

Spatial and Temporal Variability of Farm Size in China in Context of Rapid Urbanization

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Abstract: During the last 30 years, China has witnessed rapid economic growth and dramatic urbanization, with about 1.2×10^7 rural people migrating annually into urban areas. Meanwhile, especially since 1995, the rural population has been declining, which is closely linked to land circulation and the increase in farm size in many villages. Increasing scale of farming operations is often regarded as a key to avoiding the abandonment of farmland and to increasing the income of rural farmers. However, until now, there has been little research on the spatial and temporal variability of farm size at the national level in China. Using data from the national agricultural census and rural household surveys, this study examines the characteristics of land use circulation and the consequent changes in the area of farmland per household. The results show that: 1) 12.2% of rural households were involved in land circulation at the national level. The highest amounts of land circulation have occurred in those provinces where the farmland per capita is more than 0.2 ha or less than 0.1 ha; 2) over 80% of households operate less than 0.6 ha of farmland; 3) the proportion of mid-sized farms (between 0.2 ha and 0.6 ha per household) has decreased while the smallest and the largest farms have increased. This bears some similarity with the phenomenon known as the 'disappearing middle', referring to the changes in farm size. This study establishes a framework for interpreting the factors affecting the changes in farm size in China, which include two promoting factors (urbanization and agriculture) and four hindering factors (agricultural land system, household registration, stable clan system, and farmland loss).

Keywords: farm size; land circulation; urbanization; China

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1 Introduction

The world's urban population is increasing mainly due to ongoing and substantial migration from rural to urban areas, especially in developing countries. The rural-urban migrants who are migrating from farms often rent or sell their land to those remaining in rural areas, which contributes to the increases in farm size (Grigg, 1987). Farm size has been a central concern to governments because it plays a major role in determining the income levels of farmers and the efficiency of agricul-

tural production, and it also influences the possibility of monopoly power emerging in agriculture (Lianos and Parliatou, 1986; Thapa, 2007). Specifically, on one hand, an increase in farm size can accentuate the positive effects of urbanization and industrialization, in terms of improving the income of rural farmers (Fan and Chan-Kang, 2003). For instance, agriculture can release labour from low and marginally productive farms and this labour is then available for other sectors of economy (Wiggins *et al.*, 2010). On the other hand, there may be negative effects on agricultural production resulting

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from increases in farm size (Deininger and Byerlee, 2012). For example, large farms may be less efficient in terms of returns per unit area, and there is generally an inverse relationship between farm size and land productivity (Cater, 1984; Heitberg, 1998; Thapa, 2007).

Worldwide farm sizes have generally increased in recent decades in both developed and developing countries (Michailidis and Mattas, 2006; Dolev and Kimhi, 2010). However, the trend is not a simple or one way process, because there are many factors affecting or even hindering increases in farm size. In a few developed countries or regions, large farms may be dispersed because of multiple succession. For example, in the South East of England, almost one-third of the farms were divided through multiple succession between 1960 and 1999 (Burton and Walford, 2005).

During the last 30 years, China has witnessed rapid economic growth and dramatic urbanization. About 1.2×10^7 rural people migrate annually into urban areas (Tan and Li, 2010), and especially since 1995 the rural population has declined (NBSC, 2010). As a result, the intensity of cropland use is also declining, with abandonment of cropland in some areas (Chen Yuqi *et al.*, 2009; Tian *et al.*, 2010). In this context, many researchers think that increasing the scale of operations of farming is a key to avoiding the abandonment of cropland and to increasing the income of rural farmers (Chen Yangfen *et al.*, 2009; Chen *et al.*, 2010). In the meantime, government is also making efforts to create conditions for the steady development of rural land circulation. In those areas with higher amounts of farmland per capita, it is permitted to expand the cooperation in agricultural production in various forms, such as the creation of independent farm contractors, household-based farms or special farming cooperatives. For example, Central Committee of the Communist Party of China introduced the policy encouraging farmers to lease farmland to other farmers in 2008.

Thus, China is experiencing a similar phenomenon which has witnessed in many developed countries, namely land circulation in many rural areas and consequent increases in farm size. In China, some literature has examined the characteristics and perspectives of farm size (Lu *et al.*, 1996), analyzed the relationship between farm size and agricultural production efficiency (Shang, 2011), and discussed the factors affecting the farm size changes (He *et al.*, 2011). However, until now,

there has been little detailed research on the features of farm size changes at the national level, and limited consideration of regional differences produced by the vast disparities in natural resource endowments and socio-economic development levels. Indeed, not only in China, but also in other countries, scholars have largely ignored empirical description of spatial variations in farm size (Visser, 1999).

In terms of international comparison, for various reasons there are significant differences in land circulation between China and other countries. Firstly, China's rural areas are subject to a household responsibility system implemented since 1978. According to this system, land rights are distributed among farmers' collectives so that households have no power of land ownership. Because of this, land circulation only refers to circulation of land-use rights in this study. This is quite different from the situation in many countries where private ownership of property and land predominates. Secondly, a strict household registration system is one of the basic institutions of population management in China. This system categorizes people into urban or rural status based on place of birth (Li *et al.*, 2010), and provides an obstacle to the free migration of the rural population. The system affects rural out-migration and therefore may also influence the extent of land circulation.

Based on the above analyses, this study aims to grasp the geographical features of farmland circulation, farm size changes in China and the factors affecting the changes. This may provide a scientific foundation for farmland use planning and the scale operation of farmland in China in the future. In addition, this study presents a comparison of the geographical features of farmland circulation and farm size changes between China and other countries, especially the developing countries which are witnessing dramatic changes in farm size.

