# 博士論文 （要約）

Doctorate Thesis (Abridged)

Development of Agricultural Land System and Policies in China

(中国の農地制度の発展と政策)

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論文の内容の要旨

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As this doctorate thesis is anticipated to be published as papers in scholarly journals, it cannot be published online. The papers are scheduled to be published within 5 years.

This thesis highlights the developments in Chinese rural land system and land market as well as the microeconomic impacts of these developments on rural farmers. Regarding to the development in rural land market, I mainly focus on the local collectives' intermediary role in land rental market. As for the development in rural land policy, I take advantage of Chinese new round of land titling project and assess its impact from different aspects.

Chapter 1 aims to depict a general picture of Chinese rural land system by introducing the revolutions of agricultural institutions in China. China has experienced three stages of agricultural institutions since its new-born in 1949. They are concluded as: the pre-commune system (1953-57), the commune system (1958-78) and the Household Responsibility System (hereafter, HRS) (1979-now). The HRS dismantled the commune production and substantially encouraged farmers' incentives to work, which is still the basis policy in rural land system. Nonetheless, the HRS is not flawless. One of its disadvantages is the land reallocation by local governments. Land reallocation is regarded as the most

critical cause of land tenurial insecurity in China. Many studies have investigated its profound impacts on the development of Chinese agriculture. Chinese new round of land titling is implemented to stabilize land tenure in rural China, which will be the main topic of Chapter 3-5. Another disadvantage of the HRS is that it sacrifices economies of scale in agriculture (Lin 1987). To a large extent the land fragmentation in China is caused by the implementation of the HRS (Tan, Heerink, and Qu 2006; Kung 1994). Due to above reasons, polices that promote land consolidation have been announced by Chinese central government. One of them is to stabilized land property rights in rural regions, while another one is to develop rural land market where land use rights can be subcontracted, leased, exchanged and pledged. Chapter 2 discuss the development in Chinese rural land market.

Chapter 2 documents the recent emergence of local collectives' intermediary role in rural land transactions. This research has discovered some positive effects on land security when local collectives are involved in land rental transactions. From the perspective of tenant farmers, achieving a tenancy contract with the intermediary of local collectives can saliently reduce the land expropriation risk, therefore enhance their tenancy security. And reduced land risks along with longer tenancy length thus encourage farmers to increase the investment in agricultural production and to adopt environmental-friendly production strategy. Nonetheless, given this positive side, local governments' involvement should be carefully regulated. It has already been mentioned by some scholars that local governments sometimes abuse their administrative power to withdraw farmland from small farmers. This chapter thus suggest that taking advantage of local collectives under appropriate guidance could generate positive benefits.

To stabilize land property rights in rural China and encourage the development of farmland market, Chinese government launched the land titling project (LTP) in 2013 (with a pilot program in 2011).

Whether this project can substantially enhance land security has not been well proved. The study in Chapter 3 attempts to explore this topic from the perspective of its impact on farmers' renting-out behavior. This study proposes and proves that due to a simultaneous increase in farmers' perceived land value, the impact of enhanced land tenure on farmers' renting-out is offset. Therefore, this study does not observe that land titling inclines farmers to rent out their land. Instead a robust and discouraging effect from land titling has been proved. To sum up, this study implied that the encouraging impact of land titling on farmers' land renting-out is very trivial. The most fundamental reason is the unchanged HRS.

Few studies have highlighted another potential impact from this land titling project: it might cause some changes in farmers' perception about the farm size. As one key step in the process of LTP, measurement of farmland locations and sizes is conducted using the geographic information system (GIS) technology – satellite pictures. Many studies have, however, found inconsistencies between the GPS measured and the self-reported land sizes (Carletto, Savastano, and Zezza 2013; Carletto, Gourlay, and Winters 2015). Therefore, Chapter 4 hypothesizes that there might exist a gap between the LTP measured land sizes and farmers' original knowledge about the sizes of their farmlands. If this is the case, after the titling, farmers' knowledge about the land size would be updated. The result shows that using GIS method for land measurement in LTP can significantly increase self-reported land size of those households with small farmland plots. Also, the smaller is the plot, the smaller becomes the impact. However, as for those households with large plot of farmland, since GIS measurement is relatively accurate on large plots, the perception-change effect is limited in such households.

