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Impact of the top-down quota-oriented farmland preservation planning on the change of urban land-use intensity in China

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ABSTRACT

Although the National General Land Use Plan (1997–2010) came into effect in 1999, there has been no research investigating whether the farmland protection planning embedded within the top-down general land-use plans has contributed to promoting intensive utilization of urban land. This paper aims to assess the impact of farmland preservation efforts in the plans on the changes in urban land-use intensity, by focusing on two policy tools – prime farmland preservation and farmland conversion quotas. The study developed an approach to categorize and measure the change in urban land-use intensity by combining the changes in population density (in terms of population per unit of urban land area) and economic density (in terms of GDP per unit of urban land area). An ordinal dependent variable was generated based on the categories of changes in urban land-use intensity and a multilevel ordinal logit model was used in this study. The study indicates that (1) the farmland conversion quota system did not contribute to promoting urban land-use intensification between 2000 and 2010; (2) the prime farmland preservation had very limited impact on the intensity of urban land-use intensification. The prime farmland preservation would not influence urban land-use intensity when it was not high enough. The increase in the prime farmland preservation ratio in prefectural-level regions could lead to urban land-use intensification but only when the prime farmland preservation ratio was above 93%; and (3) the central government's supervision of local land-use played a significant role in promoting urban land-use intensification.

1. Introduction

Besides preserving farmland, farmland protection policy has played a role in urban growth management. While the stated purpose of the agricultural land reserve (ALR) in British Columbia of Canada is to preserve farmland, the ALR has acted as a *de facto* urban growth boundary (Smith & Haid, 2004). Existing studies have focused on two aspects when looking at the influence of farmland protection. One aspect is the effect of farmland protection policy on farmland loss (Kline & Alig, 1999; Nixon & Newman, 2016; Zhong, Huang, Zhang, Scott, & Wang, 2012). Although some studies indicate that agricultural preservation programs reduce agricultural land conversion in the USA (Irwin & Bockstael, 2004), there is no consensus about the effectiveness on farmland loss (Liu & Lynch, 2011). The second aspect is the impact of farmland protection on urban spatial expansion (Feng, Lichtenberg, & Ding, 2015). It is unclear what effect farmland zoning in Oregon, the USA has had on slowing urban expansion (Kline & Alig, 1999). Besides the scale of urban spatial expansion, urban land-use intensity in terms of population, building or employment density is also one of the key

concerns in urban growth management (Boyko & Cooper, 2011; Moomaw, 1978; Paulsen, 2013; Wang, Antipova, & Porta, 2011).

Very few studies have investigated the impact of farmland preservation policy on urban land-use intensity. Urban density has been viewed as one of the most important conditions for urban intensity (Porqueddu, 2015), but only a few pertinent studies focus on the impact of farmland protection on urban density. The influence of agricultural zoning on urban density has been investigated by some studies. Agricultural zoning is measured by a dummy variable (Anthony, 2004; Yin & Sun, 2007) or the share of subdivision perimeters in preserved farmland (McConnell, Walls, Kopits, Zoning, 2006). The impact of farmland protection on urban densities in the USA remains controversial. Some studies maintain that agricultural land protection zoning increases urban density (Anthony, 2004), while others argue that agricultural land protection zoning reduces urban density (McConnell et al., 2006; Yin & Sun, 2007). In Switzerland, agricultural zoning does not increase the intensity of construction land-use (measured by area of land-use per resident) due to the lack of necessary implementing instruments (Mann, 2009). Alongside restricting land

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development with agricultural zoning, urban growth boundaries or residential zones usually determine the size of land available for development. A study indicates that the increase in the share of land in residential development zone reduces residential densification in the Netherlands (Broitman & Koomen, 2015). Besides agricultural zoning, TDR (Transferable Development Rights) is another important tool for farmland protection in the USA. An empirical study indicates that there is no significant effect of TDR on urban density (McConnell et al., 2006).

Unlike zoning-oriented land-use planning in many countries, land-use planning in China is mainly quota-oriented. Most Chinese cities expanded towards less compact from 1990 to 2010 (Jiao, 2015). Urban land has expanded at a rate faster than that of urban population for a long time. For instance, urban land expanded by 106.8% while non-agricultural population increased by 59.7% during 1986–1996 (GOSC, 1999), translating to a ratio of about 1.8. This has been viewed as an “exogenous form” of urban expansion (Hui, Wu, Deng, & Zheng, 2015). Faced with a large population with limited land, the Chinese central government released the National General Land Use Plan (1997–2010) in 1999 (or 1997 National Plan), in which one of the main planning goals was to promote land-use transition from an expansive to intensive form (GOSC, 1999). The principal tool to achieve this goal was to control and manage rural land conversion to urban land through a top-down land conversion quota system, with its special stress on farmland to non-agricultural land-use conversion quota and farmland preservation quota (GOSC, 1999).