2 Data

In this study, the data on farmland per household and land circulation were derived mainly from *The Comprehensive Abstract of the First Census of Agriculture in China* (OSCLG and BSPRC, 1996) and *The Second Census of Agriculture in China* (OSCLG and BSPRC, 2008). Because it is difficult to obtain the land circulation data of other types of farmland, the term 'farmland' is applied to cropland rather than to all farmland, and

'land circulation' means that farmers can sub-contract, lease, exchange and swap their land use rights, or join share-holding entities with their farmland. In these processes, transfer of land ownership is limited.

Some rural households with no farmland were excluded from this study (OSCLG and BSPRC, 1996; 2008). Since farmland is mainly cultivated by families, this study uses farmland per household to represent farm size. In addition, it is not possible to directly obtain survey data for farm size per household at the provincial level. Therefore, this study employed farmland per capita in rural areas instead of farmland per household at the provincial level to analyze the spatial differences in farm size, using survey data from the *China Yearbook of Rural Household Survey* (DRSES, 2000; 2007; 2010a). Because, the yearbook can not provide the data of farmland per capita for 1996, this study analyzes the changes in farmland per capita at the provincial level during the period 1998-2009. Other data in this study were taken mainly from DRSES (2010b), and *The Report of China's Land and Resources in 2002* (MLR, 2003).

This study mainly focuses on 31 province-level divisions in the mainland of China, because land use institutions in the Hong Kong Special Administrative Region of China, the Macau Special Administrative Region of China, and Taiwan Province, China are different from the 31 province-level divisions (Fig. 1). The study area includes 22 provinces, 5 autonomous regions (Inner Mongolia, Ningxia, Guangxi, Xinjiang and Tibet), and 4 municipalities directly under the administration of central government (Beijing, Shanghai, Tianjin and Chongqing). In the following analysis, all province-level divisions are termed 'provinces'.

3 Results and Analyses

3.1 Characteristics of farmland circulation

Land circulation in China is very active. In the country as a whole, households involved in land circulation occupied 12.2% of all rural households in 2006, but with significant variation across provinces. Shanghai had the highest proportion, at around 44%. The most active ar-

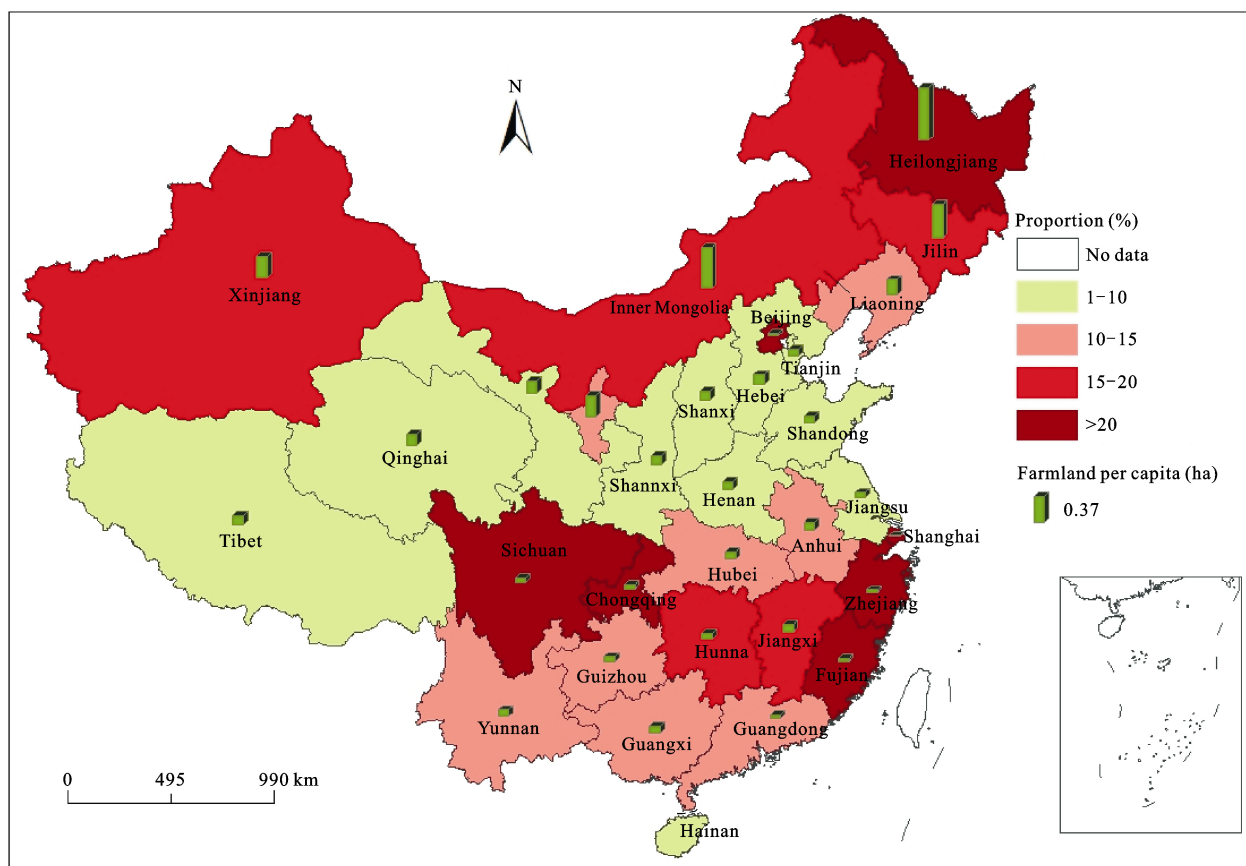


Fig. 1 Farmland per capita in rural areas and proportion of households involved in farmland circulation in China in 2006 (OSCLG and BSPRC, 2008)

eas of land circulation include two types of provinces.