The study in Chapter 5 still takes advantage of the Chinese new round of land titling project to investigate: whether and how improved land tenure help reduce farmers' usage of agricultural chemicals.

Three specific mechanisms have been hypothesized. The first hypothesis is that secured land tenure elicits an increased sense of responsibility to utilize land more sustainably, which encourages the reduction of chemicals (Chen and Innes 2013). The second hypothesis is that land titling could result in a decline of chemicals usage by encouraging labor outflow. The last hypothesis is that land titling incline farmers to adopt agricultural machines that are 'chemical-saving'. The empirical evidence proves a pesticide-reduction effect from land titling and rules out the last two hypotheses.

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# Chapter 1

# Introduction: Development and Challenges in China's Agriculture

## Household Responsibility System

China has experienced three stages of agricultural institutions since its new-born in 1949. Wen (1993) concludes them as: the pre-commune system (1953-57), the commune system (1958-78) and the Household Responsibility System (hereafter, HRS) (1979-now). During the first period, farmlands are characterized by private ownership. At the same time, voluntary rural movements, such as mutual aid groups and elementary cooperatives, were also popularized and encouraged to overcome the shortage of labor and achieve economies of scale. In 1957, advanced cooperative movement started and expropriated farmers of the ownership of their land and capital. These advanced cooperatives were soon later replaced by the commune system in 1958. From then on, China started its two-decade of collectivized agriculture. Under the collective production, decisions about resource allocation were all made by commune authorities, while farmers only need to supply labor. In the meantime, farmers were awarded with work points for each day's work. Based on these work points they accumulated during the year, they got distributed with the share of net income at the end of each year. The poor performance of commune production institution resulted in a tremendous decline in agriculture productivity, especially labor productivity, which partially becomes one cause of the Great Leap Famine. These consequences thus induced the innovation of the HRS in the early 1980s. Under the HRS, although rural land still belongs to village collectives, the management right of land should be contracted out to each member household. In this new institution, farmers make decision of agricultural inputs by themselves and take responsibility

for the production and yield. The only obligation for them was to contribute part of their yield to the state or the commune to meet the requirement of quota (Brandt, Rozelle, and Turner 2004). This quota contribution was also called as the agricultural tax, which has been abandoned in 2006.

So, why did the commune system end up with a decline in labor productivity? One consensus is that the team production in the commune system makes it impossible to accurately monitor each member's contribution to the final output, which caused farmers' low incentive to work (Alchian and Demsetz, 1972). Lin (1987) concludes that in the commune system the return to one farmer's additional effort theoretically should consist of two parts: (1) one share of the increase in the total team production, (2) a larger share of the total team income due to his/her higher work points. Since the first channel was equivalent to all farmers that in the same production team, this part of reward is insufficient to encourage farmers to offer their optimal effort. On the other hand, the realization of the second part depended the well-functioning of the work point system. Yet, seasonal production and one-time harvest in agriculture make the monitoring cost extremely high, which resulted in a poor quality of monitoring in the commune system. Thus, without a well-functioning work point system, farmers who put more effort in production received the same payoff as those who did not. And therefore, their incentives to work was discouraged by the commune system.

In addition to low incentives to work, excessive grain procurement has also been documented as another negative feature of the commune system (Kung and Lin, 2003). One reason that Chinese government decided to collectivize agricultural production is to pool together agricultural surplus so that it can fuel the industrialization. Therefore, the price they offered for the agricultural surplus is much lower than its competitive price. Bai and Kung (2014) hypothesize that this might have also changed people's believe in the effectiveness of collective framing in improve their wealth.

The HRS however substantially encouraged farmers' incentives to work. Under the HRS, the marginal return to farmers' production input is exactly the marginal product of their effort, requiring no monitoring cost (Lin, 1987). Therefore, it improved the agricultural productivity in China. Wen (1993) estimated that compared with the commune system, the HRS can significantly increase the total factor productivity in Chinese agriculture sector. At the same time, according to the estimation in Lin (1992), the HRS contributed to around 47% of the agriculture output growth during 1978-1984. The statistics from Fan and Pardey (1997) also shows that during 1979-1985 the growth rate of agricultural output in China reached 7.5% per annum, compared with annual rate of 3.3% before the innovation of the HRS. Gibson (2020) utilized a new-developed synthetic control method and discovered a similar positive impact of the HRS on grain output and food supply in China. Therefore, empirical evidences about the impact of the HRS innovation have proved that this institutional transition is one of the most important economic innovations in the history of China.

