



AgEcon SEARCH
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search
<http://ageconsearch.umn.edu>
aesearch@umn.edu

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

**Institutional Credibility, Perceptions, and Behavior:
New Round Land Certification in China**

Hao Zhang

**Nanjing Agricultural University
College of Public Administration**

Travis McArthur

**University of Florida
Department of Food and Resource Economics
tmcArthur@ufl.edu**

Shuyi Feng

**Nanjing Agricultural University
College of Public Administration**

*Selected Paper prepared for presentation at the Southern Agricultural Economics Association
(SAEA) Annual Meeting, Louisville, Kentucky on February 1-4, 2020*

*Copyright 2019 by Hao Zhang, Travis McArthur, and Shuyi Feng. All rights reserved. Readers
may make verbatim copies of this document for non-commercial purposes by any means,
provided that this copyright notice appears on all such copies.*

Institutional Credibility, Perceptions, and Behavior: New Round Land Certification in China

Hao Zhang¹, Travis McArthur², Shuyi Feng¹

ABSTRACT³

Property rights reforms may have little effect if farmers lack confidence in the rules and institutions on paper. To reap any of the expected benefits of strengthened property rights, farmers must alter their behavior, which in turn requires farmers to evaluate favorably the credibility of these reforms. We trace possible mechanisms for changes in investment, labor allocation, land transfer and credit-seeking behaviors within the context of a land title certification program in Jiangsu province in southeast China. We use data gathered from a detailed 2017 survey on farming behavior and perceived shifts in the protection of usufruct, possession, profit-taking, transfer, and inheritance rights. First, we find a strong positive relationship between sociopolitical status of farmers and a belief that the land certification program boosted the security of their property rights. We then use propensity score matching to reduce endogeneity in the estimation of the effect of altered perception and behavior. We find that farmers who perceived strengthened property rights due to the program increased their total agricultural investment and induced a shift toward the planting of cash crops. On the other hand, these changing perceptions had mixed results for land rental activity.

DRAFT. PLEASE DO NOT CITE.

¹ Nanjing Agricultural University, College of Public Administration, Nanjing, China

² University of Florida, Food and Resource Economics Department, Gainesville, FL, United States

³ This work was supported by the National Natural Science Foundation of China [grant numbers 71673144 and 71773046], the Specialized Research Fund for the National Social Science Fund of China [grant number 18VSI060].

1. Introduction

Institution plays a central role in promoting economic development⁴. Many analysts regard land tenure security as an important factor in economic development for this gives individual credibility reaping the rewards⁵. As land is still the fundamental asset in rural areas of the developing country, the development of tenure security is critically important for successful of rural economy⁶. In theory, land property right can improve farmers' living condition rural economy and farmer's income by affecting farmers' behavior, including long-terms investment, farmland transfer, off-farm employment and farmland collateral⁷. FAO defined Land tenure security as "the certainty that a person's rights to land will be recognized by others and protected in cases of specific challenges"⁸. This concept integrates a bundle of rights into land use condition, such as use right, transfer right and alienation right, which may have heterogeneous effects on farmers' behavior^{9,10}.

In order to promote economic development, several developing countries have carried out a series of land property right reform to improve farmers' property rights security. China government has realized the importance of land tenure security and tried to address them through multiple measures. Based on the introduction of the household responsibility system, the government introduced policies to prohibit land readjustment in order to stabilizing contracting right. 2003 rural land contracting law strengthen land tenure security by stipulating that farmers possess 30-year use rights and farm land transfer rights. These policies reduce farmers' risk losing their farmland, and consequently may influence farmers' behavior of land utilization.

Despite of numerous land property rights reforms implemented in rural China, the remaining problems left by previous land property rights reforms may weaken the land tenure security and ultimately affect agriculture production and rural economic development¹¹. (1) Land expropriation may weaken farmers' land tenure security. Although some farmers have received the land certification, the local government still has the power to levy farmers' farmland for the demand of "public interest". However, The relevant laws do not clearly define "public interest" and compensation standard of land expropriation is very low, farmers face the threat of losing their land without getting enough compensation during the land expropriation.

⁴ North, D. C. (1990). *Institutions, institutional change, and economic performance*. New York: Cambridge University Press.

⁵ De Soto, H. (2000). *The mystery of capital: Why capitalism triumphs in the west and fails everywhere else*, Basic Books.

⁶ Delinking Land Rights from Land Use: Certification and Migration in Mexico Author(s): Alain de Janvry, Kyle Emerick, Marco Gonzalez-Navarro and Elisabeth Sadoulet Source: *The American Economic Review*, Vol. 105, 2015, pp. 3125-3149

⁷ Delinking Land Rights from Land Use: Certification and Migration in Mexico Author(s): Alain de Janvry, Kyle Emerick, Marco Gonzalez-Navarro and Elisabeth Sadoulet Source: *The American Economic Review*, Vol. 105, No. 10 (OCTOBER 2015), pp. 3125-3149

⁸ Food and Agriculture Organization (FAO). (2002a). Land tenure and rural development. FAO Land Tenure Studies No. 3.

⁹ Yiriyibin Bambio, Salima Bouayad Agha, Land tenure security and investment: Does strength of land right really matter in rural Burkina Faso? *World Development*, Volume 111, 2018, Pages 130-147, ISSN 0305-750X, <https://doi.org/10.1016/j.worlddev.2018.06.026>.

(<http://www.sciencedirect.com/science/article/pii/S0305750X18302183>)

¹⁰ Liangliang Gao, Dingqiang Sun, Jikun Huang, Impact of land tenure policy on agricultural investments in China: Evidence from a panel data study, *China Economic Review*, Volume 45, 2017, Pages 244-252, ISSN 1043-951X, <https://doi.org/10.1016/j.chieco.2017.07.005>.

(<http://www.sciencedirect.com/science/article/pii/S1043951X17300962>)

¹¹ Li, G., Rozelle, S., & Brandt, L. (1998). Tenure, land rights, and Farmer investment incentives in China. *Agricultural Economics*, 19, 63–71.

(2) Tenure security maybe influenced by the village-level land reallocation, in which part or all household farmland is collected and redivided by the local village according to the changes in population¹². Because of the authority power of local village, farmers may also lose their land when the local collectives readjust the farmland, which account for a large part in rural China¹³. (3) Tenure security may be influenced by the lack of land certification. Although farm household should be issued land certification according to the China's Land Management Law, Previous studies show that farm households didn't receive any land documents¹⁴. (4) Tenure security may be influenced by the incomplete bundles of land property rights. In rural China, land use right is mainly restricted to growing food crops, and farm land can't be used as collateral and have been explicitly prohibited for sales.

Under the new economic and social development environment, un-security land property right has restricted farmers' behavior to allocate elements such as land and labor more efficiently. According to official statistics, the cities' migrant workers grew from 242 million in 2010 to 277 million in 2015¹⁵. Non-farm employment attracts farmer to quit land to invest household labor to the off-farm employment. However, insecurity land property rights and incomplete bundles of property rights may hinder land transfer and household off-farm employment. Consequently, household can't achieve optimized resource allocation, farmland abandonment and inefficient utilization are very common in rural China¹⁶.

Therefore, new round land property rights reform may be imperative in order for China to maintain land productive and increase household income¹⁷. From 2009, Chinese government strengthen land tenure security by stabilizing farmers' existing land property rights and expanding farmers' bundles of land property rights¹⁸. First, the program aims to strengthen farmers' land tenure security by re-measuring land and issuing new land certification. By re-measuring farmers' land boundaries and confirming land tenure, and re-extending farmers' land contract period for another 30 years, this new round land certification reform can more successfully strengthens security of possession, using, profit and inheritance rights. Second, the program aims to encourage large scale management by expanding farmland's property rights. By enacting "three rights separation policy", rural China separate land manage rights from land contracted management right and divide land property rights into 3 part, namely three right division (ownership right, contract right, and operational right). This reform may accelerate large-scale land management by

12 Wang, H., Tong, J., Su, F., Wei, G., & Tao, R. (2011). To reallocate or not: Reconsidering the dilemma in China's agricultural land tenure policy. *Land Use Policy*, 28(4), 805–814.

13

14 Deininger, K., & Jin, S. (2009). Securing property rights in transition: Lessons from implementation of China's Rural Land Contracting Law. *Journal of Economic Behavior and Organization*, 70(1-2), 22–38.

15 Baozhong Su, Yuheng Li, Lequn Li, Yue Wang, How does nonfarm employment stability influence farmers' farmland transfer decisions? Implications for China's land use policy, *Land Use Policy*, Volume 74, 2018, Pages 66-72, ISSN 0264-8377, <https://doi.org/10.1016/j.landusepol.2017.09.053>.

16 Liu, Y., Fang, F., Li, Y., 2014. Key issues of land use in China and implications for policy making. *Land Use Policy* 40, 6–12.

17 Baozhong Su, Yuheng Li, Lequn Li, Yue Wang, How does nonfarm employment stability influence farmers' farmland transfer decisions? Implications for China's land use policy, *Land Use Policy*, Volume 74, 2018, Pages 66-72, ISSN 0264-8377.

18 Yuting Xu, Xianjin Huang, Helen X.H. Bao, Xiang Ju, Taiyang Zhong, Zhigang Chen, Yan Zhou, Rural land rights reform and agro-environmental sustainability: Empirical evidence from China, *Land Use Policy*, Volume 74, 2018, Pages 73-87, ISSN 0264-8377, <https://doi.org/10.1016/j.landusepol.2017.07.038>. (<http://www.sciencedirect.com/science/article/pii/S0264837716314016>)

developing farmers' land transfer right and endowing farmer land collateral rights¹⁹. Thus, household resources can be optimally allocated.

Numerous studies have examined the economic effect of China's new round land property rights reform. Some have found this reform, especially the "Three Rights Separation Policy", can stimulate farmers to conserve soil by increasing the use of organic fertilizers²⁰. Land property rights reform can also increase proportion household renting in land and land rent in amount²¹. Furtherly, Wenli Cheng et al find this reform can increase the ratio of transferred land to the agriculture enterprises and cooperatives. This land reform can also encourage farmers to transfer their land with written contracts and pecuniary rents²².

The important influence of perceived tenure security on farmers' decision making is increasingly recognized. Available studies have examined the influence of perceived tenure security on housing consolidation, housing improvement and spatial justice in Southeast Asia and South American.²³ Other studies have focus on perceived tenure security on land investment in China.²⁴ One research as we know pay attention on the role of perceived tenure security in land renting decisions in rural China.²⁵ There is also study demonstrating perceived tenure security and household decisions to diversify livelihood strategies to ensure food security in Southeast Asia .²⁶ However, the correlation between perceived tenures security and crop planting choice has been neglected in previous studies. Beside, current studies does not fully examined the impact of perceives tenure security on household multiple behaviors.

Regarding farmers' perception about land tenure security, current literature highlight that only people have credibility about the legal property right can they think land property rights are able to protect their property rights.²⁷ How to indicate farmers' perception about land tenure security?

¹⁹ Linxiu Zhang, Yueming Cao, Yunli Bai, The impact of the land certificated program on the farmland rental market in rural China, *Journal of Rural Studies*, 2019, , ISSN 0743-0167, <https://doi.org/10.1016/j.jrurstud.2019.03.007>.

²⁰ Yuting Xu, Xianjin Huang, Helen X.H. Bao, Xiang Ju, Taiyang Zhong, Zhigang Chen, Yan Zhou, Rural land rights reform and agro-environmental sustainability: Empirical evidence from China, *Land Use Policy*, Volume 74, 2018, Pages 73-87, ISSN 0264-8377, <https://doi.org/10.1016/j.landusepol.2017.07.038>. (<http://www.sciencedirect.com/science/article/pii/S0264837716314016>)

²¹ Linxiu Zhang, Yueming Cao, Yunli Bai, The impact of the land certificated program on the farmland rental market in rural China, *Journal of Rural Studies*, 2019, , ISSN 0743-0167, <https://doi.org/10.1016/j.jrurstud.2019.03.007>.