Firstly, land circulation tends to be most active in provinces with farmland per capita over 0.2 ha (Fig. 1 and Fig. 2a). These provinces include Heilongjiang, Jilin and Liaoning in Northeast China, and Ningxia, Inner Mongolia, Xinjiang in Northwest China. The main reason is that in these northern border provinces, most farmland is located on relatively flat plains, which facilitate the easy operation of large and medium sized agricultural equipment.

Secondly, in the provinces with farmland per capita less than 0.1 ha, such as Zhejiang, Fujian and Shanghai, farmland circulation is also very active (Fig. 1). One of the reasons is that the provinces with the lowest farmland per capita often lie in the most economically developed regions, in which the non-agricultural opportunity cost is high (Chen, 1996). Thus, local farmers often rent their land to people from less developed provinces. For instance, in Langxia Town, Jinshan District of Shanghai, more than 90% of farmland is cultivated by non-local farmers (Ma and Ma, 2010). Excluding the six northern border provinces mentioned above, there is a strong negative relationship between the proportion of the households involved in farmland circulation and farmland per capita (Fig. 2b). In the provinces with a smaller amount of farmland per capita, farmland circulation is more active.

The proportions of households involved in land circulation are lower in some agriculturally developed provinces, such as Shandong, Henan, Jiangsu and Hebei, and in those provinces with farmland per capita between

0.1 ha and 0.2 ha, including Shanxi, Shannxi and Gansu (Fig. 1 and Fig. 2a).

3.2 Farm size changes

Over 80% of the households operated less than 0.6 ha of farmland in 2006, and the proportion of households with farmland over 1 ha was only 7.9% (Fig. 3). Like many Asian countries, the farm size of most households in China is extremely small by world standards, and it is insufficient to support the farm family (Fan and Chan-Kang, 2003). Even compared with other Asian countries, farmland per household is much lower in China. For instance, in Malaysia, Indonesia, Thailand, and the Philippines, the area of land under rice per owner household in the early 1990s varied from 0.44 ha (West Java) to 2.68 ha (Central Thailand) (Fujimoto, 1996).

In order to compare the characteristics of changes in farm size for different types of rural households, the size of farmland per household has been divided into five groups (Table 1). Among the five groups, the household number in group B, the mid-sized (0.2 ha to 0.6 ha) farms, fell from 1.024×10^8 in 1996 to 9.09×10^7 in 2006. As a result, the proportion of type B in all households decreased from 52.8% to 49.9%, while the proportions for the other groups all increased. This has some similarities with the phenomenon of the 'disappearing middle', which refers to the declining proportion of mid-sized farms while the smallest farms and the largest ones are increasing (Burton and Walford, 2005; Smithers *et al.*, 2005). This phenomenon mainly results

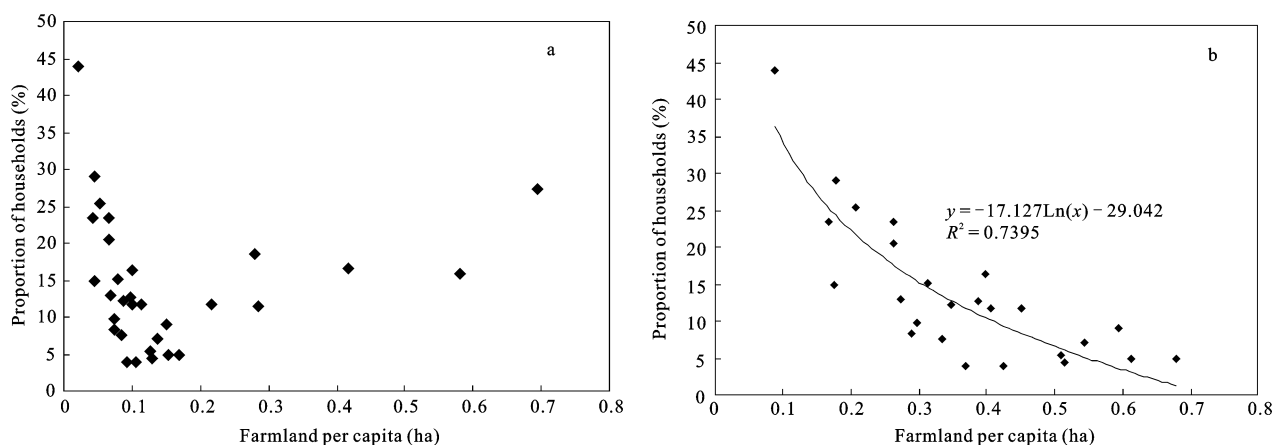


Fig. 2 Relationship between proportion of households involved in farmland circulation and farmland per capita in rural areas in 2006 (OSCLG and BSPRC, 2008). a, including 31 provinces in the mainland of China; b, excluding the provinces of Heilongjiang, Jilin, Liaoning, Inner Mongolia, Gansu, and Xinjiang