Nonetheless, the HRS is not flawless. One of its disadvantages is the land reallocation by local governments. The first round of the HRS's contract with farmers was from 1984 to 1998, while the second round extended this contract term by another 30 years until 2028. Before the termination of the second round, Chinese central government has already announced another 30 years of extension, which makes the end of current land contract term year 2058. These consecutive extensions aim at stabilizing farmers' use right of farmlands. Nevertheless, the HRS also allows local governments to reallocate farmland within their territories at some certain frequencies, and this caused the land instability among farmers. Deininger et al. (2014) exploits an 8-year panel data and reveals that before 2000 more than 50% of Chinese villages had implemented at least once of land reallocation, and this ratio is still around 14% to 20% after 2000, despite that there have been prohibitions of land reallocation announced by the central

government since 1993. Brandt, Rozelle, and Turner (2004) concludes the motives why local governments reallocate farmlands: (1) efficiency motive: by redistributing farmland from households with low productivity to those with high productivity, reallocation can improve the general production efficiency. (2) equity motive: local collectives hope to adjust the land distribution with the demographic change in the community, so that they can ensure the egalitarianism in the per-capita land allocation rule. (3) rent-seeking motive: land reallocation is also one consequence of rent-seeking behavior during community elections.

Land reallocation is regarded as the most critical cause of land tenurial insecurity in China. Many studies have investigated its negative impacts on the development of Chinese agriculture. It has been mentioned to be like a random tax on farmers' production, which hinders farmers' investment incentives (Besley 1995). When farmers' revenue is made to depend only on the consequence of their efforts, they will have an incentive to carry out production efficiently (Hayami and Otsuka 1993). However, if the return to effort also depends on other factors, such as institutional uncertainty or natural disasters, farmers' investment incentives would be suppressed. Regarding to land reallocation, many empirical studies have proved its negative impacts on the adoption of conservative productions (such as manure application), irrigation infrastructure investment, machinery utilization (Jacoby, Li, and Rozelle 2002; Hong, Luo, and Hu 2020; Ma et al. 2013; Li, Rozelle, and Brandt 1998; Xu and Zhang 2005). Furthermore, due to its negative impact on long-time conservation activities, it could also negatively affect land quality. Yu et al. (2003) exploits a plot-level dataset as well as their soil examination results and finds that secure land property right enhances the long-term fertility of land, while insecure land tenure offsets such impact and causes a degradation in land quality.

In addition to above two impacts, how land reallocation affects the development of factor market

has also attracted a lot of attentions. Rapid absorption of rural labor by non-farm sectors in recent decades urges a corresponding farm size adjustment in rural China, where a well-functioned land market is necessary. However, tenurial insecurity that is caused by land reallocation may hinder the emerging of land rental market in China. From the perspective of lessors, renting-out land is usually seen as a signal that this land is no longer needed by this household, especially when household members have left their hometown for non-farm occupations (Brandt et al., 2002; Deininger et al., 2014). Under this circumstance, local collectives have a tendency to confiscate this land and re-distribute it to other households. Therefore, small farmers' willingness to supply their land to rental markets is discouraged. On the other hand, renting in farmland from communities that have a high probability of land reallocation means a larger risk of land expropriation, which also suppresses the demand side of land rental market. Furthermore, when rural labor is stuck with their land, the development of off-farm labor market is affected too. Deininger et al. (2014) adopts past land reallocations to measure land insecurity and finds that having experienced land reallocation discourages farmers from exiting from agriculture, while an improvement in tenure security that is proxied by land certificate can largely encourage participation in off-farm work.

