sustainability

MDPI

Article

The Impact of Farmland Tenure Security on China's Agricultural Production Efficiency: A Perspective of Agricultural Production Factors

Juan Zhang [1,2] and Qin Chen [1,*]

[1] College of Economics and Management, Fujian Agriculture and Forestry University, Fuzhou 350001, China
[2] College of Financial, Fuzhou University of International Studies and Trade, Fuzhou 350001, China
* Correspondence: chenqin5588@163.com

Abstract: Improving agricultural production efficiency is an effective means to ensure food security and promote agricultural sustainable development in China. Stable agricultural land property rights help optimize the allocation of production factors and improve production efficiency, and it is of great practical significance to study the influence of farmland tenure security on agricultural production efficiency. Therefore, this research utilizes the 2018 data of the China Labor Dynamics Survey (CLDS) to analyze the influence of farmland tenure security on agricultural production efficiency and its internal transmission mechanism under the background of agricultural land ownership confirmation. The results show that the enhancement of farmland tenure security not only directly improves agricultural production efficiency, but also indirectly affects agricultural production efficiency through the intermediary variable of agricultural investment. Moreover, it also shows that farmland tenure security has heterogeneity effects on different farmer regions and production modes and can significantly improve the production efficiency of farmers in plain and hilly areas who adopt fully mechanized and partially mechanized farming. We suggest that policymakers should also deepen the reform of the rural factor market, develop diversified rural financial institutions, actively promote the involvement of small farmers in the public sector economy, and improve the service level of agricultural machinery in order to guide the development of the tertiary industry in non-plain areas and to reduce the land endowment effect of farmers.

Keywords: farmland tenure security; agricultural production efficiency; agricultural production factors; mediating effect

Citation: Zhang, J.; Chen, Q. The Impact of Farmland Tenure Security on China's Agricultural Production Efficiency: A Perspective of Agricultural Production Factors. *Sustainability* **2022**, *14*, 16266. https://doi.org/10.3390/su142316266

Academic Editor: Emanuele Radicetti

Received: 7 November 2022
Accepted: 2 December 2022
Published: 6 December 2022

1. Introduction

Agricultural production efficiency is considered to be an important indicator for ensuring national food security, maintaining farmers' livelihoods, and spurring sustainable agricultural development [1,2]. However, agricultural productivity remains very low in most developing countries, accounting for most of the difference in labor productivity between countries [3,4]. As an agriculture-oriented country, agricultural production in China has always been plagued by high resource consumption and low production efficiency. Its agricultural labor production efficiency is only 2% of the average level of developed countries, 1% of the agricultural production efficiency of the United States, and 64% of the world average [5]. At present, the nation's agriculture is in the key period of transformation from traditional agriculture to modern agriculture. Agricultural development is moving from the traditional demand of satisfying quantity to now meeting the demand for quality. The government thus needs to adjust the structure of agricultural production, reform traditional agriculture, and transform the mode of agricultural production so as to help with the improvement of production efficiency. In this context, raising agricultural production efficiency is an effective means to ensure the country's food security and to promote the sustainable development of agriculture.

Agricultural production in China has its own particularity. The small-scale farmland management mode caused by land fragmentation under the household contract responsibility system makes it difficult to form economies of scale in agricultural production [6] and inhibits the growth of agricultural production efficiency. Most papers agree that the main driving force for improving agricultural productivity in China comes from four core reforms: price reform, institutional reform, planning and marketing reform, and rural land system reform [7–9]. Among them, land system reform is a great institutional arrangement that has been continuously deepened since the founding of new China in order to liberate the productive forces. Agricultural land property rights play a key role in determining agricultural development [10], under which the theory of property rights holds that stable agricultural land property rights help promote the allocation of production factors and improve production efficiency. As a theoretical policy response, the policy implementation of stable land rights is the direction for the land reform policy efforts of China's government [11,12].

