish a national macro-control mechanism in collaboration with a coordinated land-use policy and basic legislation.

1. Introduction

Food security and sustainable development remain the basic priority of China's national development policy but are threatened by the problematic relationship between land for economic development, agricultural production and ecological protection. Due to economic development and population growth, China's land area per capita decreased by two and a half times and the amount of land under cultivation per capita was also cut in half over a sixty-five-year period. All land is scarce due to competing demands for its use, and sustainable land use and coordinated land policies have come under increasing pressure from industrialization and urbanization and ecological civilization construction. One-eighth of China's gross land area is under cultivation, and its diminishing cultivated land must be used more effectively and efficiently. Valuing and rationally utilizing every inch of land and steadfastly protecting cultivated land and natural ecosystems

are very significant in order for China to push forward with sustainable industrialization and urbanization.

The sustainability of land utilization is a key issue in the process of a nation's industrialization and urbanization in terms of economic power, food provision, land conservation and regional development (Schlager and Ostrom, 1992; Spalding, 2017; Mertz and Merens, 2017; Wang et al., 2018a). Research on the relationship between land-use change and land policies has received increased attention in recent years. Many studies have focused on Chinese economic reform and development of urban land-use policies, land-use markets and operation of land-leasing systems (Tang, 1989; Liu and Yang, 1990; Yeh and Wu, 1996; Zhang, 1997; Ye, 2007; Liu et al., 2017). Siciliano (2012) studied impacts of urbanization and socio-economic development on agriculture and rural communities in China. Some researchers studied on current land-use policies and drivers for land-use changes and their related policy changes, focused the conversion of land to non-agricultural uses (Ding,

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2003; Lin and Ho, 2003; Ho and Lin, 2004; Feng et al., 2005; Wang et al., 2012; Wang et al., 2018b), and impacts of endogenous socio-ecological forces or exogenous socio-economic factors on land-use transitions (Lambin and Meyfroidt, 2010). Some issues related to the land-use systems and land policies, such as the land allocation system and its relationship to cultivated land protection (Lichtenberg and Ding, 2008), the land requisition system reform and farmers' compensation policy (MLR, 2003), and conflicts between the land allocation system and agricultural land tenure policy (Wang et al., 2010), were discussed. The underlying concern regards uneven regional development, insecurity of ecosystem, and growing inequities between China's diminishing rural and increasing urban populations. From perspective of food security and cultivated land protection, Wu et al. (2017) analyzed and pictured Chinese future cultivated land protection policies focusing on dynamic balance system and basic farmland zoning. Li et al. (2009) studied the land administration system for cultivated land protection. Deng and colleagues (2006) have been skeptical regarding threats to national food security caused by the conversion of cultivated land to urban use using land-use data from satellite images between 1986 and 2000. They argue that such losses were and would continue to be balanced by increased productivity under agricultural modernization. From perspective of urbanization and ecological protection, relationships between urbanization and cultivated land loss/degradation (Cai, 1990; Yang and Li, 2000; Tan et al., 2005; Chen, 2007), the role of human activities on changes in ecological land (Wang et al., 2018a, 2018b), and land intensive use and land pollution (Hill, 1994; Cao and Guan, 2007; Li et al., 2017), have been studied.

Moreover, from the viewpoint of the linkages between land policies and land-use change, Mertz and Merens (2017) reviewed the driving forces and their outcomes behind land sparing or land sharing policies and concluded that land sparing is the dominant land policy paradigm in developing countries. Spalding (2017) explored the evolution of land tenure and land-use change and discussed the linkages between land-use management and land-use change at the local level in Panama. Bennett et al. (2018) concluded that the link between oil palm expansion and land rights at both the household and village levels in the study area was not a direct causal relationship. Liu et al. (2017) reviewed the development of China's cultivated land protection policies in the period following China's reform and liberalization but there was a lack of thorough explanations concerning why changes in cultivated land potentially conflicted with the legally guaranteed cultivated land policy. However, research into Chinese land-use changes and deep land issues and their links to land policies from the perspective of coordination in industrialization and agricultural modernization and ecological preservation has been hindered by an absence of reliable detail land-use data and a lack of a thorough understanding of the historical drivers and pathways of land-use changes and ensuing land policies and management regimes. Little is known about the linkages between land policies and land-use change (Jepsen et al., 2015; Spalding, 2017), and there are few discussions about solutions to land-use issues regarding the uneven and uncoordinated development that have accompanied China's rapid economic development and modernization from the perspective of land-use strategy.