Another disadvantage of the HRS is that it sacrifices economies of scale in agriculture (Lin 1987). To a large extent the land fragmentation in China is caused by the implementation of the HRS (Tan, Heerink, and Qu 2006; Kung 1994). During collective farming in the commune system, rural land was owned and managed collectively. Land was only divided based on the soil type or irrigation condition for the convenience of management. After the transition to the HRS, land use rights were assigned to each household based on family size, and agricultural production became a small scale based on the unit of households. After 1986, average farmland per household in China has decreased to around only 0.5

hectare. There is no severe disadvantage when we just compare agricultural productivity level in the HRS and the one in the commune system. According to the estimation from Lin (1987), productivity level in the HRS always dominates the one in the commune system, unless return to scale in the latter one is more than 2. Nevertheless, with time going by, the issue of land fragmentation has increasingly become the obstacle to the further rising of agricultural productivity in China. Fragmentation of farmland in China has caused a loss of efficiency in production. First, irrigation service as a public good is usually provided by communities in China. Scattered and small plots invoke extra management and negotiation costs, which have a direct negative impact on the irrigation action (Wang, Zang, and Araral 2020). In the meantime, fragmented land makes it uneconomical for small farmers to buy or rent machines by themselves. They relies on group rental transactions or public machinery services provided by local collectives, which also causes a lot efficiency loss during negotiations (Wu, Liu, and Davis 2005; Lai, Roe, and Liu 2015).

Due to above reasons, polices that promote land consolidation have been announced by Chinese central government. One of them is to stabilized land property rights in rural regions, while another one is to develop rural land market where land use rights can be subcontracted, leased, exchanged and pledged (No.1 Central Document 2014, 2015). Detailed (introductory and empirical) discussions about these two topics will be covered in the following sectors of Chapter 1 and the following chapters. Nonetheless, there are worries about the decline of agricultural productivity with land consolidation, given the evidences of Inverse Relationship between land size and productivity in developing countries (Kimhi 2006; Assunção and Braido 2007). After controlling for measurement error in land size, omitted land quality variables and transaction cost, the core reason of the existence of this inverse relationship in transition economies is the underdevelopment of factor market, such as land, labor and machinery service

markets (Binswanger and Rosenzweig 1986; Hayami and Otsuka 1993). Factor markets have developed very quickly these years. Thus, this should not be a problem anymore. Many studies have also proved that if it is not the omitted factors such as quality or measurement errors, this inverse size-productivity relationship is not inherent to China's agriculture (Chen, Huffman, and Rozelle 2011; Sheng, Ding, and Huang 2019). Therefore, efforts to promote land consolidation should be pursued. In the next section, the development of rural land market and its related research will be covered.

## Chinese Rural Land Market

Well-functioning land market improves agricultural productivity (Benjamin and Brandt 2002). It allows famers with higher productivity to be able to obtain additional land and expand operation scale and increase their income. On the other hand, it also provides a platform for those who join the off-farm labor force to rent out their land and to continue enjoying the benefits of owning land (Otsuka and Hayami 1988).

The definition of land market in China is a market where land use rights can be transacted. Under the HRS, land property rights are divided into three parts: (i) ownership, which belongs to each local collective; (ii) the land-contract right, i.e., the right to sign a contract with local collectives and get distributed with some farmlands based on family size or household labor supply; (iii) the land-use right, namely the right to manage/use the distributed land during the contract period. During the land transaction, it is the land-use rights that are transferred, while the land-contract right stays with the original peasants (Ye 2015).

Since the transition into the HRS, the central government's attitude towards land transfer has changed several times. At the beginning of 1980s, land transfer was completely forbidden by Chinese

government. In 1982, it was clearly stated in Article 10 of the 1982 Constitution that, “no organization or individual may appropriate, buy, sell or lease land, or unlawfully transfer land in other ways”. In 1984 No. 1 Document the central government loosened this control over land transfer and stated that “encouraging the land to be concentrated in the master hands of farming; peasants who ask to not contract farmland or to contract less farmland due to their inability to carry out farming or doing other business, can hand their land over to the collective for future arrangement or, by approval of the collective, transfer their land contracts to others.” Although land transaction is legally allowed since 1984, it was not very prevalent. One reason is that in 1980s off-farm sectors were still in its infancy, and labor absorption from rural region by those sectors was still inadequate. However, even until 2010s, land transaction ratio still remains a low level. According to statistics from Ye (2015), by 2013 the ratio of land transferred in the total contracted land is 26%. Therefore, to further promote the incidence of land transaction, Chinese government clearly declaimed their positive attitude in 2013 No. 1 Document, stating that ‘to inspire and support the contracted land to be transferred to specialized large-holders, family farms and peasants’ cooperatives, to facilitate certain scaling up of agriculture in various forms’. In the same year, land titling project has also been officially initiated and its main purpose is to facilitate the development of rural land market (Cheng et al. 2019).