Over the past 30 years of reform and opening up, the property rights system of farmland in China has gone through many stages. In 1984, the contract period of farmland was extended to 15 years, and in 1993, the contract period was further extended to 30 years. In 2008, it was emphasized that the contracted management right of farmland would remain unchanged for a long time. By the end of 2018, trials were carried out in 28 provinces to confirm farmland rights, and the work of confirming, certifying, and registering contracted farmland management rights was basically completed. It can be seen that the reform of China's agricultural land property rights system aims to continuously strengthen the stability of farmer land rights. A question thus arises: does the enhancement of farmland tenure security effectively improve agricultural production efficiency?

The relationship between farmland tenure security and agricultural production efficiency has always been a hot issue in academic and theoretical circles. Many studies have been carried out on this issue, but the research conclusions are divergent. One view is that farmland tenure security plays a positive role in promoting agricultural production efficiency. The enhancement of agricultural land property rights endows farmers with clear and stable land property rights, promotes farmer investment [13,14], optimizes farmer allocation of agricultural production factors [15], enhances farmers' agricultural investment capacity [16], and finally improves agricultural production efficiency. Newman et al. (2015) studied the impact of land ownership on agricultural productivity in Vietnam and believed that the clarity of farmland property rights significantly improved agricultural production efficiency [17]. Ghebru and Holden (2015) used data envelopment analysis to calculate the agricultural production efficiency of Ethiopian farmers. Their research held that the agricultural production effect of farmers with land right confirmation is higher than that of farmers with non-agricultural land right confirmation [18]. Qin et al. (2020) employed propensity score matching and the IV-Tobit model to point out that agricultural land property right certificate registration can promote agricultural land circulation and help farmers to form scale management [19]. TsegayeGebrie (2017) pointed out that property rights registration of rural land in Ethiopia improved land productivity.

Some scholars have studied the effect path of farmland tenure security on agricultural production efficiency [20]. Ji (2020) constructed an analysis framework of agricultural land property structure subject behavior factor efficiency agricultural performance. Empirical analysis suggested that agricultural land property structure affects the efficiency changes of farmers' agricultural land and labor factor allocation behavior, thus improving agricultural performance [21]. Zhuang and Xie (2022) constructed an analytical framework of farmland adjustment experience non-agricultural labor force transfer agricultural production performance. They pointed out that no adjustment and a big contrast in farmland, through farmland adjustment of non-agricultural farmers, mainly reduce the labor force and improve agricultural production performance [22]. Jin and Deininger (2009) believed that the improvement of agricultural land property rights could transfer agricultural land from farmers with non-agricultural comparative advantages to farmers with agricultural com-

parative advantages, thus realizing effective allocation of land resources and significantly improving agricultural productivity [23].

Another view holds that farmland tenure security has no significant impact on agricultural production efficiency [24–26]. In China, the current agricultural land transfer market is not perfect, land fragmentation is caused by the distribution of agricultural land according to the household, and the endowment effect of rural households has greatly reduced the impact of the agricultural land property rights policy. First, the effect of the agricultural land property rights policy should be played on the premise of a perfect agricultural factor market and infrastructure [27]. Under the current agricultural environment in China, farmland tenure security will not improve agricultural production efficiency but may play a negative role. Second, the agricultural land system with the household joint responsibility system leads to the fragmentation of agricultural land, and the improvement of farmland tenure security strengthens the pattern of farmland fragmentation by strengthening the endowment effect of farmer farmland, which has a negative impact on agricultural production. Finally, the existing farmland property rights system can ensure the security of farmers' land property rights, but the implementation process of the farmland property rights policy is not in place, and there is policy distortion, which affects the realization of the positive dividend of the farmland property rights policy.