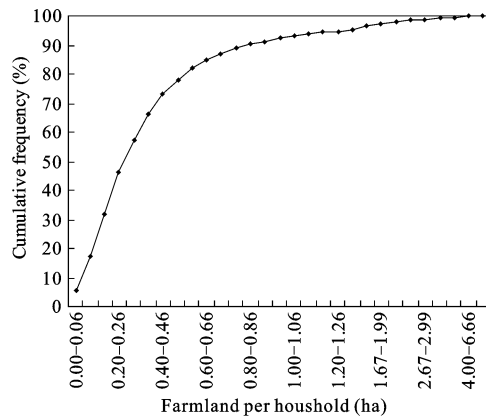


Fig. 3 Cumulative frequency distribution of farmland per household in China in 2006 (OSCLG and BSPRC, 2008)

from economic pressure which encourages some farm enterprises to 'scale-up' to become larger and more capital intensive, whilst others move towards a 'part-time' mode or become 'hobby' farms (Iraizoz *et al.*, 2007; Pritchard *et al.*, 2007). This has happened in many developed countries, including Australia (Pritchard *et al.*, 2007) and New Zealand (Mulet-Marquis, 2008). In the case of China the size of 'mid sized' farms is extremely small when compared with other countries experiencing this phenomenon. Furthermore, in many cases in China, small farms are mainly cultivated by old people due to out-migration of young people, which is very different from 'hobby' farms in developed countries.

3.3 Spatial differences in farmland per capita

From 1998 to 2009, farmland per capita increased by 11.7% (Table 2), with significant provincial differences. Among the 31 provinces, farmland per capita increased in 15 provinces, and those with the highest rates of increase include Jilin, Heilongjiang, Liaoning and Inner Mongolia (Table 2). In contrast, in some provinces, notably Beijing, Shanghai, Zhejiang and Guangdong, the farmland per capita decreased dramatically (Table 2),

mainly due to the conversion of farmland to built-up areas and to specialized production areas such as orchards, nurseries and land with aquaculture facilities, although the rural population is falling dramatically in these provinces (Yang, 2001; Tan *et al.*, 2005). In addition, in Ningxia, Qinghai, Tibet and Shanxi, farmland per capita decreased mainly because of the conversion of farmland to forest or grassland due to the 'grain for green' program. This policy has been implemented from 1998 onwards to address the growing concerns about environmental problems (Feng *et al.*, 2005; Xu *et al.*, 2006). In 2002, farmland reduction due to the program was 1.43×10^6 ha, which accounted for 70.3% of the total decrease in farmland in the country (MLR, 2003). This program has shrunk since 2004 and virtually stopped in 2008 largely because of the possible lasting impact on food security considerations (The State Council, 2007).

4 Discussion

The rapid industrialization provides more work opportunities and higher income per capita in urban areas. This raises the opportunity cost of rural workers. According to economic theory (Lianos and Parliarou, 1986; Visser, 1999), profit of land (P_0) is profit per unit land multiplied by land area. P_0 can be expressed by the following formula:

$$P_0 = (P - L - I - R) \times S \quad (1)$$

where P is total revenue; L is labour input; I is other inputs; R is land rent; S is farm size.

With labour costs increasing, one rational decision is to increase farm size in order to maintain or even increase profits, because it is very difficult to increase the price of agricultural product and decrease costs of other input and land rent. At the same time, rural-urban mi-

Table 1 Changes in proportions of households by farmland per household in China in 1996–2006

| Household type | Farmland per household (ha) | Proportion (%) | | Proportion change (%) | Household number (10^6) | |
|----------------|-----------------------------|----------------|-------|-----------------------|-----------------------------|-------|
| | | 1996 | 2006 | 1996–2006 | 1996 | 2006 |
| A | < 0.2 | 30.2 | 32.1 | 6.20 | 58.6 | 58.4 |
| B | 0.2–0.6 | 52.8 | 49.9 | –5.36 | 102.4 | 90.9 |
| C | 0.6–1.0 | 9.7 | 10.2 | 4.40 | 18.9 | 18.5 |
| D | 1.0–2.0 | 4.9 | 5.3 | 8.20 | 9.5 | 9.6 |
| E | > 2.0 | 2.5 | 2.6 | 5.70 | 4.8 | 4.7 |
| Total | | 100.0 | 100.0 | | 194.1 | 182.1 |

Sources: OSCLG and BSPRC (1996; 2008)

Table 2 Changes in farmland per capita by province

| Region | Farmland per capita (ha/person) | | Change of farmland per capita (%) |
|----------------|------------------------------------|-------|--------------------------------------|
| | 1998 | 2009 | 1998–2009 |
| Beijing | 0.057 | 0.033 | -41.2 |
| Tianjin | 0.107 | 0.100 | -6.3 |
| Hebei | 0.135 | 0.133 | -1.5 |
| Shanxi | 0.203 | 0.160 | -21.3 |
| Inner Mongolia | 0.459 | 0.653 | 42.2 |
| Liaoning | 0.189 | 0.233 | 23.2 |
| Jilin | 0.312 | 0.507 | 62.4 |
| Heilongjiang | 0.549 | 0.780 | 42.2 |
| Shanghai | 0.065 | 0.020 | -69.1 |
| Jiangsu | 0.083 | 0.073 | -12.0 |
| Zhejiang | 0.06 | 0.040 | -33.3 |
| Anhui | 0.099 | 0.120 | 20.8 |
| Fujian | 0.056 | 0.060 | 7.1 |
| Jiangxi | 0.088 | 0.107 | 21.2 |
| Shandong | 0.097 | 0.100 | 2.7 |
| Henan | 0.101 | 0.113 | 12.6 |
| Hubei | 0.098 | 0.107 | 8.8 |
| Hunan | 0.076 | 0.080 | 5.3 |
| Guangdong | 0.062 | 0.047 | -24.7 |
| Guangxi | 0.088 | 0.093 | 6.1 |
| Hainan | 0.088 | 0.080 | -9.1 |
| Chongqing | 0.067 | 0.073 | 9.0 |
| Sichuan | 0.069 | 0.067 | -2.9 |
| Guizhou | 0.069 | 0.067 | -3.8 |
| Yunnan | 0.073 | 0.073 | 0.9 |
| Tibet | 0.113 | 0.100 | -11.8 |
| Shaanxi | 0.147 | 0.133 | -9.1 |
| Gansu | 0.155 | 0.127 | -18.5 |
| Qinghai | 0.183 | 0.173 | -5.1 |
| Ningxia | 0.181 | 0.147 | -19.1 |
| Xinjiang | 0.251 | 0.293 | 17.1 |
| Average | 0.137 | 0.153 | 11.7 |

