Institutional Innovation and Policy Support to Facilitate Small-Scale Farming Transformation in China

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Abstract

While Asian food economy has been experiencing significant transitions, little transformation occurs in farm land operation. However, recent rapid emergence of middle and large farms in many regions of China is striking. Overall goal of this paper is to understand small-scale farm transformation in China based on a unique dataset surveyed in Northeast and North China. The results show that the institutional innovation through establishing land transfer service center to activate land rental market, supporting policies to incentivize and speed up land consolidation, and farm mechanization services are major driving forces in recent evolution of China's farm operations. The paper concludes with policy implications on small-scale farming transformation in China and the rest of world and identifies remaining research issues for further study.

1. Introduction

Asian food economy has been experiencing significant transitions. Driven by income growth and demographic change (e.g., urbanization), consumption pattern has changed towards more high value products such as meats, vegetables and fruits (Gulati et al., 2007; Bai et al., 2010). In addition, agrifood markets and value chains have also experienced rapidly transformation since the 1990s (Reardon and Timmer, 2007). In responses to the above changes, agricultural production structure has changed accordingly. Area share of cereal in total crop areas had decreased from 41% in 1980 to 34% in 2013 in Asia (FAO, 2015). Livestock production has grown faster than crop production. The value share of livestock in crop and livestock production increased from 18% in 1980 to 30 % in 2013 (FAO, 2015).

However, over the same period, little transformation has occurred in Asian farm land operation. Asia is a home of nearly 90% of world small farms (less than 2 hectares), average size of farms has been falling in almost every country (IFPRI, 2015). For example, according to the World Census of Agriculture, the average farm size in India declined from 2.7 ha in 1960 to 1.3 ha in 2013. Between 1960 and 2003, the average farm size in Indonesia also decreased from 1.2 ha to 0.97 (FAO, 2013).

In the literature, there is a long-standing debate on farm size and productivity. The notion of "small is beautiful" had been largely recognized after Chaianov (1966) discovered the inverse relationship between farm size and productivity (Lipton, 1993; Dyer, 1996; Deininger and Byerlee, 2012). But recently, there is rising evidence of the smaller not being necessary beautiful. Small farms have faced increasing new challenges in meeting diversified and safety food demand, are lack of capacity in response to opportunity and coping with the rising risks from the globalization and trade liberalization as well as climate change (Hazell, 2005; Huang et al., 2008; HLPE,

2013; Chhonkar and Dureja, 2014). Recently, literature tends to agree that the efforts to help smallholders should focus on assisting them to either move up or move out farming (IFPRI, 2015; FAO, 2015).

China with an average of less than 1 ha farm size and nearly 40% of world small farms had not been an exception of falling average farm size in most of the time in the past. Despite rapid growth of agriculture, manufactural and service's sectors expanded even faster, which resulted in the fall of agricultural GDP share from 30% in 1980 to less than 10% after 2013 (NSBC, 2015). Within agriculture, significant transformation has also occurred in favor of high-value products such as vegetable, fruits, livestock and fishery due to the changes in food consumption patterns resulted mainly from income growth and urbanization (Huang et al., 2014). In sharp contrast, little change had occurred in farm operation from the early 1980s to early 2000s. Indeed, average farm size had fell gradually over time before the middle 2000s.

However, rapid emergence of middle (a few hectares) and large farms (tens and hundreds of hectares) recently in many regions of China is striking. Based on the data from the Ministry of Agriculture, cultivated land transfer has been accelerated since the late 2000s. By end of 2013, nearly 53 million (or 23%) rural households rented out their cultivated land, which accounted for 26% of total cultivated land under household responsibility system (MOA, 2014).[1] Distinct with early common practices of transferring land among relatives and friends within village and nearly equal number of land rent in and rent out households (Huang et al., 2012), the land transfer has tended to move to new operators in recent years. For example, of rent out land in 2013, about 20% was transferred to the farmers' professional cooperatives, more than 9% to firms or companies, and the rest to individual households, especially those belong to newly named Family Farms (MOA, 2014)[2].

Because the emergence of new farm land operations is only a recent phenomenon, no any study in the literature has documented the above silence revolution of farm structure in international literature. Within China, while there are debates on pros and cons of raising new farm operators, particularly emergence of large farms operated by company and cooperatives, there is lack of rigorous analysis with empirical data to support the current debates.

Overall goal of this paper is to understand the change of small-scale farm transformation recently in China and its policy implications. To achieve this goal, we have the following three specific objectives: 1) document the changes in farm operational structure in the past three decades; 2) examine major factors that have driven the recent changes (or why these changes did not occur until recent years?); and 4) generate policy implications for China and other developing countries and identify research issues for further study. To limit the scope of study, in the empirical analysis, we focus our study on farming in North and Northeast China, the major grain production regions in the country. The results show that the recent changes in farming operations are miracle, a silence revolution of China's farm structure that has not occurred in any other Asian countries characterized with small-scale farms. The major factors affected the above changes are the innovated institution that create

[1] Currently, we estimate that the shares of cultivated land in the state-owned farms, household responsibility system and village collectively reserved are about 5%, 93%, and 2%, respectively.

