



## Implications of land-use change in rural China: A case study of Yucheng, Shandong province



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### ABSTRACT

Based on surveys on rural land-use change at village scale in Yucheng City, Shandong province, this paper presents how land-use change takes place in response to inhibitive institutional forces in light of an out-moded land ownership system and unreasonable land use rights administration, and discusses it in the broader social context of industrialization, rural depopulation, a dual-track land market, and land use legislation. Spatial comparison of land use maps interpreted from aerial photographs in different period unveils a decrease in arable land for farming, and an increase in rural settlements, facilities land and unused land. Despite rural depopulation, rural settlements area nearly tripled during 1967–2008. Nearly all newly gained non-agricultural land originated from farmland at the village fringe while formerly facilities land and unused land had been converted to residential use and it was abandoned later. Thus, the destructive farmland conversion from productive use to non-agricultural uses took place at multiple stages. Questionnaire survey of 1650 households in 48 villages in Yucheng City indicated that 41% of the households had multiple dwellings, even though some of them are not occupied or even ruined. This finding may damp the rosy picture of the reportedly slowdown in China's farmland reduction in recent years as these destructive changes are too small to detect from satellite imagery, and it will also provide a practical scientific basis for constituting more strict farmland protection objectives and strategies for China in the near future. In order to hold back the destructive conversion trend from farmland to non-agricultural uses, the authors argue that policy and institution innovation concerning land use and urban–rural development in China needs feature highly in the government's agenda.

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### Introduction

In China, increasing economic liberalism, integration into the global economy and the policies designed to support these economic goals have caused rapid industrialization and urbanization, technology innovations and consequent economic growth and environmental change, especially in the coastal regions, and these have become the dominant trends (Siciliano, 2012; Long and Woods, 2011; Donaghy, 2011; Woods, 2007). One of the major issues of development under rapid industrialization and urbanization is increasing socio-economic inequalities especially between rural and urban areas, as evidenced by the increasing income gap

between urban and rural residents, from 2.56:1 in 1978 to 3.33:1 in 2009 (NBSC, 2010; Long and Woods, 2011; Li, 2012).

Rapid urban sprawl usually resulted in accelerated rural restructuring due to depopulation, agriculture structure adjustment and scale management, technology innovations, as well as the spatial-territorial, administrative and industrial reorganization in rural area (Hoymann, 2011; Long et al., 2012; Woods, 2005, 2010). Accompanying with this accelerated restructuring process driven by related policies, tremendous land-use change has occurred in rural area of China (Wang et al., 2012; Peng et al., 2011; Zhong et al., 2011; Deng et al., 2009; Long and Liu, 2012; Wu and Zhang, 2012). Since farmland and rural housing land are the two major land-use types closely related to human livelihood and production activities (Long and Li, 2012), the changes of land use in rural area mainly present the changes of farmland and rural housing land in this restructuring process (Zhang et al., 2012; Su et al., 2011; Long et al., 2009; Liu et al., 2010a,b). Migration, rural economic development, and urbanization are the primary forces driving the conversion from farmland to non-agricultural uses in China (Xie

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et al., 2005; de Souza Soler and Verburg, 2010; Fan and Zhang, 2012).

Despite the large number of studies on the driving forces of land-use change (e.g., Turner, 1999; Verburg et al., 2004; Caldas et al., 2007; Hao and Li, 2011), only a few have addressed the role of inhibitive institutional forces, such as land tenure, administration of land use rights, and enforcement of land protection policies and laws, in land-use change. Usually, institutional forces have a far reaching scope of influence on land-use change that ranges from local to national in scale. Institutional forces can function as either a facilitator or an inhibitor. For instance, the state facilitates land-use change by providing services and improving accessibility (Rasul et al., 2004; Walker and Solecki, 2004). They can also act as an inhibitor by imposing restrictions on land-use change. For instance, the conversion from farmland to residential use is constrained by land-use regulations, provision of municipal services, and zoning plans (Newburn and Berck, 2006; Liu et al., 2008), in addition to environmental and social conditions (Deadman et al., 1993). Restrictions are imposed to minimize the cost of providing the service or to preserve the land resources. The demand for rural living can also be curtailed through restrictive policies that regulate the supply of residential land (Heins, 2004). Thus, the land-use change from farmland to rural settlements is subject to the influences of inhibitive institutional forces. Xu (2004) discussed the conflicting roles of local government in preventing and in promoting land-use change from agricultural to non-agricultural uses.