Hombrados et al. (2015) used survey data of farmers in Tanzania from 2008 to 2009 to empirically study that farmland right confirmation has no significant impact on agricultural production efficiency through farmer investment and farmland transfer. This may be because local farmers lack trust in government institutions and lack awareness of the policy of farmland right confirmation [28]. Toulmin (2008) believed that the security of farmer property rights in Africa south of the Sahara Desert is relatively high, but that the impact of farmland property rights on agricultural production is very small [29]. Roy (2012) studied the impact of agricultural land reform on agricultural productivity in India and pointed out that the improvement of agricultural land property rights has a negative and significant impact on agricultural productivity [30]. He (2014) stated that the confirmation of agricultural land rights will cause the tragedy of anti-commons. In the context of less arable land per capita and scattered management of farmland in China, land right confirmation strengthens farmland fragmentation, which is not conducive to agricultural production. Therefore, land right confirmation policies should be implemented with caution [31]. Luo and Wan (2019) conducted an empirical study based on the survey data of farmers in Yangshan County and Xinfeng County, Guangdong Province and pointed out that improvement in the security of agricultural land property rights inhibits the transfer of agricultural land and has a negative impact on agricultural production efficiency [32]. The empirical study of Qian (2020) presented that farmland tenure security has no significant impact on the rent and transaction costs of transferred land and even has a negative effect [33].

To sum up, as an institutional arrangement to maintain the stability and security of land rights, the social and economic effects of the agricultural land property rights system have been widely concerned by the academic community. However, most of the existing studies focus on the behavioral effects caused by the policy change from unstable land ownership to farmland right confirmation, but few studies focus on whether there are differences in agricultural production efficiency of farmers and the root causes of the differences after the completion of farmland right confirmation. In view of this, this paper takes 2018, the final year of agricultural land ownership confirmation, registration, and certification work, as the research starting point. By constructing the analysis framework of "farmland tenure security—agricultural production factors—agricultural production efficiency" and using the 2018 data of the China Labor Dynamics Survey (CLDS), the linear regression model, the tendency to score matching model, instrumental variable method, and the effects of mediation model, we analyze the influence of farmland tenure security on agricultural production efficiency and its internal transmission mechanism under the background of agricultural land ownership confirmation and further investigate

the heterogeneity of farmers' farmland tenure security on agricultural production efficiency from the perspective of economic location and business endowment, to further enrich the research in this field.

The research arrangement of this paper is as follows: Section 2 covers the theoretical analysis and research hypotheses, Section 3 covers materials and methods, Section 4 covers the empirical analysis, and Section 5 covers the conclusions and recommendations.

2. Theoretical Analysis and Research Hypotheses

A clear property right system can promote the free allocation of production factors such as land, labor, and capital according to the market price mechanism, so as to improve production efficiency. As an important resource of agricultural production, farmland also follows the theory of property rights. Improvement in the security of farmland property rights strengthens the exclusivity of farmland property rights, enriches farmland rights and powers, and encourages farmers to optimize the allocation of capital, land, and labor to promote agricultural production. Specifically, farmland tenure security influences agricultural production efficiency through farmland transfer, agricultural investment, and family division of labor [34], as shown in Figure 1.

2.1. Farmland Tenure Security, Farmland Transfer, and Agricultural Production Efficiency

The strengthening of agricultural land property rights can promote the transfer of agricultural land [35,36] and inhibit it [37,38], which is the final result of the joint action of the two aspects. Therefore, the direction of the influence of farmland tenure security on agricultural production efficiency through farmland transfer is uncertain [39]. Clear agricultural land property rights promote agricultural land transfer by reducing transaction costs [40], property rights incentive, and factor market linkage [41]. First, a clear definition of property rights can reduce transaction costs. Improvement of farmland tenure security has reduced the information asymmetry between the trading parties in agricultural land transactions, expanded the scope of agricultural land trading objects, reduced transaction costs, and promoted the transfer of agricultural land. Second, improvement in the security of agricultural land property rights guarantees the farmers' rights and interests in land by making clear the exclusiveness of the use of agricultural land property rights and the exclusive benefit, stabilizes the farmers' production expectations on agricultural land, stimulates the farmers' enthusiasm for production, and spurs farmers to increase the transfer of agricultural land in order to expand the scale of operation. Finally, clear property rights of agricultural land help protect the land rights and interests of farmers under the separation of man and land, further release and transfer a large number of the rural surplus labor force to non-agricultural sectors, allow migrant families to transfer out of the land at ease, and promote the transfer of agricultural land. In addition, the enhancement of farmland tenure security gives the right of mortgage and guarantee to the contracted management right of agricultural land. It is difficult for farmers to obtain guarantee and mortgage due to their own small contracted land area, and so the transferee can mortgage and guarantee the transferred land, thus increasing the demand for farmland transfer and promoting farmland transfer.