²² Wenli Cheng, Yuyun Xu, Nan Zhou, Zaizhong He, Longyao Zhang, How did land titling affect China's rural land rental market? Size, composition and efficiency, *Land Use Policy*, Volume 82, 2019, Pages 609-619, ISSN 0264-8377,

²³ Gustaaf Reerink, Jean-Louis van Gelder, Land titling, perceived tenure security, and housing consolidation in the kampongs of Bandung, Indonesia, *Habitat International*, Volume 34, Issue 1, 2010, Pages 78-85, ISSN 0197-3975, <https://doi.org/10.1016/j.habitatint.2009.07.002>.

Jean-Louis van Gelder, Feeling and thinking: Quantifying the relationship between perceived tenure security and housing improvement in an informal neighbourhood in Buenos Aires, *Habitat International*, Volume 31, Issue 2, 2007, Pages 219-231, ISSN 0197-3975, <https://doi.org/10.1016/j.habitatint.2007.02.002>.

Ernest Uwayezu, Walter T. de Vries, Scoping land tenure security for the poor and low-income urban dwellers from a spatial justice lens, *Habitat International*, Volume 91, 2019, 102016, ISSN 0197-3975, <https://doi.org/10.1016/j.habitatint.2019.102016>.

²⁴ Jacoby, H. G., Li, G., & Rozelle, S. (2002). Hazards of expropriation: Tenure insecurity and investment in rural China. *American Economic Review*, 92(5), 1420-1447.

²⁵ Xianlei Ma, Nico Heerink, Ekko van Ierland, Hairu Lang, Xiaoping Shi, Decisions by Chinese households regarding renting in arable land—The impact of tenure security perceptions and trust, *China Economic Review*, 2019, 101328, ISSN 1043-951X, <https://doi.org/10.1016/j.chieco.2019.101328>.

²⁶ Oulavanh Keovilignavong, Diana Suhardiman, Linking land tenure security with food security: Unpacking farm households' perceptions and strategies in the rural uplands of Laos, *Land Use Policy*, Volume 90, 2020, 104260,

²⁷ Ho, P. (2004). The 'Credibility Thesis' and its application to property rights: (In)secure land tenure and social welfare in China. *Land Use Policy*, 40, 13-27.

The existing literature mainly regard land reallocation perception during a certain time or farmers' fear of losing land in the future as perceived tenure security.²⁸ To our knowledge, only one study uses bundle of property rights to indicate perceived tenure security.²⁹ But we are not aware any empirical studies examining the roles played by farmers' perception about tenure security using different dimensions of property rights (possession right, using right, profit right, transfer right, inheritance right and collateral right) in farmers' behaviors.

Although the impacts of land property right reforms on household behavior has been studied at the empirical level, to our knowledge, two aspects of the reform that remains unstudied. One is that existing research lack a comprehensive review of China's new round land certification reform. Although some researches have analyzed the effect of land certification reform on land investment and land transfer, they payed less attention on the influence of land planting structure. The other is how the reforms affected farmers' perceptions of their property rights and how a change in those perceptions altered their behaviors.

Farmers' perception about land property rights reform may be more important than the reform itself. Number of research on China and many African countries found that land use practice remain outside the existing institution or legal which reflects a big gap between formal institution and farmers' perception.³⁰ However, farmers' specific behaviors are dominated by their perception which may match or mismatch with formal property rights.³¹ Thus, institution is nothing more than a clause printed on paper without affecting farmers' behavior if there is no overlap between formal property rights and farmers' perception.³²

The objective of this paper is therefore to understand the dynamic influence of China's new round land reform on farmers' behavior by affecting farmers' perception of land property right. We use Peter Ho's Credibility Thesis as a jumping-off point. If farmers do not believe that institutions can fulfill their stated roles, the regulations and property documents are dead letters. The claim here is that the details of the regulations are not what is most important; enforcement capability – and perception of that capability – is what matters. By focusing on farmers' property right

Ma, X., Heerink, N., Feng, S., Shi, X., 2015. Farmland tenure in China: Comparing legal, actual and perceived security. *Land Use Pol.* 42, 293–306.

Wenli Cheng, Yuyun Xu, Nan Zhou, Zaizhong He, Longyao Zhang, How did land titling affect China's rural land rental market? Size, composition and efficiency, *Land Use Policy*, Volume 82, 2019, Pages 609-619, ISSN 0264-8377,

²⁸ Fangping Rao, Max Spoor, Xianlei Ma, Xiaoping Shi, Perceived land tenure security in rural Xinjiang, China: The role of official land documents and trust, *China Economic Review*, 2017, ISSN 1043-951X, <https://doi.org/10.1016/j.chieco.2017.03.009>.

Xianlei Ma, Nico Heerink, Ekko van Ierland, Hairu Lang, Xiaoping Shi, Decisions by Chinese households regarding renting in arable land—The impact of tenure security perceptions and trust, *China Economic Review*, 2019, 101328, ISSN 1043-951X, <https://doi.org/10.1016/j.chieco.2019.101328>.

Deininger, Klaus, Daniel Ayalew Ali, and Tekie Alemu. 2011. "Impacts of Land Certification on Tenure Security, Investment, and Land Market Participation: Evidence from Ethiopia." *Land Economics* 87 (2): 312–34.

Fangping Rao, Max Spoor, Xianlei Ma, Xiaoping Shi, Land tenure (in)security and crop-tree intercropping in rural Xinjiang, China, *Land Use Policy*, Volume 50, 2016, Pages 102-114, ISSN 0264-8377, <https://doi.org/10.1016/j.landusepol.2015.09.001>.

²⁹ Yurong Wang, Ligen Chen, Kaisheng Long, Farmers' identity, property rights cognition and perception of rural residential land distributive justice in China: Findings from Nanjing, Jiangsu Province, *Habitat International*, Volume 79, 2018, Pages 99-108, ISSN 0197-3975, <https://doi.org/10.1016/j.habitatint.2018.08.002>.

³⁰ Deininger, Klaus W., 2003. Land policies for growth and poverty reduction. A World Bank policy research report. World Bank. Oxford University Press, Washington, DC, Oxford, New York

³¹ Theesfeld, Insa, 2011. Perceived power resources in situations of collective action. *Water Altern.* 4, 86–103.

³² Frederike Klümper, Insa Theesfeld, Thomas Herzfeld, Discrepancies between paper and practice in policy implementation: Tajikistan's property rights and customary claims to land and water, *Land Use Policy*, Volume 75, 2018, Pages 327-339, ISSN 0264-8377, <https://doi.org/10.1016/j.landusepol.2018.03.030>.

perception about the new round land certification, including possession right, profit right, using right, inheritance right, transfer right and collateral right this paper fills a gap in the literature about the relationship between farmers' diverse land property right perception and farmers' behavior. Specifically, Using a 2017 cross-section dataset of 600 households collected in Jiangsu province, a southeast province in Jiangsu, we employ a propensity score matching approach to explore the following questions: (1) Does land reform affect farmer's perceptions of their ability to exercise their multifarious property rights? (2) Did the change in perception affect economic behavior? and (3) As an intermediate step between (1) and (2), what characteristics were associated with a change in perception?

The rest of this paper is organized as follows. Section 2 summaries land reform background and theoretical framework. Section 3 introduces data resources, statistics, econometric model and variables used in the model. Section 4 deals with the descriptive statistics, and reports empirical results and discussion. In the final section, conclusions are drawn.

2. Background and theoretical framework

This section discusses the background of China's land property rights reform and theoretical predictions regarding farmers' perception of land property rights reform on their behaviors.

2.1 Land property rights reform program in rural China

After the founding of People's Republic of China in 1949, farmland were equally distributed to the poor farmer].³³ By the end of 1952, the central government had compulsorily distributed more than 700 million mu farmland to almost 300 million farmers for free.³⁴ However, in order to develop industrial economy, the government sacrificed farmers' interests and implemented depressed price policy by monopolizing agricultural product purchase.³⁵ In addition, because the communist government adopted the Soviet model, the central government carried out the People's Communes Movement since 1956, during which farmland and production tool were transferred from private to collective entities.³⁶ Under this land institution, land property rights were controlled by the collective and rural labor limited mobility between urban and rural were also arranged by the collective. Coupled with the average distribution of land products and the lack of supervision, farmers' generally have a free-rider preference³⁷, which severely reduced agricultural output and eventually lead to serious famines.³⁸ Therefore, from 1953-1978, individual farmers having no land property rights face problems of land tenure insecurity and food insecurity. No one is more eager than them for land tenure secure.

Since the reform and opening, China's land property rights reform has gone through the

³³ Prosterman, R., Temple, M., & Hanstad, T. (1990). *Agrarian reform and grassroots development: Ten case studies*. Boulder and London: Rienner

³⁴ Wang Jingyao, Wen Lai. *Survival, Continuity and Change in the Agricultural land system of contemporary China*, *Social Sciences in China*, Volume, 2, 2016, Pages 73-92 (in Chinese).

³⁵ Qu, F., Heerink, N., Wang, W., 1995. Land administration reform in China: its impact on land allocation and economic development. *Land Use Policy* 12 (3), 193–203.

³⁶ Hui Wang, Jeffrey Riedinger, Songqing Jin, *Land documents, tenure security and land rental development: Panel evidence from China*, *China Economic Review*, Volume 36, 2015, Pages 220-235, ISSN 1043-951X

³⁷ Qu, F., Heerink, N., Wang, W., 1995. Land administration reform in China: its impact on land allocation and economic development. *Land Use Policy* 12 (3), 193–203.

³⁸ Lin, J. Y., & Yang, D. T. (2000). Food availability, entitlements and the Chinese famine of 1959–61. *Economic Journal*, 110(460), 136–158.

following 3 stages³⁹:

Phase 1: The establishment of household contract responsibility system (1978-1984). As the world's largest developing country, China's rural areas have always been an active venue for land property right reform. With China's reform and opening up in the end of the 1970s, China's land institution changes from People's Commune System to Household Responsibility System (HRS) which was completed by the end of 1983. As the basis of land institution, the formal title to land is held by the village collective and the use right is held by the farmer, which has solved the monitoring problem and greatly improved farmers' enthusiasm.⁴⁰ Per household can manage a small plot of farmland, averaging 0.5 ha, which is allocated from the rural collective⁴¹. This implementation of the HRS stimulated farmers' enthusiasm for agriculture production which achieved 45.79 increase of output growth during 1978-1984⁴². Under the HRS, the collective land was allocated to individual households with contracts of up to 15 years. However, because land size allocated to the farmer mainly depend on the number of household members, member changes created demand for land reallocation which led to land insecurity. For the land insecurity, farmers' agriculture investment has fallen sharply and agriculture productive growth slows after 1984⁴³. What's more, the government has improved strict restriction on rural land market. And land transfer or land lease was prohibited by the Constitution in 1982. Farmland can only be used for agricultural production and can neither be reallocated through the market, nor be used as collateral⁴⁴.