[2] While nearly all individual household operated farms are family farms in China, to distinct with the general household farms with small-scale land and to promote land consolidation, many provinces have set up their minimal size of farm land for a farm to be a Family Farm.

effective land rental market and reduce the transaction cost of land transfer, policies to speed up land consolidation through the land operational right transformation, and farm mechanization services. However, while the above changes generally raise labor productivity, there is also concern on land productivity and food security.

The paper is organized as the follow. Next section introduces data using in this study. Section 3 presents overall trend of average farm size and changes in composition of farm sizes at national level and in the studied regions. Section 4 discusses the major institutional change and policy support to facilitate farm operational size changes in recent years. Section 5 quantitatively analyzes impacts of land rental institutional innovation, policy support, market based mechanization service, and other factors on farm operational size transformation. The last section concludes with policy implications on farm size transformation in China and the rest of world and identifies remaining research issues for further study in the future.

2. Sampling approach and data

The primary dataset used in this study is from a farm operational survey in Northeast and North China (NE&NC) conducted by the Center for Chinese Agricultural Policy (CCAP) in 2013. It covered three provinces in Northeast China (Heilongjiang, Jilin and Liaoning) and the other three provinces in North China (Hebei, Shandong and Henan). This survey specialized on change of farm size and productivity as well as likely factors affecting farm size in the past 10 years (2003-2013).

As both Northeast and North China are major grain production regions[3], the survey focused on rice, wheat and maize farms. In Northeast China, two rice dominated and the other two maize dominated counties were randomly selected from each of three provinces. In North China, three counties were randomly selected from each study province where maize and wheat are major crops (winter wheat + maize cropping system).

Within each county, the following stratified random sampling approach using level of farm land consolidation as stratification to select townships, villages and farm households. First, we divided all townships into two groups: with above and less than average of land consolidation. Then one township from each group was randomly selected in each county. Second, follow the same approach, one village with more than average of and the other village with less than average of land consolidation were randomly selected from each township. Finally, 10 households were selected as follow: divided all households in each village into two groups, small and large farms,[4] then 7 households from the small farm group and 3 households from the large farm group were randomly selected. In case the total number of large farm household was less than 3, then we added the number of small farm households to made up a total of 10 households from each village. In addition, we also aimed to select up to two land cooperatives and/or company in each of selected township.[5] In total, the sample covers 845 households from 84 villages in 42 townships of 21 counties in Northeast

[3] Grain production in these 6 provinces accounted for 42% of China's total grain production in 2013 (NSBC, 2014).

[4] In North China, farm with cultivated land area of more than 50 mu (or 50/15 ha, about 3.33 ha) is considered as a large farm, while this number increases to 100 mu (or about 6.67 ha) in Northeast China due to the difference in land endowment between these two regions.

[5] There are some townships without any land cooperative or company, so the number ranged from 0 to 2 in each surveyed township.

and North China. In addition, we also surveyed 55 cooperatives and 4 companies from these 21 counties.

Surveys were conducted at township, village and household levels. At township level, we collected information on major institutions and policies that may have affected land consolidation. At village level, beside village characteristics, we collected information on the shares of households by farm size and number and type of land cooperatives and companies. These village level data are used to create sample weights for estimation of sample means and statistical analysis.

As our samples are for Northeast and North China only, to have an overview of changes on farm size over time for the nation as a whole and how difference or similarity of our studied regions are from the national trend, we also use the other two datasets. First one is from the Rural Household Income and Expenditure Survey conducted by NBSC (or RHIE dataset) and the other one is from the Rural Land and Labor Survey conduced by CCAP (or RLLS dataset). THIE is a national representative survey with average number of about 60,000 rural households surveyed each year. NBSC publishes average cultivated land per capita of rural household and average number of rural household population. We use these two numbers to generate average size of cultivated land per rural household (column (a), Table 1).

However, the average farm sizes per rural household, the numbers often interpreted as average farm size in China, must be underestimated because households living rural include both farming and non-farming ones. To correct this problem, we use the RLLS dataset that allows us to estimate the percentage of rural households without farming activities (e.g., households fully rent out their farm land). The RLLS is also a national representative samples with three rounds of surveys in 2000, 2008 and 2013. It includes a full panel of 1149 households from 58 villages in 6 provinces (Hebei, Liaoning, Shaanxi, Zhejiang, Sichuan and Hubei provinces) that represent 6 agricultural production regions in China.[6] Based on this dataset, we estimate the percentage of rural households living in rural but without crop production or without cultivated land (column (b), Table 1). With data presented in columns a and b, we estimate actual average size of farm over time in China (column (c)).