Sources: DRSES (2000; 2010b)

gration also provides the possibility of increasing the scale of operations of farming. The scale of operations and growing use of agricultural machinery can further promote rural-urban migration by releasing labour from farm-based operations.

Determination of the causes of farm size changes is difficult because of the complex interrelationships and interactions between natural and socio-economic factors. Indeed, in the process of farm size changes, there are

some factors hindering increases in farm size in China, such as the household responsibility system, the household registration system, the stable clan system in rural areas, and farmland loss. This study establishes a framework for interpreting the principal features of farmland size changes (Fig. 4).

4.1 Factors promoting increase of farm size

4.1.1 Urbanization

Mainly due to rising wages for labour in urban areas, 1.2×10^7 of rural people are migrating into urban areas every year. This study uses per capita annual net incomes of urban and rural residents to reflect labour costs. Figure 5 shows that the income gap between urban and rural areas was very noticeable and even getting wider between 1996 and 2006. This will continue to spur massive migration from rural areas to urban areas in the country.

Because of the high rate of natural growth, rural population continued to increase until 1995, when they reached a peak of 8.59×10^8 . It is well known that the one-child policy has been carried out in China for several decades, but in rural areas the effects of its implementation are not as significant as in urban areas (Zhang, 2000). In addition, life expectancy is increasing because of the improvements in diet, hygiene and medical conditions, contributing to a high natural population growth rate in rural areas. However, during the period 1995–2009, the rural population decreased by 1.46×10^8 (Fig. 6), due to the surge of out-migration.

The level of urbanization in China is still lower than the world average (UNPD, 2009). In 2010, it was 49.7% in China (NBSC, 2011), though projections from the United Nations Population Division argue that China's urbanization level will reach 73% and rural population will decrease to 3.79×10^8 by 2050 (Fig. 6). Figure 7 shows that the urbanization level has a positive relationship with the proportion of households involved in land circulation. In the provinces with a higher level of urbanization, land circulation is more active. During the period 2011–2050, China will still be in the stage of rapid urbanization (Fig. 6) and hence it is likely that there will be further changes in the farm size distribution due to significant amounts of land circulation.

4.1.2 Agricultural machine use

With ongoing economic growth, increasing numbers of the rural population are working in urban areas or in

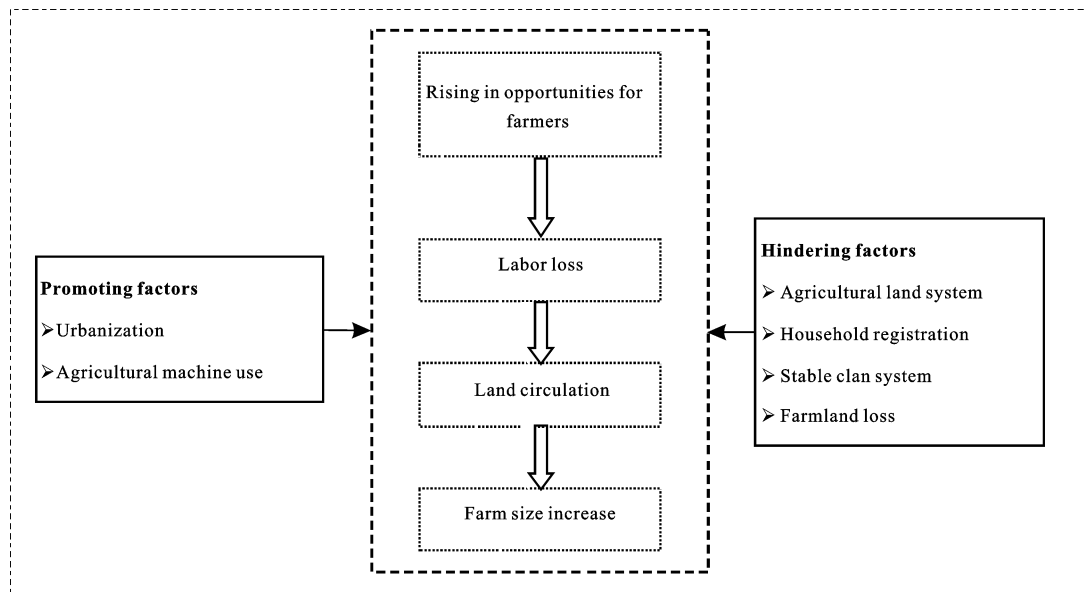


Fig. 4 Factors affecting farm size changes in China

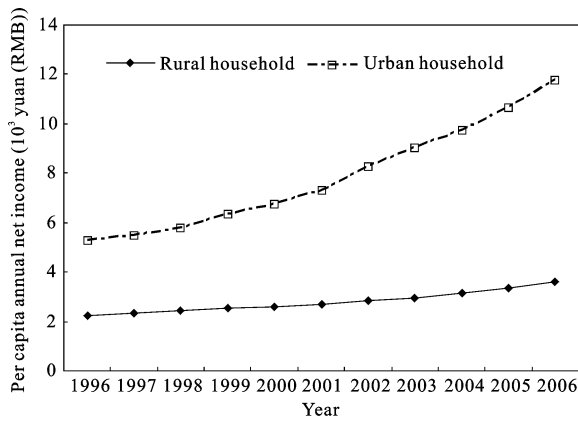


Fig. 5 Changes in per capita annual net income of urban and rural households in 1996–2006 (NBSC, 2007)