Phase 2: Consolidation and stabilization phase of HRS (1985-2008). To furtherly stabilize rural land contracting relationship and increase farmers' enthusiasm for agriculture production. By enacting laws and regulations, the government not only extend land contract period, but also endow farmers more property rights to the farmer. **First**, the program strengthen farmer' land security, in 1993 the Chinese Communist Party issued the No.1 document to extend the land contract period for another 30 years before the expiration of the original land contract period which was reaffirmed by the central government in 1997. This was the so called second round land contracts which aims to stabilize land contracting relationships and encourage farmers to increase investment in agriculture production. The 1998 Land Management Law required the farmers should get document of their 30-year land use right⁴⁵. 2002 Rural Land Contract Law (RLCL) strictly restricted land adjustment, which aims to protect long-term relationship of land contract. In 2007, the newly promulgated Property law defined land contracting right as property right. **Second**, In addition to the basic possession, use and profit rights, farmer access to land transfer right. In 1993, the Third Plenary Session of the Fourteenth Central Committee of the Communist Party of China allowed farmer to transfer land following the law. Furtherly, 2002 RLCL clarifies the transfer mode of land contract right, such as subcontracting, leasing,

³⁹ Summary by the Chinese Ministry of Agriculture.

<https://baijiahao.baidu.com/s?id=1621104490161985686&wfr=spider&for=pc>.

⁴⁰ Jessica Leight, Reallocation wealth? Insecure property rights and agricultural investment in rural China, *China Economic Review*, Volume 40, 2016, Pages 207-227, ISSN 1043-951X,

⁴¹ Ni, H., 2015. New thoughts about China's agricultural trade. *Pap. Rural Econ.* 2015 (03), 26–32.

⁴² Lin, J. Y. (1992). Rural reforms and agricultural growth in China. *American Economic Review*, 82(1), 34–51.

⁴³ Wen, G. J. (1995). The land tenure system and its saving and investment mechanism: The case of modern China. *Asian Economic Journal*, 31(9), 233–259.

⁴⁴ Brandt, L., Whiting, S.H., Zhang, L., Zhang, T., 2017. Changing property-rights regimes: a study of rural land tenure in China. *China Q.* 232, 1026–1049.

⁴⁵ Hui Wang, Jeffrey Riedinger, Songqing Jin, Land documents, tenure security and land rental development: Panel evidence from China, *China Economic Review*, Volume 36, 2015, Pages 220-235, ISSN 1043-951X, <https://doi.org/10.1016/j.chieco.2015.09.005>.

exchanging, transferring or other ways. But the inheritance right is not security. However, land property rights are still incomplete. Although article 50 of the Land Contract Law stipulates that its heirs can continue to contract farmland during the contract period, the heirs must be members of the collective villages. Under the trend of non-agricultural employment, many offspring of farmers have migrated to cities and lost provinces of collective members. Using right is severely restricted by the Regulations on the Protection of Basic Farmland since 2004. These regulations stipulate that basic farmland, accounts for 80% of total cultivated land, can't be used in forestry and fruit industry, fish industry, non-agricultural construction. Land collateral is also prohibited by law in China. Considering the incomplete rights, farmers are worried about their land tenure security⁴⁶.

Phase 3: Refinement and deepening stage (2009-till now). In order to solve the problems left by previous reform and adapt to the economic develop environment, China's central government launched a new round land reform from 2009. Compared with previous land adjustment or land certification reform, this new round land certification reform has some special features. (1)The new round land property rights reform furtherly clarify the ownership relationship, contract period and boundary. This may reduce farmers' worry about their contracted land; (2) the new round land land property rights reform give every farmer a new land certification and built a land property right information database which help farmers check land information; (3) On the basis of clear definition of land property rights, this new land property rights reform will separate the original household right of contractual right into a contracture right and an operation right known as "three-right-division" namely ownership rights, contract rights and operational rights. This aims to promote farmland large-scale management by activating rural land management rights and granting farmers new collateral right of land management^{47,48}. By November 2017, China's 28 provinces had promoted the land confirmation and registration reform, and the ascertaining land area had reached 11.1 acres which account for 82% of the second round contracted land. Our study will focus on the performance of this new round land property rights reform.

2.2 Concept and insecurity of farmers' six property rights on farmland

Possession right: possession right is the de facto control of land by the household. Farmers may fell their land possession right is insecure, since land disputes often happen among adjacent land and their land may be invaded by a third party. Land readjustment and land expropriation happened in many area may also cause farmers to lose land possession right.

Using right: Use right is households' specific decision about how to use land and obtain benefit from their contracted land. Farmers' use right is still insecure before this new round land property right reform. In order to protect farmers' cultivated land, the Regulations on the Protection of Basic Farmland identifies 80% of cultivated farmland as basic farmland and strictly limits the use of cultivated land which can't be used for forestry, fisheries and other agricultural purposes.

⁴⁶ Baoling Zou, Ashok K. Mishra, Biliang Luo, Aging population, farm succession, and farmland usage: Evidence from rural China, *Land Use Policy*, Volume 77, 2018, Pages 437-445, ISSN 0264-8377, <https://doi.org/10.1016/j.landusepol.2018.06.001>.

(<http://www.sciencedirect.com/science/article/pii/S0264837718305738>)

⁴⁷ Qianxi Wang, Xiaoling Zhang, Three rights separation: China's proposed rural land rights reform and four types of local trials, *Land Use Policy*, Volume 63, 2017, Pages 111-121, ISSN 0264-8377, <https://doi.org/10.1016/j.landusepol.2017.01.027>.

⁴⁸ Linxiu Zhang, Yueming Cao, Yunli Bai, The impact of the land certificated program on the farmland rental market in rural China, *Journal of Rural Studies*, 2019,ISSN 0743-0167, <https://doi.org/10.1016/j.jrurstud.2019.03.007>.

Profit right: Household's agricultural profit is secure, because farmers can reap the whole benefit from agricultural production, especially after the policy of abolishing agricultural tax from 2006. The insecurity of profit right is mainly due to the following two reasons. One is that profit right mainly depends on farmers' possession and using right. So loss of farmers' possession and using right may lead to insecure profit right. The other is that farmers face the threat of land expropriation with no or less compensation.⁴⁹

Transfer right: land transfer right means household have the right to rent in or rent out land. Farmers may face risk of losing land.⁵⁰ Due to land insecurity, farmers fear of losing farmland during land transfer and they prefer to rent out their farmland to relatives with less return.⁵¹ Farmers may also face the risk of losing land rent. When large-scale managers face losses due to natural disasters or depressed agricultural market, they will violate contracts and even flee away. Both of these have negative effect on farmers' security of land transfer right.

Inheritance right: Inheritance right refers farmers can inherit land or choose inheritors. Inheritance right is full of insecurity. Farmland is usually inherited by male offspring in rural China, so many married women may lose their farmland under the circumstance of unadjusted land policies. Land inheritance is a major cause of family dispute as land scrambles often occur in household with more than 2 male offspring. What's more, immigrant household members also face risk of losing farmland, as Land contract law stipulates that rural collective land can only be inherited by collective members.

Collateral right: Collateral right refers farmers have the right to use land as collateral to obtain loans from financial institutions. Farmers' land collateral right is still insecure, because it had been forbidden by the law by the end of our survey.

2.2 Theoretical Framework

2.2.1 Land tenure security is very important to agriculture economic development

Land tenure security could affect rural economy mainly through the following 3 key channels: first, land tenure security can encourage farmers to develop long-term investment on land to maximize agriculture benefits^{52,53,54}. Second, land tenure security can reduced land transaction costs (including clarifying land boundaries and identifying legitimate land holders) , which can lead to higher net gains and more beneficial land transfer opportunities. Therefore, land tenure security is benefit for the farmer to take part in the land market and transfer land to more efficient farmers⁵⁵. Third, land tenure security facilitates the use of land as collateral for credit. Land tenure

⁴⁹ Deininger, K., & Jin, S. (2009). Securing property rights in transition: Lessons from implementation of China's rural land contracting law. *Journal of Economic Behavior and Organization*, 70, 22–38.

⁵⁰ Deininger, K., Jin, S., Xia, F., Huang, J., 2014. Moving off the farm: land institutions to facilitate structural transformation and agricultural productivity growth in China. *World Dev.* 59, 505–520.

⁵¹ Wenli Cheng, Yuyun Xu, Nan Zhou, Zaizhong He, Longyao Zhang, How did land titling affect China's rural land rental market? Size, composition and efficiency, *Land Use Policy*, Volume 82, 2019, Pages 609-619, ISSN 0264-8377,

⁵² Alchian A A , Demsetz H . Production, Information Costs, and Economic Organization[J]. *IEEE Engineering Management Review*, 1975, 3(2):21-41.

⁵³ 郁亮亮, 黄季焜, Scott R , et al. 中国农地流转市场的发展及其对农户投资的影响[J]. *经济学(季刊)*, 2011, 10(4):1499-1514.

⁵⁴ Robyn Meeks, Property Rights and Water Access: Evidence from Land Titling in Rural Peru, *World Development*, Volume 102, 2018, Pages 345-357, ISSN 0305-750X, <https://doi.org/10.1016/j.worlddev.2017.07.011>.

(<http://www.sciencedirect.com/science/article/pii/S0305750X16301723>)

⁵⁵ Deininger, K., Ali, D. A., & Alemu, T. (2011). Impacts of land certification on tenure security, investment, and land market participation: Evidence from Ethiopia. *Land*

security can not only make it easier and less costly to verify land ownership, but also provides some of insurance for lender which can decrease land credit risk⁵⁶ and improve credit access for landholders^{57,58}. However, at present the government wants to gain more experience through the collateral pilot of farmland manage rights which has not been implemented nationwide. Considering the limitation of collateral of land manage right, farmland can't be taken as collateral and law explicitly prohibits land sales^{59,60}. So only the first 2 channels for economic development can be caught in rural China.

2.2.2 Institution credibility can improve China's rural land security

According to credibility theory, because land security perception is more important than the land reform itself, the impact of land reform on farmers' behavior should be based on farmers' credibility^{61,62}. The credibility theory proposed by Ho Peter is a useful theoretical which highlight the institution function toward efficiency⁶³. Credibility has been defined as a measure of how actors perceive institutions as a jointly shared rule, which highlights the institution function at a given time and space, rather than the form of the institution. Institutions include any form of constraints that human beings devise to shape human interactions⁶⁴. If the farmers can't accept the new institution or think it is non-credible. Then the new institution will become an empty institution which can give little effect on farmers' behavior⁶⁵. Thus, the institution remains a paper agreement or a hollow shell with little or even negative impact on the behavior of social actors and economic agents⁶⁶. So behavioral responses to policy pronouncements much depends on perception about the utility value to the particular farmer relative to the policy⁶⁷. And perception in institutions can bring about different decision making among the farmers from the same policy pronouncement⁶⁸. If farmers do not believe that land institution is benefit for them, they will not

Economics, 87(2), 312–334.

56 Domeher D, Abdulai R. Access to Credit in the Developing World: does land registration matter?[J]. Third World Quarterly, 2012, 33(1):161-175.

57 Deininger, K., 2003b. Land Policies for Growth and Poverty Reduction. World Bank, Washington, DC.

58 Kemper, N.; Klump, R. and Schunacher, H.: Representation of property rights and credit market outcomes: evidence from land reform in Vietnam, proceeding of the German development economics conference, Berlin, 2011.

59 Jacoby, G., Li, G., & Rozelle, S. (2002). Hazards of expropriation: Tenure insecurity and investment in rural China. *The American Economic Review*, 95(2), 1420–1447.

60 张龙耀,王梦瑶,刘俊杰.农地产权制度改革对农村金融市场的影响——机制与微观证据[J].中国农村经济,2015(12):14-30.

61 Peter Ho, The 'credibility thesis' and its application to property rights: (In)Secure land tenure, conflict and social welfare in China, *Land Use Policy*, Volume 40, 2014, Pages 13-27, ISSN 0264-8377.