Farmland preservation has been used as a tool to promote intensive use of urban land. Intensive utilization of urban land has been a well-discussed research topic and an important issue in government policy making in Mainland China (Hui et al., 2015). In China, land has played a critical role in economic growth (Bai, Chen, & Shi, 2012), and land supply has been used as a governmental apparatus for intervention in urban development (Tian & Ma, 2009). Along with population and economy, land-use planning is an important factor that influences urban spatial expansion patterns (Reginster & Rounsevell, 2006). Urban expansion in China is not only impacted by local governments but also subject to the quota of newly-increased urban land allocated by the central government (Liu & Lin, 2014), especially the quota of farmland conversion to non-agricultural use (Zhong et al., 2017). As urban expansion has been one of the major causes of farmland loss (Wang, Chen, Shao, Zhang, & Cao, 2012) and farmland the primary source for urban land supply (Du, Thill, Peiser, & Feng, 2014; Kuang, Liu, Dong, Chi, & Zhang, 2016; Wang, Li et al., 2012), farmland protection and urban land growth management have been adopted by the Chinese central government to support each other (Zhao, 2011). Thus, farmland protection has also been used to control urban spatial growth (Liu, Liu, & Qi, 2015), and strict farmland protection is one of the principal urban containment strategies (Zhao, 2011). As availability of land is an important factor for urban economic growth (He, Huang, & Wang, 2013), strict control of farmland conversion to urban use has been imperative in enhancing urban land-use efficiency (Liu et al., 2015).

There are three research gaps in previous studies. First, research has focused on zoning-oriented farmland preservation and little attention has been paid to quota-oriented farmland preservation. Previous studies have investigated the impact of agricultural zoning on urban land-use intensity (Anthony, 2004; McConnell et al., 2006; Vyn, 2012), with a lack of understanding of the influence of quota-oriented farmland protection planning on urban land-use intensity. Although the 1997 National Plan with the planning horizon of 1997–2010 came into effect in 1999, to our knowledge there have been no studies investigating whether the farmland protection planning embedded in the top-down general land-use planning has contributed to promoting intensive utilization of urban land. Second, research has focused on land-use intensity measured by population, employment and dwelling densities (Boyko & Cooper, 2011), and little attention has been paid to land-use intensity measured by economic density and the combination of

population and economic density. Third, most studies have focused on individual cities (Zhang et al., 2016) and little attention has been given to the effect of national farmland preservation planning on national scale urban land-use.

This paper aims to investigate the impact of China's top-down farmland protection planning on the change in urban land-use intensity during the planning period of 1997–2010, and answer the following questions: (1) whether the level of prime farmland preservation mattered; (2) whether farmland conversion quotas in land-use plans contributed to increasing the intensity of urban land-use; (3) whether the supervision from the central government contributed to intensive use of urban land. In the following sections, the paper gives a brief description of the top-down quota-oriented farmland preservation planning. Then the data and methodology are presented, followed by the results, discussions and conclusions.

2. Theoretical analysis on the influence of farmland preservation on urban land-use intensification

2.1. Quota-oriented top-down farmland preservation planning in China

There has been a top-down land-use planning system in China since the 1990s. The Land Administration Law amended in 1998 requires that a local general land-use plan be developed on the basis of its immediate upper level general land-use plan (SCNPC, 1998). After the 1997 National Plan came into effect in 1999, a series of local general land-use plans for the planning period of 1997–2010 were introduced around 2000, including provincial-, prefectural-, county- and township-level plans.

There are two kinds of key quotas regarding farmland preservation that affect urban expansion: prime farmland conversion quotas (FCQ) and prime farmland preservation quotas (FPQ), which are handed down to the township level through the top-down land-use planning system. Farmland conversion quota (FCQ) refers to the amount of farmland that is planned to be converted to non-agricultural use. The 1997 National Plan stipulates that the amount converted from farmland should be less than 1.97 million ha between 1997 and 2010 (GOSC, 1999). Prime farmland preservation quota (FPQ) refers to the amount of farmland that should be designated as prime farmland. The conversion from prime farmland to non-agricultural use needs approval from the State Council (SCNPC, 1998). The 1997 National Plan planned to preserve 108.56 million ha of prime farmland in the planning period of 1997–2010.

County- and township-level land-use plans are required to designate prime farmland protection zones (PFPZ), where most farmland is assigned as prime farmland (Zhong et al., 2012, 2017). Five types of farmland are required to be designated as prime farmland in the PFPZ (SC, 1998). Farmland in the vicinity of cities or towns, or along railways or highways, is listed in the five types (SC, 1998), which aims to curb urban expansion. However, the boundaries of PFPZ are actually quite flexible as local government could easily reassign prime farmland and adjust PFPZ boundaries (Ping, 2011; Yang & Wang, 2008).

2.2. The linkage between farmland preservation and urban land-use intensification

The farmland preservation planning could decrease the supply of urban land in China. The farmland preservation planning sets a cap for farmland conversion to non-agricultural use for a planning horizon (Zhong et al., 2017). Farmland is a major source for urban expansion in China (Feng et al., 2015). About 74% of new urban land in Beijing-Tianjin-Hebei region was converted from farmland from 1990 to 2000 (Tan, Li, Xie, & Lu, 2005). At the national-level, about 63% of urban and industrial land expansion occurred on farmland during the same time (Kuang et al., 2016). It is estimated that about 68.7% of the land for urban expansion was converted from farmland during 2000–2010

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