Farmland tenure security also inhibits farmland transfer through the endowment effect. Agricultural land is endowed by the state according to household registration and membership rights, has strong identity characteristics, and is a kind of personal property [42]. Specifically, rural land has a social security function for farmers, and farmers have a complex of land love and disposal in place, giving rural land a high endowment effect. Therefore, the agricultural land transfer market does not conform to Coase's assumption about the subject of rights [43]. It is not only a simple factor market but also a special market including kinship, geography, and human relations. Stable property rights of farmland may strengthen the emotional value and security value of farmers' farmland, further aggravate the endowment effect of farmers, and increase the expected price of farmland transferred

by farmers, leading to the failure of buyers and sellers to reach an agreement on the value and thus inhibiting the transfer of farmland.

Agricultural land transfer raises agricultural production efficiency through resource allocation, large-scale management, and technological change. First, the acceleration of land transfer improves the market transactions of agricultural land transfer, so that agricultural land flows from farmers with low agricultural production efficiency to farmers with high agricultural production efficiency, improves the allocation efficiency of agricultural land resources, and promotes agricultural production efficiency. Second, agricultural land transfer helps farmers realize a potential scale effect by concentrating agricultural land, laying the foundation for large-scale agricultural land management and specialized agricultural management [44], reducing agricultural production costs, and thus improving agricultural production efficiency. Third, it helps farmers to adopt agricultural machinery and other advanced agricultural production technologies and reduce agricultural production costs through technological change [45]. At the same time, the adoption of new technologies changes the allocation of agricultural production factors by farmers and promotes their free allocation of agricultural production factors according to their endowment conditions and behavioral capacity [46], so as to improve agricultural production efficiency.

2.2. Farmland Tenure Security, Family Division of Labor, and Agricultural Production Efficiency

The arrangement of property rights affects the allocation of resources, and the allocation behavior of farmers for production factors is determined by the joint decision-making behavior of farmers [47]. As an important reform of the rural land system, the farmland property rights policy has clarified the four ranges of farmer land, strengthened the security of farmland property rights, and changed the vague land property rights in rural areas of China to a great extent. Therefore, the improvement in the security of agricultural land property rights is bound to affect the allocation of rural labor resources [48], and the current allocation of rural labor is mainly reflected in the choice of family labor between agricultural and non-agricultural sectors under the influence of non-agricultural labor transfer.

There are two ways that farmland tenure security affects agricultural production efficiency through non-agricultural transfer. First, the improvement in the security of agricultural land property rights promotes the off-farm transfer of rural labor force through transaction liberalization [49] and restrains the off-farm transfer of labor force through property rights incentives [50]. Farmland tenure security also promotes the non-agricultural transfer of the rural labor force through trade liberalization. The rural labor force cannot realize full employment, which makes non-agricultural income much higher than agricultural income. In the case of ambiguous property rights of agricultural land, when laborers go out for work, if they transfer their agricultural land, then there will be a risk that the land rights will be infringed upon by the transferee or the village collective. Therefore, farmers will choose to leave the farmland for work or give up migrant work to engage in agricultural production. Farmland property rights security improves the extent of farmers land, such as spatial location information, maintaining the long-term stability of the land contract relations, improving the agricultural land requisition of farmers in the process of negotiating position and bargaining power, reducing the dispute in the process of farmland conversion or risk of farmer land rights violation by the transferee, and allowing farmers to turn out farmland migrant workers. Farmland tenure security inhibits the non-farm transfer of labor force through property rights incentives. Instability of farmland property rights damages the investment income of farmers in farmland, restricts the investment of farmers in farmland, especially long-term investment, causes a loss of agricultural production efficiency, and defeats the enthusiasm of farmers in agricultural production. By improving the security of agricultural land property rights, the income expectation of farmers in agricultural production can be stabilized, the enthusiasm of farmers engaged in agricultural production can be stimulated, and the labor input of families in agricultural production can be increased, so as to inhibit the non-agricultural transfer of the labor force.