3. Evolution of small-scale farms and major driven forces

3.1 Overall trends of farm size in China and the studied regions

Our study show that average farm sizes based on RIES present a falling trend in China (column 1, Table 1), which is also consistent with the observation by Fan and Chan-Kang (2005) using official data. However, based on RLLS dataset, we estimate that percentage of households living in rural without crop farming activities has increased significantly from less than 5% in 2000 to about 21% in 2013. These households are those who worked fully on non-farm rural employment but stayed at home. Estimation without excluding these households obviously underestimates average farm size.

Our new estimates show that, for the nation as a whole, while average farm size had fell gradually in 1980s and 1990s, it stabilized in the early 2000s and then has started

[6] Based on the first two rounds of RLLS, a serious of papers have been published. For details of sampling approach, see Brandt et al. (2004) and Gao et al. (2012).

to rise since the middle 20002 (column c, Table 1). Although the rise in average farm size was only about 0.20 ha in 2003-2013, it increased by 36%. The more significant increase has occurred since the late 2000s. Average farm size reached 0.78 ha by 2013.

For the study areas in NE&NC, while changing trend is similar to the national one, expansion of average farm size has been more rapidly (column d, Table 1). Generally, average farm size in NE&NC is large than the national average mainly due to relatively abundant land resource in Northeast China. For NE&NC as a whole, average farm size was about 60% higher in than the national average in the early 2000s. However, the regions has witnessed more remarkable farm size transformation recently, increased from 1.03 ha in 2008 to 1.73 ha in 2013, a rise of nearly 70% within 6 years.

A close look at dynamic of rural households and land rental market further revealed that where and how cultivated land has been consolidated. As the RLLS is a full panel data that include both households living in rural area and migrated to urban or other rural areas for off-farm employment, we are able to estimate percentages of rural households that have no farming activity at all, that have rented out part or all of their land, and that have rented in land from other farmers (columns 1, 2 and 3, Table 2). Comparing the data in column 1 of Table 2 with column (b) of Table 1, it suggests that migration has increasingly contributed to reduction of farming household number over time. For example, in the early 2000s, the percentages of no farming households (column 1, Table 2) were close to the percentages of households living in rural without farming (column 2, Table 1), but the difference has gradually increased over time. There are two explanations: in the early period, migrants often left his/her partner home to take care farming activity. But recently, there is increasing trend of migration with whole family. Moreover, when rental market was not well developed in the early 2000s, even all household labors working in off-farm away from home, some might return home to work on farming during busy farming season or asked their relatives and/or friends to take care their land

The dynamic of rural transformation is also vividly reflected in land rental markets. For example, in the early 2000s, the number of rent out land households was only slightly higher than the number of rent in land households (columns 2 and 3, Table 2). However, the ratio of these two numbers (rent out vs rent in households) reached nearly 3 times (29.3% vs 10.8%) in 2013, indicating more land has been consolidated to fewer households who decided to stay in farming.

3.2 Evolution of farm size in Northeast and North China

Table 3 presents the composition of farms and average farm size by type of farms and size of household farms in NE&NC. We divide all farms into three types, land cooperative, company, and household farm. Land cooperative is a newly production organization operated often within a village. When it is formed, in principle, farmers voluntary should be followed. Unfortunately, we have no information to show how many land cooperatives did followed this principle in our studied areas. A cooperative is normally managed and operated by some of able villagers who can either hire members or labors out side their village to work on farming activities. They can be divided into the following three groups: the members are paid land rent only, shared profit only, and paid land rent and also shared profit from their cooperative.

The most striking finding is emergence of land cooperatives and company run farms. Although the share of these farms in total number of farms are very minimal, it has been rising rapidly and reached 0.14% and 0.01% for cooperatives and farm companies, respectively, in 2013 (Table 3). In 2013, average farm size reached 216 ha for cooperatives and 109 ha for companies. As the number and size of these farms rise, their share in total land areas increased from a negligible in 2008 to nearly 20% in 2013 (Figure 1).

Within household farms, significant changes have also occurred in the average farm size and the composition of farms by household's land size. In the last ten years, average farm size increased by 265%, from 1.7 ha in 2003 to 4.5 ha in 2013 (row 6, Table 3). The most rise in farm size occurred in the period of 2008-2013. It is worth noting that the rising farm size is not due to expanding cultivated land but direct results of the following two changes. The first is a fall in the number of farms, a trend similar to those presented in the column 1 of Table 2. The second is the rise of farm size of the current farming households. For example, the percentage of these households with less than 1 ha land accounted for 73.3% in 2003, this number decreased to 68.5% in 2008 and 59.5% in 2013 (row 6). On the other hand, the shares of farming households with more than 1 ha increased in every category of household farms ranged from 1-2 ha to more than 70 ha (rows 7-13, Table 3). Similar to all trends discussed above, the changes in composition of different land sizes of farms have been accelerated since 2008.