62 Wenli Cheng, Yuyun Xu, Nan Zhou, Zaizhong He, Longyao Zhang, How did land titling affect China's rural land rental market? Size, composition and efficiency, *Land Use Policy*, Volume 82, 2019, Pages 609-619, ISSN 0264-8377.

63 Ho, P., 2013. In defense of endogenous, spontaneously ordered development: institutional functionalism and Chinese property rights. *J. Peasant Stud.* 40 (6), 1087–1118. <https://doi.org/10.1080/03066150.2013.866553>.

64 North, D., 1990. *Institutions, Institutional Change and Economic Performance*. Cambridge University Press, Cambridge, NY, 159 pp

65 Ostrom, E., 2005. *Understanding Institutional Diversity*. Princeton University Press, Princeton and Oxford, 376 pp

66 Ho, Peter. The 'credibility thesis' and its application to property rights: (In)Secure land tenure, conflict and social welfare in China[J]. *Land Use Policy*, 2014, 40:13-27.

67 Arbuckle Jr., G.J., Morton, L.W., Hobbs, J., 2015. Perspectives on climate change adaptation and mitigation: the roles of trust in sources of climate information, climate change beliefs, and perceived risk. *Environ. Behav.* 47 (2), 205–234 SAGE

68 Borges, J.A.R., Foletto, L., Vanderson, T.X., 2015. An interdisciplinary framework to study farmers' decisions on adoption of innovation: insights from expected utility theory and theory of planned behaviour. *Afr. J. Agric. Res.* 10 (July (29)), 2814–2825.

likely undertake adaptive actions. So farmers need to believe their land property right are actually secure and have confidence in the institution⁶⁹.

The ability to measure credibility, how farmer think about the land property rights, is significant to evaluate the policy effect of the reform, which is a very important and difficult matter⁷⁰. There are 2 more components to measure the credibility⁷¹: one significant proxy about the credibility is through the perception of farmers' property right, seen as a right to a certain benefit. As credibility is a measure of how institutions are perceived, farmers can judge whether the new land property right reform is credible or non-credible according to their autonomous perception. The other indicator of credibility is conflict. Conflict will be higher if the credibility is lower. The conflict can be measured by the following 7 indicator: source, frequency, outcome, timing, intensity, duration, and nature (See Ho⁷²⁷³). Because this new round land certification reform aims to increase farmer' land tenure security and endow farmer more complete property rights, which is good policy for farmers, land dispute are less during this reform. Therefore, we mainly focus on the influence of farmers' property perception on their behavior.

2.2.3 Farmers' perception of property rights and behavior.

Property rights refer to a bundle of rights, which mean multiple kinds of right an individual can have over a property⁷⁴. Bundle of rights can overcome oversimplified measurement of resource property rights⁷⁵. Schlager and Ostrom offer a framework with 3 main bundles of property rights: using right, control rights and alienation right (including selling and transfer right)⁷⁶. Furtherly, Kung think Chinese farmers on the collective farms were deprived 3 types of bundle rights: control, profit, and alienation. According to land property rights reform and related legal rules in rural China, it is necessary to identify these classified property right systems, and focus on possession, using, profit, translate, inheritance and collateral rights.

Farmer's perception of possession right. Holding the possession rights gives the owner power to exclude the third party to protect owners' occupation on the land⁷⁷. So we expect farmers' perception about this right can increase farmers' investment on the land. As security possession right can reduce farmers' fear of losing land, this reform may also encourage farmer to transfer land and participate off-farm employment. Of course, if farmers think the land is safe enough, they can also grow more lucrative crop. So farmers are willing to replace traditional grain crops with

⁶⁹ Ma, X., Heerink, N., Feng, S., Shi, X., 2015. Farmland tenure in China: Comparing legal, actual and perceived security. *Land Use Pol.* 42, 293–306.

⁷⁰ Shengyue Fan, Jinfei Yang, Wenwen Liu, He Wang, Institutional Credibility Measurement Based on Structure of Transaction Costs: A Case Study of Ongniud Banner in the Inner Mongolia Autonomous Region, *Ecological Economics*, Volume 159, 2019, Pages 212-225, ISSN 0921-8009, <https://doi.org/10.1016/j.ecolecon.2019.01.019>. (<http://www.sciencedirect.com/science/article/pii/S092180091830908X>)

⁷¹ Ho, Peter. The 'credibility thesis' and its application to property rights: (In)Secure land tenure, conflict and social welfare in China[J]. *Land Use Policy*, 2014, 40:13-27.

⁷² Ho, P. 2014. The 'credibility thesis' and its application to property rights: (In)secure land tenure and social welfare in China. *Land Use Policy* 40 (September): 13–27. Doi:10.1016/j.landusepol.2013.09.019.

⁷³ Peter Ho (2016) An endogenous theory of property rights: opening the black box of institutions, *The Journal of Peasant Studies*, 43:6, 1121-1144, DOI: [10.1080/03066150.2016.1253560v](https://doi.org/10.1080/03066150.2016.1253560v)

⁷⁴ Klein, D. B., & Robinson, J. (2011). Property: A bundle of rights? Prologue to the property symposium. *Econ Journal Watch*, 8(3), 193–204.

⁷⁵ Alchian, Armen A., Demsetz, Harold, 1973. The property right paradigm. *J. Econ. Hist.* 33 (01), 16–27

⁷⁶ Alchian, Armen A., Demsetz, Harold, 1973. The property right paradigm. *J. Econ. Hist.* 33 (01), 16–27.

⁷⁷ Frederike Klümper, Insa Theesfeld, Thomas Herzfeld, Discrepancies between paper and practice in policy implementation: Tajikistan's property rights and customary claims to land and water, *Land Use Policy*, Volume 75, 2018, Pages 327-339, ISSN 0264-8377, <https://doi.org/10.1016/j.landusepol.2018.03.030>.

cash crops⁷⁸.

Farmer's perception of using right. Using right means the right to use land resources. Holding this right helps farmers freely determines the type of crop to be planted. Under the protection of this using right, farmers may think it is their right to choose crops freely to reap more agricultural benefits. Thus, holding a secure perception of using right can incentive farmers to change their land planting structure and increase cash crop production to get more income. Meanwhile, household will also allocate more assets and labor to crop production, which has positive effect land investment and the side of land rent in, and negative effect on the side of land rent out and negative effect on off-farm employment.

Farmer's perception of profit right. This right mainly refers farmers' agriculture profit from the farmland. Profit is the core of farmers' agricultural production. Security of profit right can reduce the risk of expropriation and strengthen farmers' income expectations⁷⁹. Since this right can ensure farmers' benefits from the land resource, we think that the profit right will incentive them to increase their investment on farmland and turn higher-yielding cash crops. Security of profit right can also encourage farmer to rent in farmland in order to obtain agricultural profit beyond their private farmland. On the contrary, this security of profit right may have little or negative impact on land rent-out and off-farm employment.

Farmer's perception of transfer right. First, if land certification can protect farmers' transfer right, farmers can safely transfer farmland with less concerns. Thus, security of transfer land can reduce the transaction cost, which leads to more land transfer opportunities and higher net income⁸⁰. However, we should note that households renting land out usually take part in off farm employment and we can't found them in our survey, the land rent-out side is underenumerated. This may lead to a selection bias to assess the impact of land reform on land rent-out⁸¹. Thus, we expect farmers' credibility of land transfer right has positive effect on the side of land transfer-in, and the side of land rent-out needs further analysis. In addition, under the protection land transfer right, the user have to maintain land productive, or the owners may take it away from them⁸². Vice versa, the land owners will also select households better at agricultural production, and farmers also can cash their long-term investment via renting out their farmland^{83,84}. Giving this, we assume the land transfer right could be positively correlated with farmers' land investment (both land rent

⁷⁸ Jacoby, G., Li, G., & Rozelle, S. (2002). Hazards of expropriation: Tenure insecurity and investment in rural China. *The American Economic Review*, 95(2), 1420–1447.

⁷⁹ Robyn Meeks, Property Rights and Water Access: Evidence from Land Titling in Rural Peru, *World Development*, Volume 102, 2018, Pages 345-357, ISSN 0305-750X, <https://doi.org/10.1016/j.worlddev.2017.07.011>.

(<http://www.sciencedirect.com/science/article/pii/S0305750X16301723>)

⁸⁰ Wenli Cheng, Yuyun Xu, Nan Zhou, Zaizhong He, Longyao Zhang, How did land titling affect China's rural land rental market? Size, composition and efficiency, *Land Use Policy*, Volume 82, 2019, Pages 609-619, ISSN 0264-8377,

⁸¹ Xianlei Ma, Nico Heerink, Ekko van Ierland, Hairu Lang, Xiaoping Shi, Decisions by Chinese households regarding renting in arable land—The impact of tenure security perceptions and trust, *China Economic Review*, 2019, 101328, ISSN 1043-951X, <https://doi.org/10.1016/j.chieco.2019.101328>.

(<http://www.sciencedirect.com/science/article/pii/S1043951X19300896>)

⁸² Maddison, D., 2006. The Perception and Adaptation to Climate Change in Africa. CEEPA Discussion Paper No. 10. Centre for Environmental Economics and Policy in Africa, University of Pretoria, South Africa.

⁸³ Karen Macours, Alain de Janvry, Elisabeth Sadoulet, Insecurity of property rights and social matching in the tenancy market, *European Economic Review*, Volume 54, Issue 7, 2010, Pages 880-899, ISSN 0014-2921, <https://doi.org/10.1016/j.euroecorev.2010.02.002>.

(<http://www.sciencedirect.com/science/article/pii/S0014292110000176>)

⁸⁴ Liangliang Gao, Dingqiang Sun, Jikun Huang, Impact of land tenure policy on agricultural investments in China: Evidence from a panel data study, *China Economic Review*, Volume 45, 2017, Pages 244-252, ISSN 1043-951X, <https://doi.org/10.1016/j.chieco.2017.07.005>.

in and out). Because more land planting area needs more labor, transfer right may have a mixed effect on off-farm employment (land rent-out has a positive effect on off-farm employment, and land rent-in has negative effect on off-farm employment).

Farmers' perception of inheritance right. If farmers think this land reform can protect their inheritance right, farmer are willing to conserve land for future generation. Thus, farmers will increase their long-term investment on their land and keep them productive. So we assume that inheritance right will have positive impact on farmers' land investment⁸⁵. In addition, security of inheritance can also reduce farmers' worry about losing farmland without using land themselves, which can promote development of land transfer market and incentives farmers to invest labor in non-agricultural employment. Subsequently, inheritance right is expected to be positively correlated with land rent-out and off-farm employment.

Farmer's perception of collateral right. Theoretically, security of collateral right can increase a households' land collateral and decrease banks' low interest rate, which is benefit for farmers to get the credit. Subsequently, this can contribute to farmland investment and land rent-in through reducing restriction of capital^{86,87}. However, the land collateral is not permitted by law in major areas of rural China in 2017, although some regions have begun to explore ways to implement land collateral with policy support. Thus, the security of collateral right may have little impact on land investment and land transfer.