To date, land policies that have accompanied China's rapid economic development and modernization have been somewhat unsustainable in certain periods. The underlying concern regards conflicts between economic development and agricultural production and ecological protection, uneven regional development, and growing inequities between rural and urban areas. Developing effective land policies is crucial to addressing China's national and regional development and sustainability goals. The present study was conducted to analyze the undergoing dynamics for Chinese land policies and land-use changes and to discuss the pathways between land policies and land-use changes in the context of economic development and urbanization drivers and outcomes. In addition, we propose transformations of land-use policies accompanied by rapid economic development and

urbanization. This study is based on a longer-term view framed by an understanding of the country's land-use changes and policies that have occurred over different periods in Chinese urbanization processes, using reliable surveyed land data.

2. Materials and methods

Details on land-use changes were obtained from official sources that included the first national land-use survey by the former China State Land Administration Bureau (CSLAB) in the mid-1990s (CSLAB, 1996; Ma, 2000; Liu, 2000), the second national land-use survey by the Ministry of Land and Resources (MLR) in 2009, and the annual land-use change surveys carried out by the MLR and published as the 'Comprehensive Statistics Annals of Land and Resources'. Those data were supplemented by other various data published by the China State Statistics Bureau (CSSB) that included the "China Statistics Yearbook" and "New China's 55 Years Compilation of Statistical Data" (CSSB, 1995). The data on cultivated land from 1978 to 1995 were extrapolated from the net increase (or decrease) of cultivated land according to the statistical data, and the other data on land use in 1978 and 1995 were cited from "New China's 50 Years 1949–1999" published by the China State Statistics Bureau (CSSB, 2000). The social and economic data from 1949 to 1999 were cited from "New China's 50 Years 1949–1999". The data from 2000 to 2015 were cited from the "China Statistics Yearbook", which was also published by the China State Statistics Bureau (CSSB, 2000–2015).

The degree of land use was calculated using a land-use degree model (Liu, 1992):

$$L_i = 100 \times \sum_{i=1}^n (A_i \times P_i) \quad (1)$$

where L_i is the degree of land-use type i , A_i represents the graded index of land-use type i , P_i represents the percentage of land-use type i area to the total land area of the region, and L_i value is distributed between 100–400. The degree of land use represents the level of land intensive use to some extent. The degree of developed land intensive use was evaluated through a comprehensive model of multi-index comprising the following factors: land investment intensity, land-use level, land-use efficiency and sustainable land-use status. The factor of land investment intensity included three indicators: fixed investment per square kilometer of land, fiscal expenditure per square kilometer of land, and road density. The factor of land-use level was composed of three indicators: the area of developed land per capita, the developed land-use rate, and degree of land use. The factor of land-use efficiency was composed of two indicators: the primary, secondary and tertiary industrial GDPs per square kilometer of land as well as the total industrial production value per square kilometer of land. The factor of sustainable land-use status was composed of two indicators: the area of public green space per capita and urban afforestation coverage. The weights of the evaluation factors and indicator were obtained using the expert scoring method.

The comprehensive model of multi-index can be expressed as:

$$S = \sum_{i=1}^m \left\langle w_i \times \left\{ \sum_{j=1}^n [w_j \times Y_j] \right\} \right\rangle, \quad (2)$$

where S is the degree of developed land intensive use, w_i represents the weight of evaluation factor i , m represents the number of evaluation factors, w_j represents the weight of evaluation indicator j , n represents the number of evaluation factors, and Y_j represents the value of the evaluation indicator j .

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