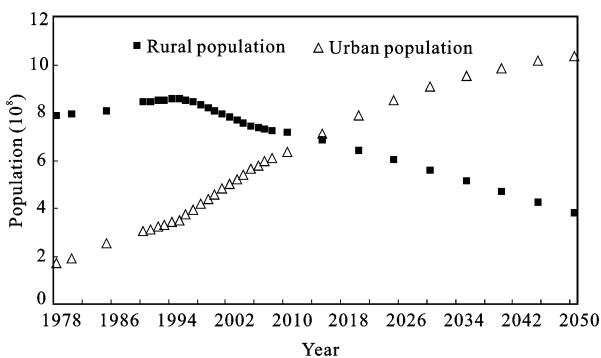


Fig. 6 Population change processes and trend in China in 1978–2050 (UNPD, 2009; NBSC, 2009)

non-agricultural sectors. Because of rising opportunity costs of rural labour, agricultural machine is increasingly used instead of human labour in agricultural pro-

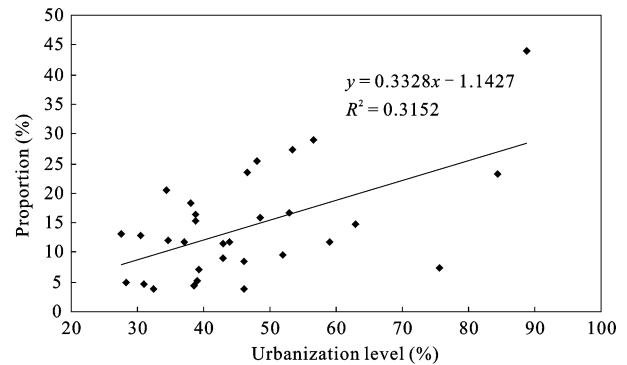


Fig. 7 Relationship between urbanization level and proportion of households involved in land circulation in China in 2006 (OSCLG and BSPRC, 2008); NBSC, 2007)

duction. Therefore, the use of agricultural machine is rising very rapidly in the country. Here, the numbers of tractors are used as a surrogate to exemplify the changes in use of agricultural machine. From 1985 to 2009, the number of mini-tractors for agricultural production increased by about 350% (Fig. 8). In contrast, the numbers of large and medium sized tractors decreased from 8.5×10^5 in 1985 to 6.7×10^5 in 1996. One major reason for this was that China’s agriculture shifted from a collective-based production system to a family-based one due to the implementation of the housing responsibility system from the early 1980s. Before then, large and medium sized tractors were bought by the village collectives. After this shift, a single family generally could not afford new large or medium sized tractors. Thus, in

many areas the number of medium and large machines becoming obsolete and disused was greater than the number of new machines being purchased (Fig. 8). After the decrease during the period 1985 to 1996, the number of large and medium sized tractors increased dramatically, from 6.9×10^5 in 1997 to 3.52×10^6 in 2009. Even so, large and medium sized tractors per hundred persons were still at a very low level: less than 1 per hundred persons in 2009 at the national level. The number of large and medium sized tractors per hundred persons has a close and positive relationship with farmland per capita (Fig. 9).

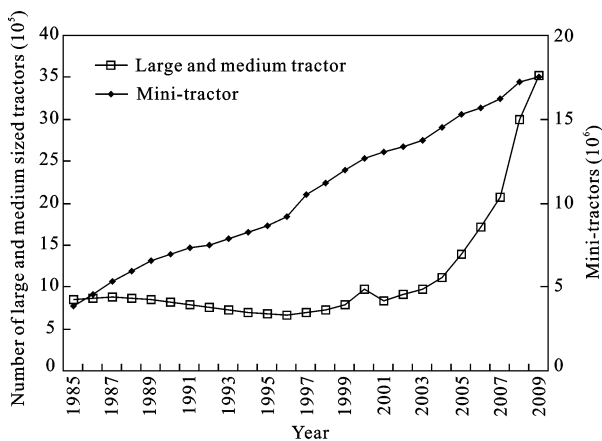


Fig. 8 Number of agricultural tractor in China in 1985–2009 (NBSC, 2010). Mini-tractors refer to those with power less than 14.71 kW, and large and medium sized tractors refer to those with more than 14.71 kW

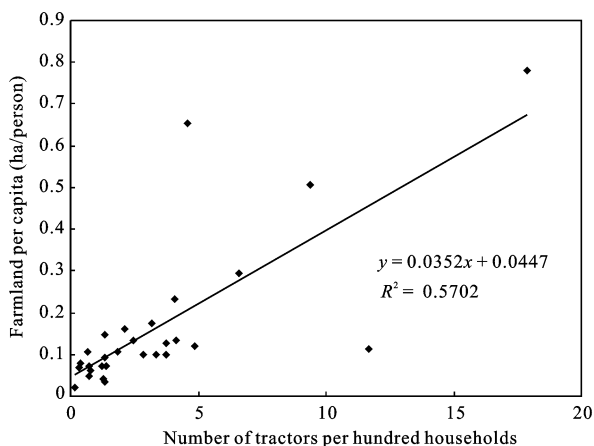


Fig. 9 Relationship between numbers of large and medium sized tractors and farmland per capita in different provinces in 2009

In addition, there is the scale of operation of large agricultural machines, which differs to that in other countries. Due to the very small amounts of farmland per

capita, it is impossible for every household to buy new agricultural machine and so many families have no agricultural machine, and only a small fraction of households purchase large agricultural machines. These are then often rented to other families. For instance, during the harvest season for the wheat crop, many combine harvester machines will be operated trans-county or even trans-province, making full use of time differences in wheat maturation between south and north. This phenomenon prevails in some large agricultural provinces, such as Shandong, Henan and Hebei, and may be one of the key factors causing the lower proportion of land circulation in these provinces.