3.3 Driving forces of small-scale farming transformation

There could be many reasons behind the changes in the size and composition of farms presented above. In additional to the rapid rise of wage since the middle 2000s, which may induce mechanization and land consolidation, here we discuss the other three major forces that have rapidly evolved recently but have not been documented and assessed in the literature. They are: 1) land transfer service, an institutional innovation to reduce farmers' transaction cost of land transfer; 2) policy supports for land consolidation; and 3) farm mechanization services.

Land transfer service center (LTSC). Providing information service on land transfer for farmer is likely the most innovated institutional change in rural China in recent years. While farmers have land contract right, cultivated land property right belongs to village collective. Selling cultivated land by farmers is prohibited by law. Only the original households in the village entitle to have land contract right that was set up in 1979-1984 for 15 years and renewed for the other 30 years in the late 1990s. So transfer of land among farmers is neither the property right nor contract right but operational right within the contracted period. Previously, land operational right transfers occurred mainly among friends and relatives due to lack of formal rental markets (Guo et al., 2012). To facilitate land transfer and consolidation, various cultivated land transfer service centers or platforms created by the local government have emerged recently. Most of these land transfer service centers or platforms were established at township level and, in some cases, a larger networking platform pooling rental information across townships have also been set up at county level. Major mandates of these LTSCs are: 1) conducting land rental market survey and collecting information on who are willing to rent out their land; 2) facilitating land operational

right transfer by providing clients information on location, area, major characteristics, and suggested price for each piece of lands to be rented out; 3) providing service on preparing formal land contract when land transfer transaction is completed and keeping land transfer contract file records; and 4) be responsible for land transfer contract dispute mediation.

In our study areas, the first land transfer service center was established in one of 42 townships surveyed in 2010 and has increased rapidly in recent three years. By 2013, the number of townships with LTSCs increased to 8, accounted for about 20% of the total townships in our samples.

Policy support for large farms. To facilitate farm land consolidation, government also provides policy support for large farms in major grain production counties in our study areas. While the supporting policies differ among provinces and counties, generally they include: 1) providing loan guarantee service and subsidized loans for land rental payments and purchasing inputs when farm size is expanded; and 2) subsidies on investment in irrigation, drainage and storage infrastructures, purchasing large machineries and agricultural insurance. Based on our survey, the above support policies appeared in 2 townships in 2008, and then this number increased to 9 (or 21.4%) in 2011 and 15 (or 35.7%) in 2013 (Figure 2).

Accessing to mechanization service. The provision of mechanization services started many years ago in China. These paid services includes mainly land preparation and harvest, but in some areas they also expand to other field operations such as planting/sowing and fertilizer and pesticide applications. The providers of these mechanization services are individual farmers or farmers' machinery cooperatives/companies within or outside villages. The farmers' machinery cooperatives and companies often sell their mechanization services across large areas, even across the provinces for several months (Yang et al., 2013). Based on our survey data, we found that the mechanization service has been available in every village since 2008. To distinguish the mechanization service among villages, we create a variable called the years having mechanization services available in each village. The results suggest that, on the average, the villages had experienced 3.5 years of these mechanization services in 2003, increased to 7.3 years in 2008 (Figure 2). By 2013, average village received more than 12 years of mechanization services.

3.4 Institutions, policies, market and farm size

Table 4 examines the relationship between farm size and the major drivers of farm size. As we would expected, the survey data do show that both land transfer service and policy support for large farms are positively associated with farm size in 2013. For example, sampled farms in the townships with land transfer service center had a weighted average farm size of 2.1 ha (or 23.2 ha of sample unweighted average) in 2013, while it was only 1.2 ha 3.5 ha (or 3.5 ha of unweighted average) for the farms

in the townships without land transfer service center (Table 4).[7]

There are also evidence of the effects of policy support and mechanization service on farm size. For example, there is significant difference on the average farm size observed between the farms in the townships with and without policy support for large farms (rows 3 and 4, Table 4). The weighed average farm size in the townships with policy support (2.3 ha) was nearly twice as that in the townships without policy support (1.2 ha). The last six rows in Table 4 further show the positive relationship between average farm size and the number of years having mechanization service and between average farm size and off-farm wage.