Hypothesis of farmers' perception of property rights perception and farmers' behavior

	Land investment	Crop choice	Land rent in	Land rent out	Off-farm employment
Possession	+	+	+	+	+
Using right	+	+	+	-	-
Profit right	+	+	+	No or -	No or -
Transfer right	+	unknown	+	unknown	Mixed
Inheritance right	+	unknown	+	+	+
Collateral right	unknown	unknown	unknown	unknown	unknown

Theory summary between farmers' perception of property rights perception and farmers' behavior

	Land investment	Crop choice	Land rent in	Land rent out	Off-farm employment
Possession	Holding the possession rights gives the owner power to exclude the third party to protect owners' occupation on the land	if farmers think the land is safe enough, they can also grow more lucrative crop	This reform may reduce farmers' fear of losing farmland.	This reform may reduce farmers' fear of losing farmland.	This reform may reduce farmers' fear of losing farmland.
Using right	farmers may think it is their right to choose	farmers may think it is	since this right	since this right means	household will also

⁸⁵ Rosaine N. Yegbemy, Jacob A. Yabi, Silvère D. Tovignan, Geoffroy Gantoli, Sènakpon E. Haroll Kokoye, Farmers' decisions to adapt to climate change under various property rights: A case study of maize farming in northern Benin (West Africa), *Land Use Policy*, Volume 34, 2013, Pages 168-175, ISSN 0264-8377, <https://doi.org/10.1016/j.landusepol.2013.03.001>.

⁸⁶ Besley, T. (1995). Property rights and investment incentives: Theory and evidence from Ghana. *Journal of Political Economy*, 103(5)

⁸⁷ Zikhali, P. (2010), Fast Track Land Reform Programme, tenure security and investments in soil conservation: Micro - evidence from Mazowe District in Zimbabwe. *Natural Resources Forum*, 34: 124-139. [doi:10.1111/j.1477-8947.2010.01298.x](https://doi.org/10.1111/j.1477-8947.2010.01298.x)

	crops freely to reap more agricultural benefits	their right to choose crops freely to reap more agricultural benefits	means farmers how to use farmland by themselves, we think farmers' perception about the using right has no relationship with land transfer.	farmers how to use farmland by themselves, we think farmers' perception about the using right has no relationship with land transfer.	allocate more labor to cash crop production, which has negative effect on off-farm employment
Profit right	Security of profit right can reduce the risk of expropriation and strengthen farmers' income expectations. We think this right has positive effect on farmer' investment	Since this right can ensure farmers' benefits from the land resource, we think that the profit right will positively impact on farmers' decision to turn higher-yielding cash crops.	This right gives farmers the expectation of growing income, not others. We think this has no effect on land transfer.	This right gives farmers the expectation of growing income, not others. We think this has no effect on land transfer.	
Transfer right	1. under the situation of security land transfer right, the user have to maintain land productive, or the owners may take it away from them; 2. the land owners will also select households better at agricultural production, and farmers also can cash their long-term investment via renting out their farmland	security of transfer land can reduce the transaction cost, which leads to more land transfer opportunities and higher net income	security of transfer land can reduce the transaction cost, which leads to more land transfer opportunities and higher net income	security of transfer land can reduce the transaction cost, which leads to more land transfer opportunities and higher net income	because more land planting area needs more labor, transfer right may have a mixed effect on off-farm employment
Inheritance right	If farmers have the inheritance right, farmer are willing to conserve land for future generation. Thus, farmers will protect their land and keep it productive.		security of inheritance can also reduce farmers' worry about losing farmland	security of inheritance can also reduce farmers' worry about losing farmland	security of inheritance can also reduce farmers' worry about losing farmland
Collateral right					

3 Methods

3.1 Sampling and data collection

Research area and data description. This paper uses the data from household and village survey in 14 villages in Jiangsu Province in the 2017, a main grain producing areas, located in the south-east of China. The villages were selected using series of criteria, such as economic development and geographical conditions. Considering the different economic development level in Jiangsu Province, namely developed regions in South area, mid-developed regions in middle area and developing regions in North area, the 14 villages were selected in these 3 areas. Firstly, we select 2 cities in each region based on agriculture production condition. Then we randomly selected 2 villages and 50 farmers in each village for this survey. The farm household survey was carried out. The questions in the survey referred to the entire year of 2016. In every village, we

used the random method to select the household. Finally, a total of 600 farm households and 14 village leaders were interviewed. The information collected included the demographic characteristics, land property right reform, agricultural production, land transfer, income and many other related factors.

3.2 Empirical models

3.2.1 Model specification

As previous studies show that land property rights reform affect farmers' behavior through farmers' perception⁸⁸, we focus on the influence of farmers' security perception of land property right reform on farmers' behavior, including land investment and land transfer. We specify the standard model to investigate the influence of farmers' security perception on land investment, crop structure and land transfer.

$$Y_i = \alpha + \beta_i \text{perception}_i + \gamma_i \text{HH}_i + \theta_i \text{HC}_i + \varphi_i \text{LP}_i + \delta_i \text{PI}_i + \mu_i \text{V}_i + \rho_i \text{T}_i + \epsilon_i \text{D}_i + \epsilon_i \quad (1)$$

Where Y_i represents household behavior defined in 3.3.1. perception_i represent whether farmers think land property right reform can protect their right, including possession right, using right, profit right, transfer right, inheritance right and collateral right, with one for yes and zero for no. HH_i , HC_i , LP_i , PI_i , V_i , T_i , and D_i represent the characteristics of household head, household, land, Policy implication, village, trust and district, as listed in section 3.3.2, respectively. β_i , γ_i , θ_i , φ_i , δ_i , μ_i , ρ_i , ϵ_i are the coefficients measuring the contribution to farmers' land investment or land transfer, respectively. α is unknown coefficients; and ϵ_i is resident.

3.3.2 Estimation approach

To estimate the models, 2 potential problems must be solved. First, although as many variables as possible have been considered in the model, some unobserved fact will influence farmers' security perception of property right and their behaviors simultaneously, which may result in bias coefficient estimates. Second, land property rights reform is not strictly exogenous for the village, as land reform program can't start in all places at the same time, but started earlier in some places than in others⁸⁹. Possibly, initially tenure security and developed districts take the lead to implement the tenure security reform. Because tenure security areas may be easy to implement this new land property rights reform and developed villages have the ability to carry out this reform and, these districts are more likely to be selected to implement this reform initially. These reasons may lead to biased estimates of the correlation between farmers' security perception about this new reform and their behavior in the model⁹⁰. Therefore, we use PSM, a popular approach to estimate causal treatment effects, to reduce estimate bias.

The propensity score is useful when using observations to assess the effect of treatment on outcomes and possible selection bias due to non-randomized treatment assignments⁹¹. The basic

⁸⁸ Wenli Cheng, Yuyun Xu, Nan Zhou, Zaizhong He, Longyao Zhang, How did land titling affect China's rural land rental market? Size, composition and efficiency, *Land Use Policy*, Volume 82, 2019, Pages 609-619, ISSN 0264-8377,

⁸⁹ Niels Kemper, Luu Viet Ha, Rainer Klump, Property Rights and Consumption Volatility: Evidence from a Land Reform in Vietnam, *World Development*, Volume 71, 2015, Pages 107-130, ISSN 0305-750X,

⁹⁰ Yahui Wang, Xiubin Li, Huiyan He, Liangjie Xin, Minghong Tan, How reliable are cultivated land assets as social security for Chinese farmers?, *Land Use Policy*, Volume 90, 2020, 104318, ISSN 0264-8377, <https://doi.org/10.1016/j.landusepol.2019.104318>

⁹¹ Garrido, Melissa M. Kelley, Amy S., Paris, Julia Roza, Katherine, Meier, Diane E., Morrison, R. Sean, Aldridge, Melissa D. Methods for Constructing and Assessing Propensity Scores, *Health Services Research*, 49: 1701-1720. doi:10.1111/1475-6773.12182. Garrido, M.M., Kelley, A.S., Paris, J., Roza, K., Meier, D.E., Morrison, R.S. and Aldridge, M.D. (2014), Methods for Constructing and Assessing Propensity Scores. *Health Serv Res*, 49: 1701-1720. doi:10.1111/1475-6773.12182

ideal of PSM for solving the self-selection problem is to summarize the pre-treatment characteristics of each group into a single index variable, and uses the propensity score to match treated individuals and untreated individuals that are similar.

Four steps to implement PSM method are as follows⁹²: First, we estimate the propensity score that farmers think land property rights reform can protect their property rights; Second, we choose a matching partner for treated farmer (thinking the land certification can protect their property right) that is closest in terms of propensity score by using algorithms of kernel matching; Third, we check the overlap and common support to judge whether the common support is large enough and confirm observations outside of the common support have been deleted. Forth, we check whether the matching procedure has balanced the distribution of the relevant variables in both treatment and un-treatment group. Finally we run the regression on the matched set of households according to equation (1).

3.3 Definition of variables

3.3.1 Dependent variables

Table 1 presents the definition of variables used in the model. Variables in the selection function should be correlated simultaneously with the perception and the outcomes (farmers' behavior)⁹³. However, many studies emphasis variables influencing the participation are more important than variables influencing the outcome for the significance of adjusting differences between the treated and untreated⁹⁴. According to previous studied^{95,96}, we base our selection function on variables that mainly influence farmers' security perception of property rights. We have 3 groups of 6 dependent variables.

Group 1: land investment. The first group includes one dependent variable to measure land investment, which was calculated by adding the following 8 items, namely green manure, organic fertilizer, farmyard, farmland leveling, straw returning, deep plowing, canal building, and soil conditioner using and each item equals to one if the household has invested and zero others.

Group 2: land planting structure. Land planting structure is calculated by taking cash crop sown area divided by the total sown area.

Group 3: land transfer. This group includes 4 dependent variables to measure land rent in and land rent out. The first dependent variable is weather land rent-in, which equals to one if the household rent in land in 2017 and zero otherwise. The second dependent variable is land rent-in amount, which is measured by the area of land rent in in 2017. The third dependent variable is whether land rent out, which equals to one if the household rent out land in 2018 and zero otherwise. The forth dependent variable is land rent-out amount, which is measured by the area of land rent-out in 2017.

3.3.2 Independent variables

We have 8 groups of 32 independents variables.

Group 1: The land reform perception. The most important independent variable is farmers'

⁹² Caliendo, M., Kopeinig, S., 2008. Some practical guidance for the implementation of propensity score matching. *J. Econ. Surv.* 22 (1), 31–72.

⁹³ aliendo, M., Kopeinig, S., 2008. Some practical guidance for the implementation of propensity score matching. *J Econ Surv* 22, 31–72.

⁹⁴ Mazunda, J., Shively, G., 2015. Measuring the forest and income impacts of forest user group participation under Malawi's Forest co-management program. *Ecol Econ* 119, 262–273.

⁹⁵ aliendo, M., Kopeinig, S., 2008. Some practical guidance for the implementation of propensity score matching. *J Econ Surv* 22, 31–72.

⁹⁶ Dehejia, R.H. and Wahba, S. (1999) Causal effects in nonexperimental studies: reevaluating the evaluation of training programs. *Journal of the American Statistical Association* 94(448): 1053–1062.

perception about this new round land reform. In our research, we examined farmers' perception whether land certification can protect their possession right, using right, profit right, transfer right, inheritance right and collateral right. Each key independent variable equals to one if farmer think the land certification can protect their right and zero others.

Group 2: Household head characteristics. We control household head's education and health. Farmers' behaviors are usually made by household head in rural China⁹⁷⁹⁸. Households with educated household heads may easier access to knowledge about land property rights reform, which may affect farmers' perception about this reform. Unhealthy household heads have less control on their farmland, which lead them to have high expectations about this land reform. However, new land reform may be not perfect enough to satisfy these households' expectation, which may lead to a negative correlation between this land property rights reform and farmers' perception.