The increase in numbers of tractors has varied greatly across the provinces. In the eastern coastal areas of China, including Beijing, Shanghai, and Fujian, the numbers of large and medium sized tractors declined by 33%, 44% and 50% respectively from 1996 to 2009 (Table 3), mainly because of farmland loss. At the same time, in some less developed provinces of China, such as Inner Mongolia, Hunan, Heilongjiang, Jilin and Anhui, the increases in large and medium sized tractors were all very high. In 2009, Inner Mongolia, Heilongjiang and Xinjiang had the largest numbers of large and medium sized tractors, utilizing wide plains supporting larger-scale farming operations. Thus, land use circulation is very active in these provinces, although farm size was already higher compared with elsewhere.

4.2 Factors hindering increase of farm size

4.2.1 Agricultural land system

China's agricultural land system has some unique features, which affect farm size changes. Firstly, the village collectives control land ownership and the power to allocate land use rights to households. Farm households are allocated the rights to use farmland for a finite contract term (often for 30 years). Although it is permitted for land use rights to be legally circulated, the process is very complicated and associated with many problems. For instance, farmers may face the risk of farmland loss during the process of land circulation, since farm households have no legal ownership of land. In addition, according to the *Law of China on Land Contract in Rural Areas* promulgated by the Ninth National People's Congress in 2003, the term of circulation may not exceed the remaining period of the contract. Thus, the legal term of land circulation is often short.

Table 3 Changes in number of large and medium sized tractors, 1996–2009

| Region | Number in 1996 (10 ³) | Number in 2009 (10 ³) | Increase rate (%) | Region | Number in 1996 (10 ³) | Number in 2009 (10 ³) | Increase rate (%) |
|----------------|-----------------------------------|-----------------------------------|-------------------|-----------|-----------------------------------|-----------------------------------|-------------------|
| Beijing | 12 | 8 | -33 | Henan | 49 | 247 | 404 |
| Tianjin | 8 | 13 | 63 | Hubei | 71 | 119 | 68 |
| Hebei | 29 | 155 | 434 | Hunan | 5 | 75 | 1400 |
| Shanxi | 24 | 63 | 163 | Guangdong | 7 | 16 | 129 |
| Inner Mongolia | 33 | 483 | 1364 | Guangxi | 12 | 20 | 67 |
| Liaoning | 31 | 136 | 339 | Hainan | 3 | 25 | 733 |
| Jilin | 29 | 251 | 766 | Sichuan | 6 | 81 | 1250 |
| Heilongjiang | 79 | 583 | 638 | Guizhou | 9 | 25 | 178 |
| Shanghai | 9 | 5 | -44 | Yunnan | 10 | 209 | 1990 |
| Jiangsu | 23 | 85 | 270 | Tibet | 2 | 13 | 550 |
| Zhejiang | 6 | 7 | 17 | Shaanxi | 19 | 71 | 274 |
| Anhui | 10 | 105 | 950 | Gansu | 14 | 58 | 314 |
| Fujian | 4 | 2 | -50 | Qinghai | 3 | 8 | 167 |
| Jiangxi | 8 | 15 | 88 | Ningxia | 4 | 22 | 450 |
| Shandong | 101 | 399 | 295 | Xinjiang | 50 | 218 | 336 |

Note: Chongqing is excluded in this table because it was a part of Sichuan Province in 1996. Source: (NBSC, 1998; 2010)

Secondly, the household responsibility system requires the village collective to divide farmland according to household size (Hu, 1997), and guarantees that every household has the same rights of access to land and that every rural villager enjoys equal rights of using land in the village. Based on this, a family may have some high-yield land parcels and some low-yield ones, combined with some land parcels far from home and some located near the house. Thus a household may own land parcels in more than one place and most farmland is still separately cultivated by local households. The fairness in allocation of farmland once greatly stimulated agricultural production and rural development (Guo, 2004; Long *et al.*, 2009), but it also led to the fragmentation of land holdings (Qu *et al.*, 1995). This then became one of the reasons that farm size remains so small, and it has had a negative impact on labor productivity.

4.2.2 Household registration

A legal distinction is made between urban and rural dwellers. Rural-urban migrants who are not registered officially as urban population are known as the 'floating population'. These people are a vulnerable group who frequently face relatively low wages and limited benefits (Li *et al.*, 2010), high workplace hazards, and lack of social security. They are also blamed, usually unfairly, for causing urban social problems. Furthermore, most of

the floating population can not afford the increasingly expensive housing in urban areas (Hu and David, 2001). They tend to migrate as individuals to work in urban areas, leaving their families behind. For example, according to an investigation by the All-China Women's Federation, the number of children left behind under 14 years of age is nearly 5.8×10^7 (Li, 2010).