Second, the impact of non-agricultural transfer of the rural labor force on agricultural production efficiency is uncertain as it promotes agricultural production efficiency. On the one hand, the non-agricultural transfer of labor improves the specialization level of labor division, gives play to the comparative advantages of labor, encourages farmers with comparative advantages in agricultural production to increase agricultural labor input, improves the efficiency of resource allocation [51], and promotes agricultural production. On the other hand, non-agricultural transfer of the rural labor force has changed the input structure of agricultural production factors and improved the efficiency of agricultural production. Non-agricultural transfer of the rural labor force also inhibits agricultural production efficiency. With the large number of non-agricultural transfers of the rural labor force, the income of family migrant work exceeds the income of agricultural production, and the dependence of farmers on agricultural land gradually decreases. On the one hand, the loss of the labor force will make agricultural production labor input insufficient and not conducive to agricultural production. On the other hand, the labor force shortage in family agriculture and the concurrent feminization and aging of agricultural production are not conducive to the adoption of new agricultural production technologies, leading to extensive agricultural operation and lower agricultural production efficiency [52].

2.3. Farmland Property Rights, Agricultural Investment, and Agricultural Production Efficiency

Farmland tenure security improves agricultural production efficiency by promoting agricultural investment [53]. First, the farmland tenure security promotes agricultural investment through transaction liberalization and income exclusivity. The enhancement of farmland tenure security can clarify property rights, thus strengthening the exclusivity and security of farmland property rights, reducing the risk of farmers' farmland being adjusted during the adjustment of village collective farmland, reducing the cost of farmland protection, and thus promoting the increase of agricultural investment. Second, the enhancement of farmland tenure security improves the liberalization of agricultural land transactions and the confidence of farmers in the future conversion of agricultural land investment into considerable land rent income, thus encouraging them to make agricultural investments in order to improve the demand for agricultural land transactions and improve the condition of agricultural land. Third, the household contract responsibility system has separated land ownership from use right, endowed farmers with the right to use land, greatly stimulated farmer production enthusiasm, and greatly improved agricultural production. However, the following agricultural growth lingered for a long time, and scholars put forward that the property right incentive effect of the family co-production responsibility system is exhausted [54]. At present, the contract right of land property rights is not stable, and the right to use is not clear, thus reducing the investment expectation of farmers. By enhancing farmland tenure security, the property rights can be clarified, the ambiguity of agricultural land property rights can be solved, the residual claim of farmers to agricultural production can be guaranteed, the exclusive ownership of agricultural land income of farmers can be guaranteed, and the long-term investment of farmers in agricultural land can be promoted [53,55].

Agricultural investment through technological change and scale management helps improve agricultural production efficiency. On the one hand, the increase in agricultural investment allows farmers to adopt new agricultural technologies, optimize agricultural investment structure, and improve agricultural production efficiency. On the other hand, the increase in agricultural investment can provide financial support for farmers to expand their scale of operation, which is conducive to them achieving large-scale operation and better agricultural production efficiency [56].