4. Econometric analysis on determinant of farm size

4.1 Empirical model and estimation measure.

Since descriptive analyses presented above do not control for the influence of other factors, to examine the impact of the major driven forces on farm size, an econometric model is specified as follows:

$$H_{ijht} = a_0 + a_1 L_{jt-1} + a_3 P_{jt-1} + a_2 S_{ijt-1+} + a_4 W_{ijt} + a_5 C_{ijt} + a_6 A_{ijht} + a_7 D + \varepsilon_{ijht}$$

where H_{ijht} represents farm size (ha) of the h^{th} farm in the i^{th} village, the j^{th} township at year t during 2003-2013. L_{jt-1} is a binary variable, which equals 1 when the township j had land transfer service center in the previous year (lagged one year), 0 otherwise. P_{jt-1} is a dummy variable with a value of 1 if the townships j had policy support for large farms and 0 otherwise, also lagged one year. S_{ijt-1} denotes the years having mechanization services measured at village level and lagged one year. To better quantify the impacts of three policy variables, in the empirical model we also include the following control variables: 1) W_{ijt}, the daily off-farm wage (yuan/day) deflated by rural consumer price index and measured at village level; 2) C_{ijt}, the average cultivated land per household in the village; 3) A_{ijt}, a vector of variables reflecting the household characteristics, including age (years) and education (years) of the household head; and 4) D, a set of provincial dummy variables to control for non-time varying unobservable regional differences. a_k (k=1,…,7) are the coefficients to be estimated. The term ε_{jiht} is the specific error term and are assumed to be subjected to independent identical distribution. Summary statistics of the dependent and independent variables are in Appendix Table 1.

In estimation, we made two efforts to avoid the likely endogenous problem. First, as we explained above, three variables on the driving forces are lagged one year. Second, we apply the household fix effect (FE) measure to estimate the above model based on the unbalanced panel data from 2003 to 2013, including balanced panel data for all household farms in 2003-2013, and companies and cooperatives data in recent years. When using FE model, all non-time varying variables such as household characteristics and provincial dummies are dropped. For robust check and gaining

[7] The large difference between unweight and weight sample means is due to the stratified randomly sampling approach used in this study. That is, the sampled farms with extreme large farm sizes have a very small weight in the whole population (or farms).

information on the impact of household characteristics on farm size, we also estimate the model with OLS and presented. In either OLS or FE model, the weight regression is applied as our data are from a stratified random sample.

4.2 Estimation results

In general, the signs of the estimated coefficients based on two estimation measures, FE and OLS (Table 2), demonstrate that the results on the impacts of land transfer service, policy support and mechanization service on farm size are robust and also consistent with descriptive discussions presented in the previous section. Here, we highlight several key findings based on the results presented in Table 5.

The most important result is the estimated coefficients for key driving factors are positive and statistically significant (Table 5). Holding all other constant, institutional innovation through creating land transfer service center at township can increase average farm size by 1.23 ha (column 1, Table 5). The magnitude of this impact is remarkable as it is more than average farm size in 2009 (1.17 ha, column d, Table 1) before the land transfer service center was established in the NE&NC regions.

Policy support targeted at large farm also generates significant impact on farm size as it has encouraged some farmers to increase their farm sizes to a level entitled for this policy support. The estimated coefficient (1.83) for the policy support variable suggests that farm size can be raised by 1.83 ha after this policy was implemented (column 1, Table 5). This impact indeed is more than average farm size in 2013 in the study areas (Table 1).

The impact of mechanization service on farm size is also positive and statistically significant. Villages experienced an additional year of the mechanization service, farm size can be increased by 0.12 ha (row 3, Table 5). This result is not difficult to understand because farmers can manage more crop land when key farm activities such as land preparation, crop planting and harvest can be conducted by machinery companies/cooperatives.

The estimated coefficient for off-farm wage is positive but not statistical significant in the FE model, while it is positive and statistically significant in the OLS estimation (row 4, Table 2). This implies that farmers in the village with higher off-farm wage has more incentive to increase their farm size than farmers in the village with lower off-farm wage. But for a given farm (FE model), the insignificant impact of rising off-farm wage in the village over time on farm size still needs a further study.

While the results from the OLS estimation could be bias on the impacts of the first three variables on farm size due to the likely endogenous problem, the estimated coefficients for households characteristics do provide interesting findings. The estimated results show that the villages with more cultivated land per household have more potential to increase farm size, which is consistent in both the FE and OLS estimation (row 5, Table 5). Statistically significant and negative coefficient for the age of farm's head implies that youth tends to have a large farm size. Interestingly, more educated farmers are tend to have the larger farm size.

5. Discussions, conclusions and policy implications

Driven mainly by demand change due to income growth and urbanization, market liberalization, and supply chain change, Asian agricultural structure and rural labor employment have been undertaking significant transformation. However, agricultural transformation has generally been associated with the falling average farm size. While there has been a long debate on efficiency of small-scale farms, recent literature tends to agree that the small-scale farms are facing increasing challenge in improving its competitiveness and their income.