The development of the land market and the change in the central government’s attitude towards it are the result of structural transformation in the Chinese economy. From 1980 to 2019, the ratio of rural population in the total population of China has decreased from 80.6% to 39.6%, at the same time, the value-added share of agriculture in GDP has also declined from around 30% to only 7% (World Bank 2020). According to Zhang et al. (2011), China has reached the Lewis turning point in 2010. With limited young labor available in rural region, agriculture is now mainly undertaken by the female and the elderly,

whose productivity is relative low (Ye 2015). Transferring land from low-productivity farmers to high-productivity farmers is the solution to this problem, which means a well-developed land market is necessary.

Therefore, two questions for researchers and policy makers are: 1. what kind of land market should be developed under China's special agricultural system; 2. how to promote such rural land markets. Since the beginning of the discussion about land transaction market, researchers have always tried to list pros and cons of administrative land reallocation and decentralized land rental market, and to make a choice between them (Deininger and Jin 2005). Many studies have provided evidences to prove that land reallocation brings a loss in productivity and decentralized land market can optimize the distribution of land resources (Jacoby, Li, and Rozelle 2002; Li, Rozelle, and Brandt 1998; Brandt, Turner, and Rozelle 2004; Zhang et al. 2011). However, transaction costs, containing such as difficulties during negotiation and collection of land information, remain as barriers to land market development. Recently, a new type land transaction has been observed in rural China. Under the call of the central government and the guidance of the continuously promulgated policies, more and more village governments are participating in the land transaction market as intermediaries. After decades of managing the farmland, local collectives own the information of each plot of land and each household in their territory. Therefore, with them involved in the land market, transaction cost can be saliently slackened. Two kinds of intermediaries are actually undertaken by local collectives, the dealer and the market maker (Rust and Hall 2003). Some local collectives participate in the transactions as a role of dealer. They first negotiate with member households within communities and gather land from those who are willing to lease out. In this step, they offer a bid price to each small farmer for their land. After collecting land sources, they find one or several suitable farmers who are willing and able to rent in a large amount of farmland to rent out farmland. Here,

the price for those to-be large-scale farmers is an ask price. In this kind of intermediary market, ask price is usually higher than bid price. The price gap is then to compensate for the transaction cost that is undertaken by local collectives. At the same time, the ask price for land lessees is also higher than the competitive price in a market without a dealer. This requires those farmers who want to rent in land from local collectives to have a higher valuation for those land. Namely, their potential productivity should be higher than those who are not willing to rent from an intermediary market.

In the second type of intermediary land market, the main role of local collectives is the market maker or the information provider. They do not transact directly with lessors nor lessees. Instead, they provide information about available land or households who are seeking transaction patterners to those farmers who wish to expand their production scale. Therefore, barriers to access to land information are largely eliminated in this case. Nevertheless, negotiation cost still exists. In the case of a large transaction, lessees need to negotiate and accomplish contracts individually with a large number of small farmers, given a high level of land fragmentation in China. This cost is still tremendous. Local collectives, therefore, tend to involve in the negotiation process. They may represent one side to negotiate with another side or provide a platform for both sides to negotiate together. Regarding to the rent, they may also provide recommended rent price to both sides, given that they can access to information of rent transactions happening in other communities. However, in this kind of transaction, rent contracts (if any) are signed directly by large farms with small farmers. Therefore, bid price and ask price are the same, and there is no space for local collectives to earn from such transactions. The reason why they actively participate in land transactions is to promote the transfer rate of land so as to comply with the instructions of the higher government. On the other hand, village cadres do not have to take responsibility for these transactions.