Destructive land-use change, defined usually as a change from a productive use to a non-productive use, has been studied by Witmer (2008) who examined war-induced farmland abandonment. It is important to study destructive land-use change such as the conversion from productive farmland to other uses because it has profound repercussions for food security in a land resource-scarce country such as China where rapid industrialization has encroached a huge quantity of agricultural land, and given rise to continuous reduction in farmland on an unprecedented scope (Liu et al., 2010c; Long et al., 2009). According to the bid-rent land use theory developed by Von Thünen (1966), a renter is prepared to pay the most for obtaining the rights of using the land to maximize the return. Thus, the land is treated as a factor in the production of agricultural goods, subject to the distance to the market, a proxy for transportation costs. What has been missing from this theory is a stage component. A certain type of land-use change takes place at two stages with the objective of the former stage of change differing from that at the second stage. The first and destructive stage of change may not bring any return at all, in contravention to the bid-rent theory.

The aims of this paper are to elucidate how destructive land-use change can take place in productive farmland in the vicinity of villages in rural Shandong province in order to overcome inhibitive institutional forces, and to explore the implications of such destructive change for effective farmland protection. In particular, this paper unveils how the collective land owners circumvent institutional restrictions by engaging in multi-stage land-use changes.

## The study area

Shandong province, located in eastern coastal China approximately 400 km southeast of Beijing, has experienced drastic changes in land use since the initiation of economic reforms in 1978. Rapid urbanization and industrialization boosted the development in the rural areas. In 2009, the rural population in Shandong province was 59 million, accounting for 62.5% of the total population, which was only about 9 percent points higher than that of the national level. In 2009, the shares of primary industry, secondary industry and tertiary industry in gross domestic product

(GDP) were 9.5%, 55.8%, and 34.7%, respectively, in Shandong; however, they were 10.3%, 46.3%, and 43.4%, respectively, in China (SSB, 2010; NBSC, 2010). It shows that Shandong has similar primary industry structure to China. In addition, there is an obvious gradient of regional economic growth from the eastern to the central, and to the western Shandong, which is extremely similar to that of China. As such, Shandong province can be considered a miniature of rural economic development in China. The per capita net income of rural households in Yucheng City is 6211 RMB¥ (US\$ to RMB¥: 1–6.83) in 2009, almost the same as that of Shandong province (6119 RMB¥), and a little higher than the overall Chinese per capita net income of rural households of 5153 RMB¥. However, the GDP per capita of Yucheng is 27137 RMB¥ in 2009, just a little higher than the overall Chinese GDP per capita of 25575 RMB¥ (SSB, 2010; NBSC, 2010). Therefore, Yucheng was taken as a case study area for analyzing the rural land-use change in Shandong province, even in China as a whole, to some extent.

Situated in northwestern Shandong province, Yucheng City extends from 36°41'36" N to 37°12'13" N and from 116°22'11" E to 116°45'00" E (Fig. 1). With an elongated dimension of 58 km by 33 km, it covers an area of 990.7 km<sup>2</sup>, of which built-up area makes up only 25 km<sup>2</sup>. Yucheng is a predominantly agricultural area. Falling under its jurisdiction are several towns and hundreds of villages with a combined population of 500,000, of which 68% is registered in rural area. Arable land in Yucheng is farmed intensively. However, farmland has been encroached increasingly for non-agricultural purposes. Outward migration of rural population has caused numerous dwellings to be vacant, even ruined (Liu et al., 2011).

## Data and methodology

The data used in this study include detailed land use information acquired from historical aerial photographs, and from questionnaire survey. Since difficulties arise in differentiating low-density residential areas due to the diverse range of land use types within them, and their spatial variability from satellite imagery (McCauley and Goetz, 2004), mapping of detailed residential land use in rural areas has to rely on fine resolution data such as aerial photographs (Turner, 1990). Aerial photographs have the capacity of yielding details about residential areas, such as structural improvements to residential units (Niedzwiedz, 1990). In this study very fine resolution (0.25 m) color aerial photographs taken during April/May of 2008 at a scale of 1:2000 were used to map land uses at the village level, assisted by intensive field checks. In addition, black-and-white aerial photographs of 1:20,000 taken in the summer of 1967 were also used to map historical land use.

The aerial photographs were scanned and rectified to the Xi'an coordinate system (1980) at a horizontal accuracy of 1 m. These digital photographs were then imported to ArcGIS, intersected individually with the boundaries of three villages (Paizi, Wan and Zhao). The clipped photographs were visually interpreted via direct delineation of land use parcels on the screen. Land uses were mapped into seven categories, i.e., farmland, woodland, rural settlements, rural facilities land, transportation, waterbody, and unused land. Rural settlements refer to the land for dwellings including currently occupied, vacant and abandoned/ruined as well as the vacant land. Rural facilities land refers to threshing fields that are used seasonally for temporarily storing and drying harvested crops. It used to be an essential component of traditional farming operation. However, with the widespread use of farming machinery, it is no longer necessary to thresh crops in a separate field. With a diminished role, threshing fields are left idle. Waterbody includes ponds and irrigation canals. Ponds are the by-products of excavating the earth as materials to elevate the foundation of dwellings.

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