Similar to nearly all other countries in Asia, China had also experienced a gradual fall in average farm size until the early 2000s. However, the recent rise on average farm operation, particularly the rapid and significant change in farming structure toward medium- and large-scale farms are striking and exceptional.

This study shows that several driving forces have shaped China's unique farm operational evolution. These include institutional innovation through establishing land transfer service center to activate land rental market, policy supports for land consolidation, and innovated mechanization service for millions of family farms. They have been jointly assisted some small-scale farms to scaling up their farm and meantime helped other small-scale farms rented out land and moved to off-farm employment. On the other land, these driving forces have also induced the emergence of large-scale farms operated by land cooperatives and companies. While the number of these farms is still small, their share in total cultivated land is significant and rising rapidly in recent years.

The results of this study have several policy implications for China and the rest of world. First, there is market failure in farm operational transformation and therefore institutional and policy intervention are necessary. With rise of rural population, farm size is expected to continue its falling trend in many developing countries in Asia. China's recent experience shows that the land rental market can be effectively activated with land transfer service provided by government. While the role of this service is reflected mainly on expanding farm size in China's rural villages where land has been equally distributed to all households, it may also play roles in other countries such as helping landless farmers to access to land, assisting some small-scale farms shift to off-farm employment, and enlarging size of small-scale farms that decide to stay in farm.

Second, enlarging the size for small-scale farms through market based mechanization service is an alternative and maybe also effective way to improve farming productivity. This type of mechanization service can also overcome capital constraint in purchasing and improving utilization of machineries.

The last but not least, the impacts of China's recent movement on the small-scale farm transformation on food security, farm employment and farmer's income need further investigation. While there is no doubt that labor productivity can be increased significantly with the rise of farm size and mechanization, there are also concerns on land productivity and profitability with significant increase in farm size. A study based on the same dataset by Huang and Ding (2015) has showed that there is evidence of the inverse U-shape relationship between farm size and land productivity or profitability as well as total profit per farm in rice, wheat and maize production in China (also see Figures 3 and 4). These findings suggest that while the small is not necessary better, the excess large farm size could even be worse. Having appropriate

farm sizes operated by households might be the path of farm operational evolution which China should follow and the support policy should target on.

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Table 1. Estimations of average farm size (ha) in China and the Northeast and North China regions.

	Average farm size in China			Average farm size in Northeast and North China regions
	Including all households living in rural, based on RIES dataset	Percentage of households living in rural without farming, based on RLLS dataset	Estimated farm size in China by this study, based on (a) and (b)	
	(a)	(b)	(c)	(d)
1985	0.73			
1990	0.67			
1995	0.65			
2000	0.55	4.6	0.58	
2001	0.55	4.6	0.58	
2002	0.55	5.2	0.58	
2003	0.53	6.4	0.57	0.92
2004	0.55	7.8	0.59	0.97
2005	0.57	8.4	0.62	1.00
2006	0.58	9.1	0.63	1.02
2007	0.57	10.3	0.64	1.03
2008	0.58	11.8	0.66	1.03
2009	0.61	15.2	0.72	1.17
2010	0.61	17.1	0.73	1.41
2011	0.60	18.6	0.73	1.61
2012	0.61	19.8	0.76	1.72
2013	0.61	20.7	0.78	1.73

Note: Data in column (c) are adjusted farm size with excluding households living in rural but either fully rent out or gave up their land or lost land due to land acquisition. The formula used is: $c = a /(1- b/100)$.

Data in column (d) are based on surveys in 6 provinces in Northeast and North China.

Table 2. Percentages of no farming households and rural households with rent in or rent out land in China, 2003-2013.

	Percentage of rural households		
	No crop farming at all	Rent out their land	Rent in land from others
2003	8.6	15.7	11.5
2004	10.7	17.8	13.1
2005	12.0	19.1	12.5
2006	13.4	20.6	14.6
2007	15.4	22.4	16.5
2008	17.5	24.6	18.4
2009	21.0	24.4	7.8
2010	23.2	25.5	8.5
2011	24.9	26.5	8.7
2012	26.4	27.5	9.7
2013	27.9	29.3	10.8

Sources: authors' analyses based on RLLS dataset.

Table 3. The composition of farms and average farm size by type and size of farms in Northeast and North China in 2003, 2008 and 2013.