Compared to a completely decentralized land market, a centralized but still market-oriented land market may have some advantages. First of all, as introduced above elimination of transaction cost is the primary merit of involving local collectives in land transactions. It accelerates land consolidation and land market development. Second, involvement of local collectives makes land rented in more secure. As introduced in the previous section, the main tenurial insecurity in rural China comes from local collectives. Ownership of farmland in China belongs to communities, therefore they tend to arrange or reallocate farmland due to different purposes. Dealing directly with collectives or through them to some extent makes them endorse on this transaction. Thus, as one partner of a transaction, they will be less likely to default. At the same time, lessee farmers in such transactions are more likely to be able to extend their transaction term without being affected by land reallocation nor the termination of land contract term, so that they can make long term production plans. This hypothesis will be empirical examined in Chapter 2.

## Land Titling Projects

Back to the second question confronted by policy makers, how to promote the development of the land market. No matter which kind of market to construct, the key is to encourage the supply and demand of land in rural China. Stabilizing land property rights is the first and the most fundamental task. Although the central government has emphasized many times in documents that local collectives should respect farmers' land-use rights and do not reallocate farmland during land-contract period, these commands have not been strictly followed (Brandt, Turner, and Rozelle 2004). Therefore, to improve the fundamental condition for a better development of land rental market, Chinese government introduced Land Titling Program (LTP) firstly in Document No.1 of 2008, and officially launched it from 2013 (with

a pilot program in 2011). Based on a *de facto* rule, this titling program measures the location and size of each plot of farmland that one household has been allocated with, and then distribute to each household a land certificate with detailed information recorded on. This whole program lasted for 5 years and has ended in 2018. The general process is usually comprised of 4 steps: Sensitization meeting, Land measurement, Result publication, and Certificate distribution.

Most studies suggest that the land titling project encourages the land renting-out via two different pathways: reducing expropriation risks and decreasing transaction costs (Besley 1995; de Janvry et al. 2015; Deininger et al. 2014; Deininger, Jin, and Nagarajan 2005; Jacoby, Li, and Rozelle 2002; Kimura et al. 2011; Macours, Janvry, and Sadoulet 2010). The LTP clarifies the spatial boundaries and location of each plot for every household, which to some extent would enhance the security of land property right and reduce the expropriation risk during transaction. At the same time, the land certificate per se makes land information more readily available and verifiable (Cheng et al. 2019; Deininger, Savastano, and Xia 2017). Therefore, extra land measurements are no longer needed, which may increase the net revenue and shorten the period of handling land transactions.

In Chapter 3 to 5, empirical analysis on the impacts of land titling project on farmers' renting-out decision and their production behaviors will been covered.

# Chapter 2

# Reconsidering the Role of Local Collectives in Land Transactions in China: Evidence from the Perspective of Large-scale Farmers in Henan Province

(This part of thesis is anticipated to be published in a scholarly journal)

# Chapter 3

# Can Land Titling Really Enhance Tenurial Security of Farmlands in China? Evidences from Its Impact on Farmland Renting-out

(This part of thesis is anticipated to be published in a scholarly journal)

# Chapter 4

# Land Titling in China and Its Effects on Farmers' Land Size Perception

(This part of thesis is anticipated to be published in a scholarly journal)

# Chapter 5

## How does improved land tenure reduce agricultural chemical use in China: labor outflow, machinery adoption or ecological protection?

(This part of thesis is anticipated to be published in a scholarly journal)

# Chapter 6

# Conclusion and Policy Implications

This dissertation aims to response to two main questions that are raised in Chapter 1: (1) what is the development in Chinese rural land market and what impact it would impose on farmers? (2) whether Chinese land titling project could stabilize land tenure in agriculture and how would it affect farmers' behaviors?