Under this situation, it is difficult for the migrants to completely give up their farmland. Although the quantity of farmland per capita is very small, farmland becomes a form of social welfare and living dependence for migrants' families (Wang *et al.*, 2007), especially for the older people and young children remaining in the countryside. One consequence is that farmland is mainly cultivated by older people in many rural households. In this respect, strict household registration systems hinder farmland circulation and farm size increase.

4.2.3 Stable clan system

China has a long history of agricultural development, during the course of which highly stable social relationships have been established in rural communities. A typical enduring feature is the clan, with a single village often mainly comprising just one small clan. In such villages, men and children usually have the same surname, which implies a common ancestor. Thus, the village is often associated with just one surname. For instance, Liu, Xu, Cheng, Wang and Zhang are all typical

Chinese surnames. Each of these villages has formed its own stable collective and most of its members have a blood relationship. In such a village, when there are major events, such as building a house, or organizing a wedding, all the villagers come together to provide assistance or to help in overcoming difficulties. When there are traditional festivals villagers who are working elsewhere return to meet their families or friends. The stable collective provides a sense of security, a local identity and a local emotional co-ownership by rural residents, which has also become an important factor influencing rural development and choices made by villages (Dumreicher and Kolb, 2008). Under these conditions, it is not easy for farmers to give up their farmland and the place of their upbringing, and this increases the difficulty of introducing any changes to farm management practices.

4.2.4 Farmland loss

Last but not least, farmland loss affects increases in farm sizes. During the period 1996 to 2008, the area under crops decreased by 6.1%, from 1.30×10^8 ha to 1.22×10^8 ha in China (NBSC, 2001; 2009). The main causes of this reduction of farmland include non-agricultural construction, readjustment of land-use structures within the agricultural sector (which mainly refers to the conversion of farmland to orchards, nurseries and land with aquaculture facilities) and the conversion to conservation land (Li, 1999; Lu *et al.*, 2006; Tan *et al.*, 2009). Among the 31 provinces, only in Xinjiang and Heilongjiang farmland has actually increased (by 0.8% and 0.5%, respectively). In all other provinces, the farmland has decreased. In the more developed provinces, such as Beijing, Shanghai and Guangdong, farmland loss mainly results from expansion of urban land and growth of industrial land. In some western provinces, including Ningxia, Shannxi and Sichuan, farmland declined significantly, mainly because of the conversion of farmland to conservation land. In addition, in order to meet various demands of agricultural products, the structure adjustment of agriculture is pervasive in every province, contributing to farmland loss. At present, farmland loss has become the most significant factor in the decrease of farm size, especially in Beijing, Shanghai, Zhejiang, Ningxia and Shanxi.

Overall, because of these factors, farm size growth is lagging behind the process of urbanization, despite farmland circulation being active in the country. This

can be shown by considering phenomena related to farmland use, such as farmland abandonment, the conversion of fertile farmland to forest in the eastern coastal areas of China, and decreases in multiple cropping.

5 Conclusions

During the last 30 years, China has witnessed rapid economic growth and dramatic urbanization, with about 1.2×10^7 rural people migrating annually into urban areas. Meanwhile, especially since 1995, the rural population has been declining, which is closely linked to land circulation and increases in farm size in many villages. Increasing the scale of farming operations is often regarded as a key to avoiding the abandonment of farmland and to increasing the income of rural farmers.

In this context, this study has discussed farmland circulation and farm size changes in China. The results show that farmland circulation is active, but with barriers restricting its extent and the amount of land in circulation. In the country as a whole, 12.2% of rural households were involved in land circulation in 2006, with strong spatial regularities. The regions with the highest proportions of farmland circulation include: 1) the six northern border provinces (farmland higher than 0.2 ha per household) where farmland is rich and mainly located on relatively flat plains, and where it is possible to operate large and medium sized agricultural machine; 2) the provinces with farmland per capita less than 0.1 ha, such as Zhejiang, Fujian and Shanghai. These provinces lie in the most economically developed regions, and local farmers often rent their land to migrants from less developed provinces. On the contrary, the proportions of farmland circulation were lower in some agriculturally developed provinces and those provinces with farmland per capita between 0.1 and 0.2 ha, including Jiangsu, Hebei, Henan, Shandong, Shanxi, Shannxi and Gansu. If the six northern border provinces are excluded, there is a negative relationship between the proportion of households involved in farmland circulation and farmland per capita.

A large proportion of households operate very small farms, which are insufficient to support the rural households. In 2006, about 80% of the households had an area of farmland less than 0.6 ha.

At the national level, numbers of rural households decreased by 6.2%, from 1.941×10^8 in 1996 to $1.821 \times$

10⁸ in 2006. During the same period, the number of households with a mid-sized area of farmland (between 0.2 ha and 0.6 ha) declined most dramatically, a fall of 11.2%. This bears some resemblance to the phenomenon of the 'disappearing middle', which mainly results from the intensified economic pressure which encourages some farms to 'scale-up' to become larger and more capital intensive, whilst many small farms are retained and cultivated by older people.

To explain the farm size changes and their regional differences, a simple explanatory framework was presented emphasizing two things: 1) the factors causing the increases in farm size, including urbanization and the agricultural machine use; 2) the factors hindering the increase of farm size, including the agricultural land system, the household registration, stable clay system, and farmland loss. Because of the factors hindering the increase of farm size, farm size growth lags behind the process of urbanization in China, despite active land circulation.

In examining the characteristics of farm size changes in present-day China, this outline study suggests that farm size changes are complex. Some aspects identified are worthy of further study. For instance, China may face an unavoidable problem: how to obtain a balance between food security and the scale operation of farmland since at present there is an inverse relationship between farm size and land productivity, which has also happened in other countries.

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