	Composition of farms by farm type and size (%)			Average farm size (ha)		
	2003	2008	2013	2003	2008	2013
Cooperatives with land consolidation:	0	0.0007	0.14	--	55	216
a): Paid rent only	0	0.0005	0.12	--	67	138
b) Shared profit only	0	0	0.01	--	--	128
c) Both (a) and (b)	0	0.0002	0.01	--	43	500
Company	0	0	0.01	--	--	109
Household farm	100	99.9993	99.85	1.7	2.2	4.5
<1 ha	73.3	68.5	59.5	0.5	0.5	0.5
1-2 ha	15.7	17.2	18.8	1.4	1.4	1.4
2-3 ha	6.6	8.6	12.7	2.4	2.4	2.3
3-7 ha	4.1	5.4	8.1	4.4	4.6	4.4
7-15 ha	0.2	0.2	0.5	9.7	9.7	9.9
15-30 ha	0.0	0.0	0.1	18.0	19.2	19.0
30-70 ha	0.0	0.0	0.1	30.4	30.4	40.4
>70 ha	0.0	0.0	0.02	--	--	260

Note: All numbers in this table are weighted averages.
Source: Authors' survey.

Table 4. Land transfer service, policy support for large farms, mechanization services, and farm size in Northeast and North China in 2003-2013.

	Average farm size (ha)	
	Unweighted	Weighted
Townships with land transfer service center		
Yes	23.2	2.1
No	3.5	1.2
Townships with policy support for large farms		
Yes	12.1	2.3
No	3.5	1.2
Years having mechanization services		
<7	3.1	1.1
7-14	3.9	1.2
>14	7.9	2.0
Off-farm wage (yuan/day)		
<50	2.6	1.0
20-100	5.5	1.5
>100	12.2	3.6

Note: All numbers are weighted averages.
Source: Authors' survey.

Table 5. Results of multivariate analysis on the farm size (ha) during 2003-2013, the weight regression.

	FE model	OLS
With land transfer service center (t-1)	1.23*	0.84**
	(1.78)	(2.11)
With policy support for large farms (t-1)	1.83**	0.73**
	(2.19)	(2.17)
Years having mechanization services	0.12**	0.04***
	(2.53)	(9.78)
Off-farm wage	0.02	0.007***
	(1.37)	(3.25)
Average cultivated land per household in the village	1.66***	0.55***
	(2.65)	(5.47)
Age of household head		-0.01***
		(4.03)
Education of household head		0.04***
		(3.37)
Jilin		-1.26***
		(5.64)
Liaoning		-1.66***
		(6.09)
Hebei		-2.05***
		(11.25)
Shandong		-2.14***
		(10.57)
Henan		-2.03***
		(10.09)
Constant	-1.32**	2.22***
	(2.17)	(12.20)
R^2	0.038	0.044

Note: Absolute values of t-ratio in parentheses; *, **, *** indicate statistically significant at the 10%, 5%, and 1%, respectively. The sample size used in regression is 9444.

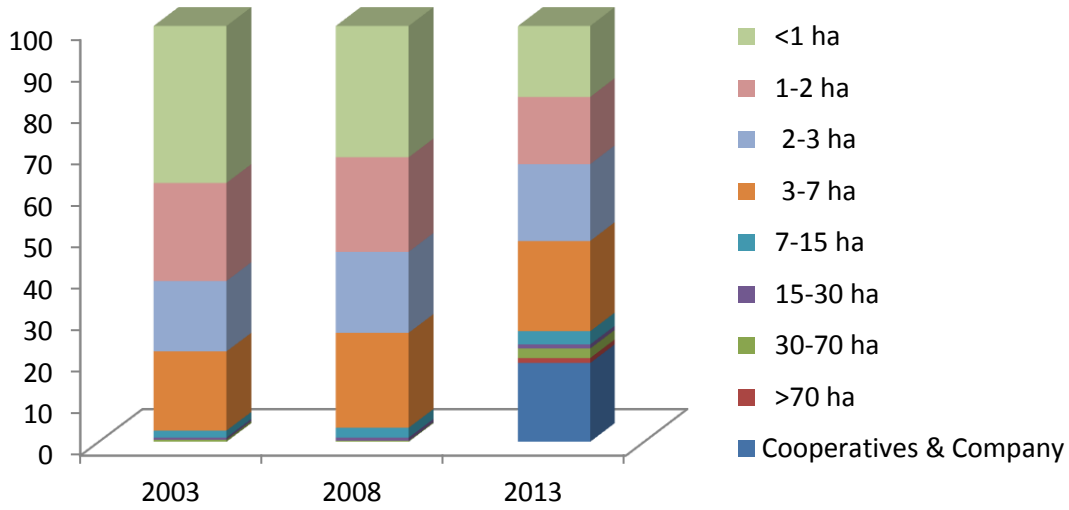

Figure 1.The cultivated land share by farm size or type of farms in Northeast and North China in 2003, 2008 and 2013.