Chapter 2 sheds light on the first question. This chapter documents that many local governments are involved in rural land markets as an intermediary following the call of the central government. Normally, they take two kinds of role as an intermediary: dealer and market maker. The market-dealer type of local collectives first gather farmland from their member households with a 'bid' price and then rent it out to one or several large-scale producers with an 'ask' price, while the market maker type of local collectives just provide information about available land sources or households who are seeking transaction partners to farmers who wish to expand their production scale. The emergence of governmental intermediary agencies therefore could affect Chinese rural land market. In the study explained in Chapter 2, I hypothesized that renting-in farmland with the involvement of local collectives implies better tenancy security to tenants. This rationale can be explained from two perspectives: land expropriation risk and contract enforcement. First, land expropriation or land reallocation are only conducted by local collectives in rural China, and it is still a serious threat to tenancy security. Trilateral transactions that involve local collectives as the intermediary could lower this possibility, since local collectives have the ownership of land and they are less likely to default in their own land contracts. Second, local collectives

not only are the basic government agencies in rural China, but also take the role as the mediation agency regarding conflicts. Therefore, the coordination of the local collective is to some extent an endorsement of the transaction, which also implies stronger contract enforcement. Thus, the improvement in both factors implied a better land security to tenants.

Following this hypothesis, study in Chapter 2 has discovered some positive effects on land security when local collectives are involved in land rental transactions. When farmers rent in farms through the intermediary of local collectives, one year longer in tenancy contracts averagely contributes to 20% increase in machinery value and 4.4% decrease in pesticide application. Form this result we can understand that reduced land risks along with longer tenancy length encourage farmers to increase the investment in agricultural production and to adopt environmental-friendly production strategy. Therefore, this study implies that despite of a lot of negative comments on local collectives' role in rural development, taking advantage of local collectives under appropriate guidance could generate some positive benefits.

Chapter 3 tries to link discussions about Chinese land titling project and rural land market development. The main question answered in this chapter is whether land titling project could incline small farmers to rent out their farmland. Researches in the literature have investigated this question but reached no consensus. In this study, I first construct a theoretical model by incorporating a factor of perceived land value in our consideration, which is normally ignored in previous models. The results derived from theoretical analysis implies that there are two different and opposite impacts of land titling on farmers' willingness to rent out. When expropriation risk is reduced by LTP, households' demand for self-cultivated farmland will also be lower, and they are more willing to rent out their farmlands. However, when people's expectation of their land value is increased by LTP, farmers tend to cultivate

more land by themselves. Furthermore, these two effects rely on each other. First, the magnitude of the encouraging effect through expropriation risk reduction is a monotonical increasing function of the total value of farmlands. While, the second discouraging effect through land value increase is also a function of the expropriation risk level the larger the expropriation risk, the stronger this discouraging effect, and when the land property right becomes 100% safe, this effect will not exist.

The empirical analysis does not find any encouraging effect of land titling on farmers' renting-out behavior. Instead, a robust and discouraging effect has been observed in region with high grain-productivity. Although this paper is not claiming that the theory developed is the only explanation why land titling causes a discouraging effect on farmers' willingness to rent, it is one of the possibilities that land titling project could have increased farmers' perceived land value. In the meantime, there still exists some expropriation risks after land titling, since land reallocation is still not strictly forbidden by Chinese government. Thus, this study suggests: (1) policies that aim to stabilize land property rights need to be implemented and followed strictly. Otherwise, with a large amount of fiscal investment, the effectiveness of these policies or projects would still be limited. (2) Chinese government should also be careful with the mechanism of the discouraging effect i.e., farmers' perception change caused by land policies. This kind of perception change probably will come with all land-related policies. Depending on the policy settings, sometimes it will strengthen the intentional impact, but sometimes it will have a distorting effect as the case in this study.

Chapter 5 continues to examine the tenure-enhancing effect of Chinese land titling project, but mainly focuses on its relationship with agrochemical overuse. By utilizing the same dataset as chapter 3, study in chapter 5 attempts to investigate the causal relation between land titling project and farmers' agrochemical reduction behavior and to confirm the mechanisms behind this impact. The main analysis