Group 3: Household characteristics. Number of elderly members may influence farmers' perception about land inheritance right. Labor endowments have an impact on land allocation of household, which may affect farmers' perception about this reform. We use can be indicated by household dependency ratio⁹⁹¹⁰⁰. Previous studies show that off-farm employment is a critical factor affecting land transfer¹⁰¹, which may also influence farmers' perception of property rights, especially transfer right and inheritance right. Compared with agricultural production households, off-farm employment households may pay more attention to their land transfer rights and land inheritance rights. We use ratio of migration member to indicate this variable. Second school education can expand farmers' cognitive and behavior ability¹⁰². We use share of agriculture training and off-farm training as an indicator of second education household has receiving. Households with a larger share of members receiving agricultural training not only can quickly recognize the protective effects of this reform, but they are more likely to engage in agricultural production, such as increasing agricultural investment and renting-in land. Households with a larger share of members receiving off-farm training not only can have better access to off-farm employment, but also can perceive current security status of this latest land property rights reform¹⁰³. Social capital not only can help households access to special information including land market information and job market information, but also make farmers have a better understanding of this latest policies. We use number of communist party membership, number of village cadres in the household and whether farmer takes part in village decision as proxies for

⁹⁷ Yan, X., Huo, X., 2016. Drivers of household entry and intensity in land rental market in rural China: evidence from North Henan Province, China. *Agric. Econ. Rev.* 2 (8), 345–364.

⁹⁸ Linxiu Zhang, Yueming Cao, Yunli Bai, The impact of the land certificated program on the farmland rental market in rural China, *Journal of Rural Studies*, 2019,, ISSN 0743-0167, <https://doi.org/10.1016/j.jrurstud.2019.03.007>.

(<http://www.sciencedirect.com/science/article/pii/S0743016718301050>)

⁹⁹ Ziming Liu, Jens Rommel, Shuyi Feng, Markus Hanisch, Can land transfer through land cooperatives foster off-farm employment in China?, *China Economic Review*, Volume 45, 2017, Pages 35-44, ISSN 1043-951X, <https://doi.org/10.1016/j.chieco.2017.06.002>.

(<http://www.sciencedirect.com/science/article/pii/S1043951X1730086X>)

¹⁰⁰ Feng, S., Heerink, N., Ruben, R., et al., 2010. Land rental market, off-farm employment and agricultural production in Southeast China: a plot-level case study. *China Econ. Rev.* 21 (4), 598–606.

¹⁰¹ Huang, J., Gao, L., Rozelle, S., 2012. The effect of off-farm employment on the decisions of households to rent out and rent in cultivated land in China. *Chin. Agric. Econ. Rev.* 4 (1), 5–17

¹⁰² Alam GM, Hoque KE, Khalifa MTB, Siraj S, Ghani MFA (2009b). The role of agriculture education and training on agriculture economics and national development of Bangladesh. *Afr. J. Agric. Res.*, 4(12): 1334-1350.

¹⁰³ Lan Zhang, Shuyi Feng, Nico Heerink, Futian Qu, Arie Kuyvenhoven, How do land rental markets affect household income? Evidence from rural Jiangsu, P.R. China, *Land Use Policy*, Volume 74, 2018, Pages 151-165, ISSN 0264-8377, <https://doi.org/10.1016/j.landusepol.2017.09.005>.

(<http://www.sciencedirect.com/science/article/pii/S0264837716314363>)

political network. Insurance can mitigate risk of losing land¹⁰⁴, which may make farmers optimistic about this land reform. We use whether household takes part in endowment insurance as an indicator of insurance.

Group 4: Land plot characteristics. We expect land endowment has a negative effect on farmer perception about land property rights. As farmland is a major asset of household, households with more land area are more likely to lose land during the future land readjustments. This may decrease police effectiveness of the land reform. What's more, as agriculture is a labor-intensive work, land area may affect farmers' agricultural investment¹⁰⁵, including labor investment and capital investment. We use the amount of contracted land represents the land endowment. Fragmentation, measured by the number of contracted land plots, may have negative on farmers' perception of property rights, because severe land fragmentation may cost farmers more energy to protect farmland¹⁰⁶. Amount of contracted land plots can be represented the fragmentation. Plot-specific variables may potentially influence households' perception of this new round land reform. Since land reallocation increase instability of farmers' expectation in the further, we think land reallocation may undermine farmers' credibility perception about this land reform¹⁰⁷. We define household land adjustment readjusted from the second round land contracted as land reallocation. As an important standard for reallocation, land quality decide farmers' losing or benefiting from land readjustment. Households with good land quality don't want the land readjust and Protecting high-quality land is also a basic policy in China, so farmers expect land reform can protect their property rights¹⁰⁸. Soil quality is good proxies of land quality¹⁰⁹. Soil quality is predicted to be positive.

Group 5: Policy implication. Propaganda is a necessary part of implementation of land property rights reform, but many village leaders did not publicize this land reform in our survey. If rural cadres have propagated the new land certification reform required by the local government, farmers may have a better understanding of this new land certification reform and think this land can protect their rights. So we predict propaganda has positive effect on farmers' perception about this reform, which can be represented by variable of land reform propaganda.

Group 6: Village characteristics: Farmers' living in village with better transportation and smaller distance to the town will cost less to get land inform information and off-farm employment. However, Land closer to town is more likely to be expropriated for the development of urbanization. This may have a negative effect on farmers' perception about land inform protection¹¹⁰. A bus dummy variable can represent the transportation and sub urban area can be

¹⁰⁴ Rui Li, Qinghai Li, Xiaofeng Lv, Xi Zhu, The land rental of Chinese rural households and its welfare effects, *China Economic Review*, Volume 54, 2019, Pages 204-217, ISSN 1043-951X, <https://doi.org/10.1016/j.chieco.2018.11.004>.

¹⁰⁵ Linxiu Zhang, Yueming Cao, Yunli Bai, The impact of the land certificated program on the farmland rental market in rural China, *Journal of Rural Studies*, 2019., ISSN 0743-0167, <https://doi.org/10.1016/j.jrurstud.2019.03.007>.

¹⁰⁶ Feng, S., Heerink, N., Ruben, R., et al., 2010. Land rental market, off-farm employment and agricultural production in Southeast China: a plot-level case study. *China Econ. Rev.* 21 (4), 598–606.

¹⁰⁷ Gong, B., 2018. Agricultural reforms and production in China: changes in provincial production function and productivity in 1978-2015. *J. Dev. Econ.* 132, 18–31

¹⁰⁸ Deininger, K., Ali, D. A., & Alemu, T. (2011). Impacts of land certification on tenure security, investment, and land market participation: Evidence from Ethiopia. *Land Economics*, 87(2), 312–334.

¹⁰⁹ Fangping Rao, Max Spoor, Xianlei Ma, Xiaoping Shi, Perceived land tenure security in rural Xinjiang, China: The role of official land documents and trust, *China Economic Review*, 2017, ISSN 1043-951X, <https://doi.org/10.1016/j.chieco.2017.03.009>.

¹¹⁰ Ma, Xianlei, Heerink, Nico, van Ierland, Ekko, Shi, Xiaoping. Land tenure insecurity and rural-urban migration in rural China, *Papers in Regional Science*, 95: 383-406.

used to control village location. Land transaction market founded on the initiative of the government to realize large-scale land management, which plays an important role in protecting farmers' land transfer right. A land market dummy was introduced to represent land transaction market. Ratio of transferred household in the village level is also included, because this variable can influence farmers' land transfer right perception and behavior¹¹¹.

Group 7: Trust variable: Previous study found that without a trustworthy enforcement system, formalization will have a negative impact on enhancing land tenure security. However, informal institution and formal institution may also have substitution effect. Farmers' trust in informal institution may weaken their trust in formal institution. Therefore, the correlation between trust and farmers' credibility about this land reform is unclear. Interpersonal trust is considered to be closely associated with informal institution, such as morality, culture and religion¹¹².

Group 8: District variables: Finally, 2 district variables are included to control for unobserved factor, since these 3 regions have different level of economic development and land reform progress. As farmers living in the pilot of land collateral area have a positive perception about the land reform, we also add variable of collateral area.

Table 1 Definition of variables

Variables	Description
Dependent variables	
Land investment	How many agricultural investments does your household make? (green manure +organic fertilizer+ farmyard+ farmland leveling+ straw returning+ deep plowing+ canal building+ soil conditioner)?
Ratio of cash crop	Ratio of cash sown crop area to total sown area
Whether land rent-in	=1 if household rent-in farmland in 2016, =0 otherwise
Land rent-in areas	Amount rented in (mu)
Whether land rent-out	=1 if household rent-out farmland in 2016, =0 otherwise
Land rent-out areas	Amount rented out (mu)
Independent variables	
Possession right	=1 if farmer thinks the land certification reform can protect land possession right, =0 otherwise
Using right	=1 if farmer thinks the land certification reform can protect land using right, =0 otherwise
Profit right	=1 if farmer thinks the land certification reform can protect land profit right, =0 otherwise
Transfer right	=1 if farmer thinks the land certification reform can protect land transfer right, =0 otherwise
Inheritance right	=1 if farmer thinks the land certification reform can protect land inheritance right, =0 otherwise
Collateral right	=1 if farmer thinks the land certification reform can protect land collateral right, =0 otherwise
Control variables	
Household head characteristics	
HH education	Education year of the household head (years)
HH health	Body health of household head: =1 very poor; =2 poor; =3 medium; =4 good; =5very good
Household characteristics	

¹¹¹ Yahui Wang, Xiubin Li, Wei Li, Minghong Tan, Land titling program and farmland rental market participation in China: Evidence from pilot provinces, Land Use Policy, Volume 74, 2018, Pages 281-290, ISSN 0264-8377, <https://doi.org/10.1016/j.landusepol.2017.07.030>, (http://www.sciencedirect.com/science/article/pii/S026483771730039X)

¹¹² Fangping Rao, Max Spoor, Xianlei Ma, Xiaoping Shi, Perceived land tenure security in rural Xinjiang, China: The role of official land documents and trust, China Economic Review, 2017, ISSN 1043-951X, <https://doi.org/10.1016/j.chieco.2017.03.009>.

Number of elderly	The number aged over 65 in the household
Dependency ratio	The number aged over 65 or below 18 divided by family size (%)
Ratio of migration	Ratio of household members working outside the county for at least 6 months to total adult members
Share of agriculture training	Proportion household members with training in agricultural techniques to total adult members
Share of off-farm training	Proportion household members with training in unemployment to total adult members
If party member	=1 if the household has communist party member(s); 0=otherwise
If cadre member	=1 if the household has village cadre member(s); 0=otherwise
Endowment insurance	=1 if the household has taken part in endowment insurance; 0=otherwise
Village decision participation	=1 if the household can participate in major decisions in the village; 0=otherwise
Land characteristics	
Area of contracted land	Amount of contracted land (Mu)
Contracted land plots	Amount of contracted land plots the household owns
Household land adjustment	=1 if household has experienced land reallocation in the village; 0=otherwise
Soil quality	Self-evaluation of soil quality: =1 very poor; =2 poor; =3 medium; =4 good; =5 very good
Policy implication	
Land certification propaganda	=0 if the land certification reform has not been propagated in the village; =1 farmer was not sure whether land certification had been propagated; =2 otherwise
Village characteristics	
Dum-bus	= 1 if bus goes through the village; 0=otherwise
Sub urban area	=1 if the village located in the sub-urban area; =0 otherwise
Land transaction market	=1 if land transaction market is established in the village; =0 otherwise
Ratio of transferred household	Ratio of transferred households to all households in the village
Trust	
Village group member trust	Trust level of farmer towards village group member: =1 Very distrust; =2 little distrust; =3 medium; =4 little trust; =5 very trust
Neighbor trust	Trust level of farmer towards neighbor: =1 Very distrust; =2 little distrust; =3 medium; =4 little trust; =5 very trust
District	
South region	=1 if the village is located in South area, =0 otherwise
Central region	=1 if the village is located in North area, =0 otherwise
Collateral area	= 1 if the village is located in land collateral pilot area

4. Result and discussion

4.1 Descriptive statistics

Land investment variables. Table 2 shows the descriptive statistics of the dependent and independent variables, we observe that in our sample, farmers have made more than 2 kinds investment on the land. There is small difference among 3 regions. Farmers in central Jiangsu have the largest land investment.