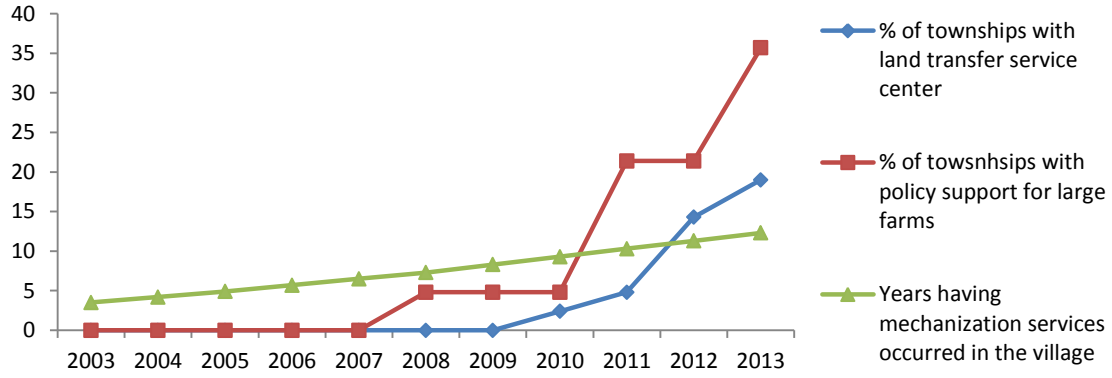

Figure 2. Percentages of townships with land transfer service center and policy support for large farms, and years having mechanization service in the village in NE&NC

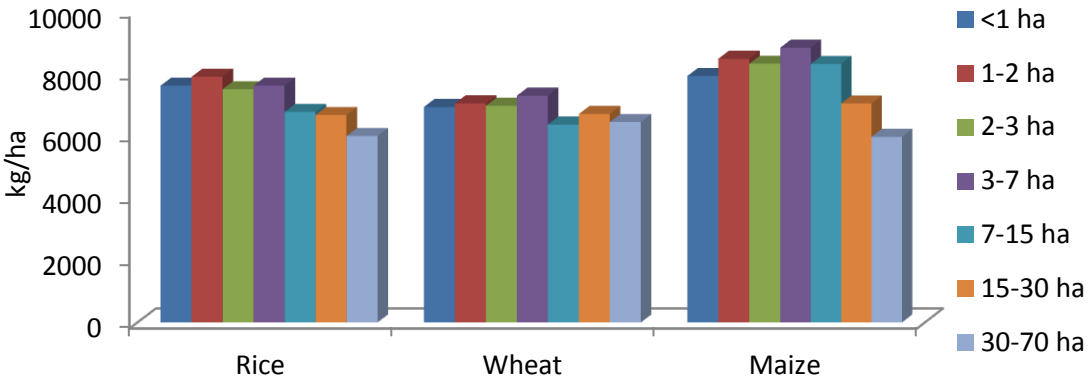

Figure 3. The relationship between farm size and crop yield in 2013.

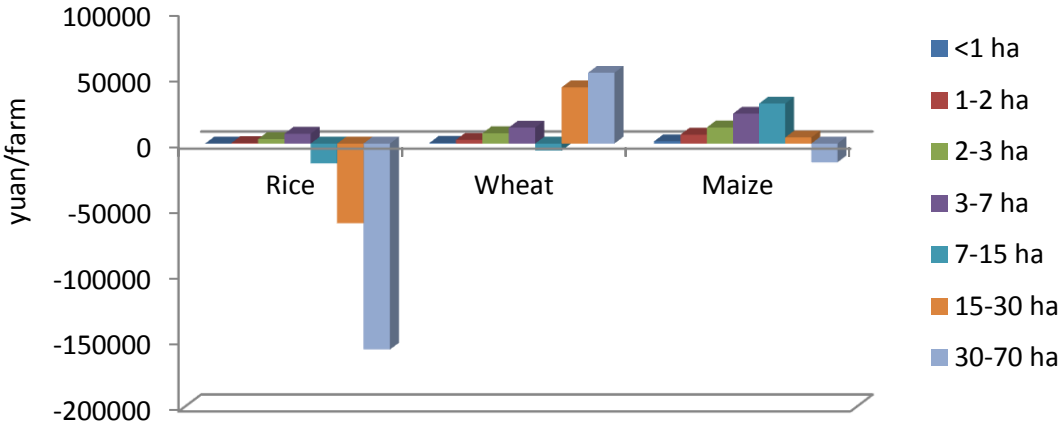

Figure 4. The relationship between farm size and total profit per farm in 2013..

Appendix Table 1. Simple means and standard deviations of all variables used in regression

Variables	Mean	Standard Deviation
Farm size (ha)	4.2	0.2
With land transfer service (t-1) (1=Yes; 0=No)	0.04	0.002
With policy support for large farms (t-1) (1=Yes; 0=No)	0.09	0.002
Years having mechanization services (years)	7.6	0.06
Off-farm wage (yuan/day)	53.5	0.2
Average cultivated land per household in the village (ha/household)	0.9	0.006
Age of household head (year)	46.5	0.1
Education of household head (year)	7.9	0.03

Note: The number of observation is 9444.
Source: Author's survey.