documents that land titling can substantially reduce farmers' expense on pesticide per mu by around 26%, while does not significantly change their chemical fertilizer input. Following this finding, this study hypothesizes that there are three potential mechanisms behind this effect: (1) land titling directly influences farmers' decision of chemical application. Secured land tenure elicits an increased sense of responsibility to utilize land more sustainably, which encourages the reduction of chemicals. (2) land titling could result in a decline of chemicals usage by encouraging labor outflow. Under a risky land tenure, labors are maintained in farming to protect the land from the threat of land expropriations. Land titling, however, reduces the probability of losing land. Therefore, it releases this part of residual labor supply to the non-farm employment. Without enough labor in farming, farmers therefore would have to cancel some 'unnecessary' fertilizing or pesticide spraying that are thought to have potentially low marginal returns. (3) land titling encourages farmers to purchase some "chemical-saving" machineries, which could automatically help reduce the consumption of agrochemicals. The mechanism-confirmation analyses then prove that this pesticide reduction effect is only functioning through the channel of increased sense for ecological protection, not the mediation by labor outflow nor machinery adoption. First, land titling is not able to encourage labor outflow given no land renting behavior. Therefore, the labor-outflow mechanism is ruled out. Second, even though land titling can significantly encourage farmers to purchase new agricultural machines, these purchased machines cannot contribute to the reduction of agrochemicals, because they are mainly used for the ploughing purpose. Thus, this possibility is also disproved. The last analysis finds that land titling has a stronger pesticide-reduction impact on farmers in villages where there is no eco-degradation problem nor biodiversity reduction problem. This therefore supports our hypothesis that land titling help reduce farmers' pesticide usage by eliciting their sense of responsibility for a sustainable farming.

The finding in this study directly contributes to the current policies regarding with this overuse issue. I provide an evidence showing the effectiveness of an existing policy in unintentionally alleviating this tricky problem. Although China has put a lot of efforts at stabilizing land tenure, the main purpose has never been to alleviate chemical overuse problem, but to foster the development of land market or increase agricultural production. By confirming this pesticide-reduction effect from the land titling project, this study supports China's current policies in stabilizing land tenure in rural regions. At the same time, since farmers' notion about sustainable production is the only proved channel of the pesticide-reduction effect, promotion of the knowledge about ecologic protection and conservative farming is also recommended to policy makers. Lastly, despite that machinery adoption is proved to be ineffective in reducing agrochemicals, it is not because land titling cannot promote machinery purchase, but due to no adoption of chemical-related machines. If future policies or strategies target on promoting chemical-related machines, improved tenure can help accelerate the adoption of such machineries and thus alleviate the agrochemical overuse.

Chapter 4 of this dissertation still focuses on Chinese land titling project but assess its effect from a different angle. this research investigates the impact of the land measurement in LTP that how it changes farmers' knowledge about their farmland size. The result shows that using GIS method for land measurement in LTP can significantly increase self-reported land size of those households with small farmland plots. Also, the smaller is the plot, the smaller becomes the impact. However, as for those households with large plot of farmland, since GIS measurement is relatively accurate on large plots, the perception-change effect is limited in such households. Aware of such unexpected impacts from land titling project is of importance. First of all, LTP measurement did make small scale farmers overreport their farm size. This overreporting behavior will result in some distortions in the future related researches,

such as the debate around the inverse relationship between land size and yield. When researchers use the overestimated land size to calculate one small farmer's yield, there is a large likelihood to discover a weakened inverse relationship. Second, one inference from our finding is that farmers' self-reported information about their land size was accurate before the implementation of the land titling. In other countries, if GPS measurement is available, it is usually preferred than farmers' self-reported information. Moreover, there is increasing number of researchers spending a large part of budget to employ GPS measurement into the survey process, since they believe there are nontrivial measurement errors in respondents' reporting. However, it might not be the case in China. According to our estimation and inference, before the land titling farmland size information provided by Chinese farmers should be reliable enough for researches, while it might not be the case anymore after the titling process.

To sum it up, both policy changes documented in this dissertation (i.e., the emergence of governmental intermediary and land titling project) are actually encouraged by Chinese central government in recent years, and studies in this dissertation have proved their impacts from some perspectives. Results explained in each chapter imply that Chinese rural land system are developing toward a positive direction. But it also necessary not to ignore some negative aspects that are found in this thesis. In the meantime, Chinese government keeps announcing land-related policies in rent years, which shows government's ambition to alleviate the intrinsic problems in current rural land system. During this transition period, this opportunity encourages us to utilize these policy changes as natural experiments to test some theoretical hypotheses, which in return also contributes to the future policy making in Chinese agricultural sector.

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*Chapter 1*

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