Land planning structure variables. The survey shows that the mean variable of ratio of cash crop only accounts for 9% of the total sown area. It ranges from 0% to 100% for the average household in our sample. On average, the ratio of cash crop household living in the south region of Jiangsu (13.9%) is much larger than the other 2 regions (9.2% and 5.3% respectively).

Land transfer variables. The average area renting in land per household is 3.808 Mu. We can find a large difference among the 3 regions. The average area renting in land per household is 6.741 Mu in mid region of Jiangsu, while it is only 0.625 Mu in south region of Jiangsu. The average area renting out land per household is 0.792 Mu. There is a small difference among the 3 regions.

Key independent variables. Farmers have a large credibility towards this new land certification perception. Almost 70% percent farmers think the land certification can protect their possession right, profit right and using right (76.4%, 75.7%, and 69% respectively), which is higher than inheritance right and transfer right (62.8% and 6.06% respectively). However, limited by the law, few farmers think land certification perception can protect their collateral right. In addition, the average farmers' perceptions of property right in south are higher than that in mid and north region.

Household head characteristics. Average education year of household head is 7.558 years ranging from 0-15 years. The mean value of is household education is 3.75. The average number of household head's health is 3.789, ranging from 1 to 5.

Household characteristics. The average number aged over 65 in the household is 0.743, ranging from 1-3. Ratio of dependency is 33.1% on average. Ratio of household members working outside the county for at least 6 months per household is 18.6%, ranging from 22% to 75%. This ratio is higher in north of Jiangsu. Among average household, only 8.1% household members have received agricultural technology training, which is higher than the number of off-farm employment training (3.4%). As much as 22.7% of the surveyed households have at least one communist party member, this share is as high as 37.6% in south Jiangsu. And 9.6% households have village cadre members. Surveyed household participating in endowment insurance equals to 84.3%, while it is only 64.4% in south of Jiangsu. 41.4% surveyed households can take part in the major decisions in the village. And the share is as high as 49.5% in south of Jiangsu, which is higher than mid and north region of Jiangsu (44.2% and 31.4% respectively).

Land characteristics. Mean area of contracted land is 4.369 Mu per household, which varies between 0.3 and 16.5. The average land plots per household in the sample is 4.173, ranging from 2.75 to 18. It also shows that land fragmentation is relatively low in central and northern Jiangsu. We observe that in our sample, 27.54% households' land have been reallocated after second round land contracting from 1998. In central region of Jiangsu, 46.3% households' land have been reallocated, whereas this share is just 7.4% in northern Jiangsu. The mean value of soil quality is 3.48, which is almost equally in the 3 regions.

Policy implication. The value of land certification propaganda is 1.46. This means many villages do not publicize this land property rights reform policy or the propaganda work is not good.

Village characteristics. 60.3% villages are available for bus. In our sample, only 8.2% villages are located in the sub-urban areas. As much as 63.8% village have established the land transfer market, which is as high as 80 in central Jiangsu. Ratio of transferred household per village is 7.306. This ratio is about double that of the central and southern regions of Jiangsu.

Trust. Interpersonal trust is high in rural of Jiangsu, and farmer' trust on their neighbors is higher on village group members.

District: Villages in central region accounts for 40% of the samples used in this article. Untill our survey, land collateral has only been implemented in Central of Jiangsu.

Table 2 Descriptive statistics of variables included in the model.

Variables	Mean				Std. Dev.	Min	Max
	South	Mid	North	Average			
Dependent variables							
Land investment	2.034	2.374	2.078	2.201	0.985	0	7
Ratio of cash crop	0.139	0.092	0.053	0.090	0.176	0	1
Whether land rent-in	0.188	0.279	0.204	0.234	0.424	0	1
Land rent-in areas	0.625	6.741	2.088	3.808	22.088	0	280
Whether land rent-out	0.347	0.289	0.219	0.280	0.450	0	1
Land rent-out areas	0.851	0.820	0.709	0.792	1.698	0	10.5
Independent variables							
Possession right (1)	0.790	0.757	0.754	0.764	0.425	0	1
Using right (2)	0.778	0.688	0.630	0.690	0.463	0	1
Profit right (3)	0.808	0.758	0.719	0.757	0.429	0	1
Transfer right(4)	0.663	0.603	0.568	0.606	0.489	0	1
Inheritance right(5)	0.640	0.624	0.625	0.628	0.484	0	1
Collateral right(6)	0.319	0.409	0.443	0.399	0.490	0	1
Control variables							
Household head characteristics							
HH education	8.297	7.416	7.212	7.558	3.409	0	15
HH health	3.891	3.911	3.526	3.783	0.969	1	5
Household characteristics							
Number of elderly	0.723	0.863	0.591	0.743	0.860	0	3
Dependency ratio	0.270	0.347	0.353	0.331	0.278	0	1
Ratio of migration	0.117	0.191	0.228	0.186	0.223	0	0.75
Share of agriculture training	0.096	0.065	0.091	0.081	0.188	0	1
Share of off-farm training	0.034	0.040	0.026	0.034	0.116	0	1
If party member	0.376	0.200	0.153	0.227	0.419	0	1
If cadre member	0.079	0.084	0.124	0.096	0.295	0	1
Endowment insurance	0.644	0.905	0.905	0.843	0.370	0	2
Village decision participation	0.495	0.442	0.314	0.414	0.493	0	1
Land characteristics							
Area of contracted land	4.400	3.961	4.913	4.369	2.676	0.3	16.5
Contracted land plots	5.703	3.547	3.912	4.173	2.754	1	18
Household land adjustment	0.178	0.463	0.074	0.272	0.446	0	1
Soil quality	3.480	3.484	3.350	3.440	0.765	1	5
Policy implication							
Land certification propaganda	1.386	1.400	1.584	1.456	0.798	0	2
Village characteristics							
Dum-bus	0.436	0.632	0.686	0.603	0.490	0	1
Sub urban area	0.000	0.000	0.255	0.082	0.274	0	1
Land transaction market	0.594	0.800	0.445	0.638	0.481	0	1
Ratio of transferred household	5.136	5.981	10.743	7.306	6.900	0	42.4

Trust							
Village group member trust	3.960	3.989	3.942	3.967	0.755	1	5
Neighbor trust	4.109	4.132	4.219	4.154	0.701	1	5
District							
South region	1	0	0	0.236	0.425	0	1
Central region	0	1	0	0.444	0.497	0	1
Collateral area	0	0.563	0	0.250	0.434	0	1

4.2 Explaining farmers' perception of property right

Table 3 presents estimates from a standard logit model explaining the determinants of farmers' perception of property rights, including possession right, using right, profit right, transfer right, inheritance right and collateral right.

Household heads' health have significant negative effect on farmers' perception of using right, profit right and inheritance right. Unhealthy household head felt this land reform can't protect their using, profit and inheritance, because unhealthy state weaken household heads' ability to protect household assets, which may increase their risk of losing land.

Households with more ratio of migration think this land reform can't help them to protect land transfer right. The impact of ratio of household migration is significant at the 10% level. Hence, migration members may change their identity from villagers to citizens who may lose land inheritance right, households' migration members face risk of land inheritance. Thus, they don't think land property rights reform can protect their inheritance of the land.

Share of agriculture indicates a positive effect on farmers' perception of property rights. Especially, effects on possession right, profit right, transfer right and inheritance right are significant. Since farmers have more knowledge about agriculture, they have a better understanding about this new land reform. Thus, they may think the land reform can protect their land property rights. Households with higher ratio of off-farm training are more likely to think this reform can protect their profit right and transfer right of farmland. This is because farmers having off-farm agricultural training are more likely to find off-farm job which can help them to eliminate the risk of agricultural profit and land transfer. Farmers still regard land as an important pension tool. While endowment insurance reduces farmers' fear of losing their land to renters (land transfer) and lender (land collateral), farmers may be optimistic about this land reform. If farmers can take part in village decision making, they can personally participate in the implementation of the land policy, which increase farmers' credibility about policies, including this new land policy.

Household land adjustment mainly indicates a significant negative effect on farmers' perception of land property rights. This is consistent with the finding from the study of Rao¹¹³. Household experienced land adjustment may fear land readjustment in the further, which has a bad influence on their perception of land security¹¹⁴, especially the transfer right and inheritance right. However, land adjustment has positive effect on farmers' perception about collateral right. Although land adjustment can reduce farmers land stability, land adjustment increase land equality, which decreases land conflicts among households. Land soil is found to be positively correlated with farmers' perception of land transfer right and collateral right. Similarly, Klaus Deininger finds land

¹¹³ Fangping Rao. Perceived land tenure security in rural Xinjiang, China: The role of official land documents and trust.

¹¹⁴ Fangping Rao. Perceived land tenure security in rural Xinjiang, China: The role of official land documents and trust.

certification can reduce farmers' fear of losing land¹¹⁵. In view of national land protection policies, fertile land is more easily to be protected by the government. So farmers may think this new land reform aims to protect their farmland.

Regarding policy implication, farmers in the village propagating this new round land reform have well knowledge about this new police and are more likely to feel the protective effect the reform. In addition, compared with the basic possession right and using right, farmers have less knowledge about the institution of land transfer, land inheritance and land collateral. If villages have propagated according to the requirements of government, farmers can receive more information about this land property right reform, and they are more likely to perceive the credibility.

Among the village characteristics, sub urban area plays a negative significant effect on land farmers' security perception of transfer right and inheritance right. We find that farmers in the village located in the sub urban area are more likely think the new round land reform can't protect their transfer right and inheritance right. This is because farmland in the sub urban area is more likely to be expropriated with limited compensation, resulting to a growing concern about losing land in the future in the process of urbanization¹¹⁶.

We find that trust variable has negative effect on farmers' perception of land property rights. This is contrast to an earlier study showing that interpersonal trust enhances mutual recognition and negotiability in reducing land tenure insecurities¹¹⁷. However, Chinese rural society filled with informal institutions and interpersonal trust has played an important role in shaping rural informal institutions, such as morality, culture and religion. Informal institution can replace, undermine and reinforce the formal rules which may dominate economy or society development¹¹⁸. Once farmers mainly rely on the informal institution, they may think that the formal system is not so credible. Thus, trust between farmers may be negatively related with function of the new land reform.

Farmers living in the village of south area think this land reform can protect their using right and profit right. This may be due to the rapid urbanization in southern Jiangsu, where farmland property rights are full of uncertainty, farmers expect this reform can protect their basic land using right and profit right. Farmers living in the village of central area think this land reform can't protect their land collateral right. This may be because farmers face dilemma of capital shortage when they are carrying out land large-scale management, they have less credibility about this new round land reform. Farmers living in the pilot of land collateral areas think this new round land reform can effectively protect their collateral right.

Table 3 Influence of farmers' perception of property rights

Variables	Possession right		Using right		Profit right		Transfer right		Inheritance right		Collateral right	
	Coef.	p-value	Coef.	p-value	Coef.	p-value	Coef.	p-value	Coef.	p-value	Coef.	p-value
variables												
Household head characteristics												

¹¹⁵ Klaus Deininger, Daniel Ayalew Ali, and Tekie Alemu . Impacts of Land Certification on Tenure Security, Investment, and Land Market Participation: Evidence from Ethiopia

¹¹⁶ Fangping Rao, Land tenure (in)security and crop-tree intercropping in rural Xinjiang, China

¹¹⁷ Fangping Rao. Perceived land tenure security in rural Xinjiang, China: The role of official land documents and trust.

¹¹⁸ Grzymala-Busse, A. The Best Laid Plans: The Impact of Informal Rules on Formal Institutions in Transitional Regimes. *St Comp Int Dev* 45, 311–333 (2010) doi:10.1007/s12116-010-9071-y

HH education	-0.025	0.519	-0.053	0.157	-0.061	0.146	0.004	0.915	0.028	0.449	0.045	0.22
HH health	-0.118	0.398	-0.270	0.038	-0.311	0.032	-0.139	0.278	-0.373	0.005	-0.204	0.115
Household characteristics												
Number of elderly									0.095	0.498		
Dependency ratio	0.725	0.127	0.649	0.144	0.091	0.85	0.393	0.371			0.007	0.986
Ratio of migration							-0.676	0.222	-0.987	0.069		
Share of agriculture training	1.830	0.066	0.988	0.191	1.721	0.063	2.557	0.003	1.779	0.022	0.991	0.131
Share of off-farm training	1.964	0.204	1.614	0.209	3.641	0.061	4.383	0.005	2.029	0.109	-1.146	0.259
If party member	-0.019	0.957	-0.230	0.463	0.039	0.914	0.345	0.275	0.418	0.188	0.173	0.554
If cadre member	0.070	0.902	0.386	0.432	0.420	0.473	0.182	0.714	-0.206	0.66	0.568	0.173
Endowment insurance	0.334	0.346	0.364	0.284	0.526	0.153	0.789	0.02	0.752	0.025	0.635	0.065
Village decision participation	0.991	0.001	0.762	0.006	0.528	0.08	0.445	0.09	0.525	0.048	0.444	0.079
Land characteristics												
Area of contracted land	-0.030	0.584	-0.063	0.222	-0.058	0.304	-0.033	0.557	-0.059	0.261	0.055	0.348
Contracted land plots	0.045	0.493	0.012	0.84	-0.002	0.972	0.061	0.333	-0.024	0.677	-0.012	0.835
Household land adjustment	-0.493	0.157	-0.084	0.801	-0.327	0.359	-0.558	0.095	-0.714	0.032	0.798	0.044
Soil quality	-0.067	0.7	0.024	0.877	-0.167	0.339	0.282	0.07	0.152	0.332	0.271	0.08
Policy implication												
Land reform propaganda	0.060	0.705	0.231	0.123	0.356	0.027	0.282	0.061	0.255	0.086	0.363	0.019
Village characteristics												
Dum-bus	0.209	0.5	-0.349	0.215	-0.115	0.708	0.151	0.664	0.204	0.47	0.300	0.281
Sub urban area	-0.704	0.16	-0.304	0.513	0.260	0.621	-1.043	0.089	-1.282	0.01	-0.412	0.378
Land transaction market							0.210	0.552				
Ratio of transferred household							-0.015	0.523				
Trust												
Village group member trust	-0.326	0.204	-0.472	0.049	-0.589	0.026	-0.250	0.268	-0.370	0.105	-0.070	0.759
Neighbor trust	-0.042	0.883	-0.191	0.467	-0.389	0.189	-0.574	0.024	-0.539	0.034	-0.315	0.191
District												
South region	0.064	0.885	0.879	0.035	0.939	0.037	0.088	0.848	-0.192	0.639	-0.503	0.203
Central region	-0.078	0.831	0.241	0.468	0.527	0.141	-0.014	0.973	-0.121	0.724	-1.375	0.009
Collateral area											1.720	0.003
Cons	2.489	0.056	3.820	0.002	5.996	0	1.749	0.162	4.252	0	-1.017	0.358
Pseudo-R ²	0.0893		0.1056		0.1342		0.1688		0.1509		0.1118	
LR Statistic	40.44		54.71		62.2		94.17		83.46		59.86	
Obs	418		420		420		416		419		398	

4.3 Estimated effects of farmers' land certification perception on farmers' behavior.

We use the propensity score from the logit model presented earlier this month to discuss the impact of land property right reform on farmers' behaviors. Then, using the nearest neighbor matching and kernel matching (KBM) models, we estimated the effects of farmers' land certification perception on 3 aspects of farmers' behavior: land investment, crop choice and land transfer. The regression results were shown in table 3. Table 6-10 present the balancing property test for the propensity score matching analysis, which show the mean bias statistic decrease a lot and the chi-square test is not significant. These mean there are no pre-treatment differences between credibility and non-credibility household. So the self-selection has been removed and the matching requirement is satisfied. Figure 1-5 show the common support which present the distribution of pair-wise propensity score between treated and untreated households . Observation that are off support are been removed from our evaluation to avoid bad matches.

Overall, the model performs well and produces results that are mostly consistent. The effects of many control variables are also as expected.

4.3.1 Farmers' certification perception and land investment

Table 4 and table 5 report the results of effects of farmers' security perception of land property rights reform on farmers' investment. The most notable finding is that farmers' perception about this reform encourages land investment. We found that farmers who think land reform can protect their profit right, transfer right and inheritance right are more likely to increase agricultural investment. Our findings suggest that once households have a high degree of credibility about land certification reform, they will take action to invest their land. We also find that the effect of farmers' perception about transfer right and inheritance right on land investment are higher than the profit right. Besides, farmers' perception about possession right and using right have none effect on land investment. This suggests that possession right and using right are relatively secure affected by previous land reform. However, transfer right and inheritance right are relatively new and complicated, households may think these 2 rights are not security and pay more attention to them. Our finding provides supportive evidence that farmland certification policy may affect land investment through improving institution credibility of transfer right and inheritance right.

4.3.2 Farmers' certification perception and crop choice

Table 4 and 5 report the results of farmers' security perception of land property rights reform on farmers' crop choice. The results show that farmers' perception of using right about this land reform can increase the likelihood of households choose to grow cash crops, significant at 10% level. This is consistent with our expectations, since farmers think this land reform can protect their using right, they have the impetus to grow more profitable cash crops. In addition, farmers' perception of inheritance right can also encourage farmers to transfer food crops into cash crops, significant at 5% level. This indicates that inheritance security rights meet the needs of household assets transfer between different generations, and farmers are more willing to grow long term profitable cash crops.

4.2.3 Farmers' certification perception and land transfer

Table 4 and 5 present the main estimation results in the land transfer equation. We found farmers' security perception about this land property rights reform positively affect households land rent-in, and negatively affect households land rent-out. Farmers' secure perception of **profit right** has a significantly positive effect on household land rent-in area. This indicates that more secure profit right can protect farmers' agriculture production, which can furtherly encourage

farmers to rent in more farmland. The correlations between farmers' secure perception of transfer right and land rent-in areas is significant and positive. With more secure land transfer right, farmer having productive ability can rent in more farmland to enhance agriculture productivity by operating large-scale farmland. Farmers' secure perception of inheritance right has a positive effect on land renting-in area. Secure inheritance right can reduce farmers' risk losing land, which can reduce land transaction costs. Farmers therefore can rent in more farmland. Farmers' secure perception of collateral right also has a significant and positive effect on land rent-in area. Security perception of collateral right gives farmer's confidence that they have capacity for repayment, which helps farmer obtain loans from formal or informal sources. Then farmers can use the loans to rent-in more farmland.

It is important to consider why the impacts of farmers' secure perception of property rights on land transfer mainly through the land rent-in area. In our survey, tenants or land demanders are limited and farmers who want to rent out land usually can't find a suitable tenant. And existing tenants can rent more farmland in a secure property right environment. Our findings provide supportive evidence that farmland certification policy may encourage farmers to rent-in more land, but it has little effect on number of land demander.

Farmers' secure perception of possession right has negative effect on whether land rent-in as well as land rent-in area. In addition, farmers' secure perception of using, transfer right and inheritance right have negative effect on land rent-out. These results are inconsistent with previous studies¹¹⁹. We think the following reasons may lead to these results. First, agricultural income remains an important part of total income, account for 38.35%¹²⁰, farmers' livelihoods still depend on agricultural production. Second, as farmers' security perception about this reform encourages farmers to invest in land, households are more likely to rent-in land and increase long-term investment on land. Thus, farmers don't want to rent-out their farmland.

¹¹⁹

¹²⁰ <http://www.fx361.com/page/2018/0903/4169960.shtml>

Table 4. The impact of farmers' perception of land property rights reform on farmers' behaviors (neighbor matching)

	Land investment		Land structure planning		Whether land rent in		Rent in area		Whether land rent out		Rent out area	
	Difference	ATT	Difference	ATT	Difference	ATT	Difference	ATT	Difference	ATT	Difference	ATT
Possession right	0.093	0.65	-0.0003	-0.01	0.064	1.14	-5.888	-1.61	-0.134	-2	-0.504	-1.8
Using right	-0.068	-0.47	0.033	1.55	-0.007	-0.13	1.073	0.47	-0.054	-0.054	-0.424	-1.91
Profit right	0.323	2.15	0.025	1.02	0.058	0.96	3.150	1.92	0.030	0.43	-0.219	-0.78
Transfer right	0.305	2.19	0.019	0.76	0.031	0.59	4.014	2.34	-0.066	-1.07	-0.498	-2.03
Inheritance right	0.284	2.09	0.049	1.77	0.086	1.5	5.274	2.97	-0.047	-0.72	-0.460	-1.63
Collateral right	0.075	0.57	0.010	0.44	0.042	0.77	4.624	1.68	0.030	0.51	-0.059	-0.25

Table 5. The impact of farmers' perception of land property rights reform on farmers' behaviors (kernel matching)

	Land investment		Land structure planning		Whether land rent in		Rent in area		Whether land rent out		Rent out area	
	Difference	ATT	Difference	ATT	Difference	ATT	Difference	ATT	Difference	ATT	Difference	ATT
Possession right	0.089	0.65	0.0051	0.2	0.056	1.05	-3.357	-0.98	-0.121	-1.93	-0.531	-2.02
Using right	-0.056	-0.45	0.035	1.76	0.002	0.03	1.440	0.66	-0.061	-1.08	-0.456	-2.05
Profit right	0.200	1.38	0.025	1.09	0.034	0.58	2.906	1.79	0.016	0.24	-0.248	-0.95
Transfer right	0.271	2.03	0.024	1.0	0.033	0.65	3.770	2.22	-0.085	-1.45	-0.569	-2.46
Inheritance right	0.219	1.65	0.048	1.85	0.070	1.3	5.225	2.95	-0.041	-0.66	-0.460	-1.75
Collateral right	0.006	0.05	-0.010	-0.45	0.031	0.6	2.231	0.82	0.057	1.03	0.043	0.2

5. Conclusions and policy implications

In this paper, we have assessed the impacts of farmers' security perception of the latest land property rights reform in rural China, using the propensity score matching method. We have distinguished 6 types of farmers' security perception of property rights and found that, the possession right is influenced by household health, ratio of migration, share of agriculture training, share of off-farm training, endowment insurance, village decision participation, household land adjustment, soil quality, land reform propaganda, sub urban area, trust and district. In addition, our results also suggest that farmers' security perception of property right about this reform have positive influence on land investment, cash crop choice and land rent-in, and negative effect on land rent-out. Specially, when farmers think this land reform can protect their profit right, transfer right and inheritance right, they are more likely to increase agricultural investment; When farmers think this land reform can protect their using right and inheritance right, they are more likely to grow more profitable cash crops; when farmers think this land reform can protect their possession right, they are more likely to rent-in land; When farmers think this new round land reform can protect their profit right, transfer right, inheritance right and collateral right, they are more likely to rent-in more farmland.

Our results have some important policy implications. On the one hand, the government should take some measures to increase farmers' security perception of these property rights to make the land . On the other hand, the