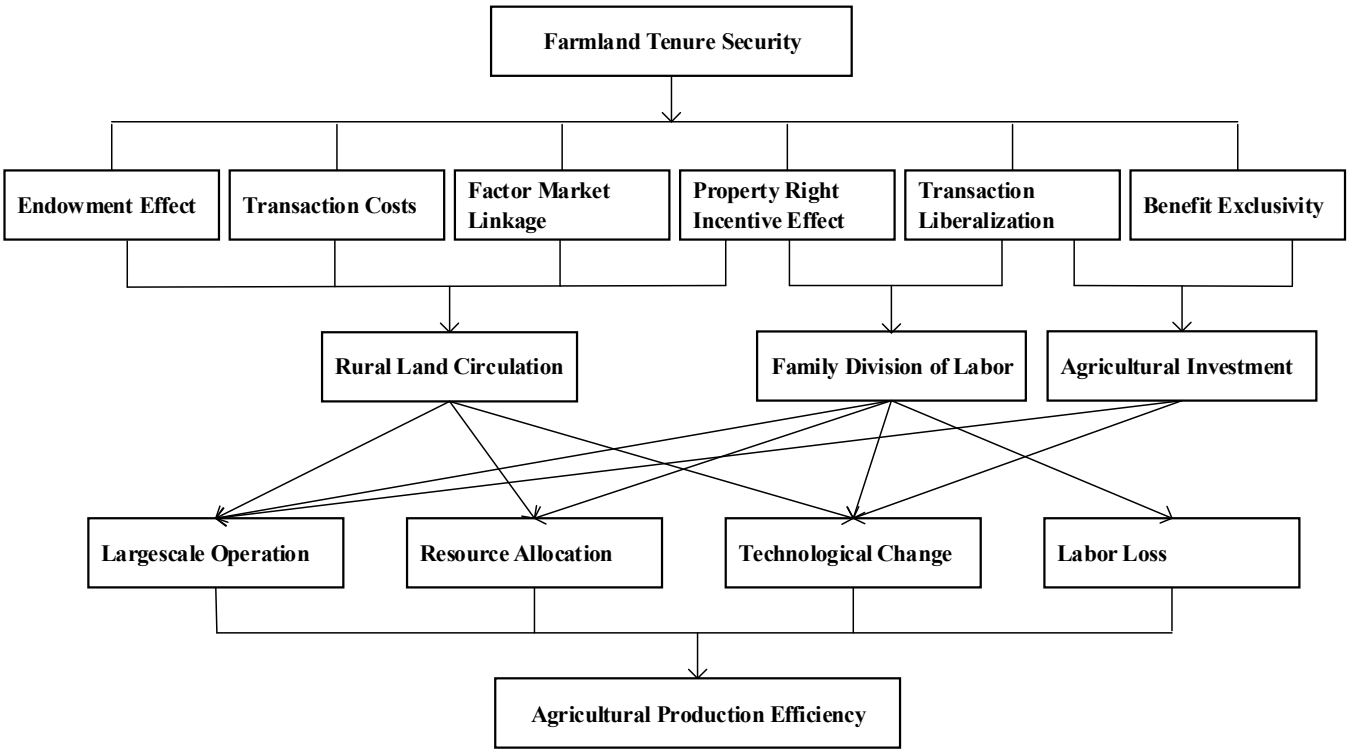

Figure 1. Theoretical analysis framework of the influence of farmland tenure security on agricultural production efficiency.

In summary, this study puts forward the following hypotheses.

Hypothesis 1. *Farmland tenure security has a significantly positive impact on agricultural production efficiency*.

Hypothesis 2. *Farmland tenure security has an uncertain impact on farmer agricultural production efficiency through farmland transfer*.

Hypothesis 3. *Farmland tenure security has an uncertain impact on farmer agricultural production efficiency through family division of labor*.

Hypothesis 4. *Farmland tenure security improves the agricultural production efficiency of farmers by promoting their agricultural investment*.

3. Materials and Methods

3.1. Data Sources

The data in the paper are from the 2018 China Labor Dynamic Survey (CLDS). CLDS is a biannual survey project on the dynamics of the household labor force in urban and rural areas with the tracking scope of community, which was implemented by the Center for Social Science Investigation of Sun Yat-sen University in 2012. The survey is a large-scale interdisciplinary follow-up survey, covering labor education, work, health, migration, economic activity, and many other topics. The sample covers 29 provinces in China (except Hong Kong, Macao, Taiwan, Tibet, and Hainan). The survey respondents are family members aged 15–64. CLDS uses a rotating sample tracking survey and a multi-stage, multi-level probabilistic sampling method proportional to the size of the labor force. The questionnaire includes data sets at the individual, household, and village levels. This data set includes relevant information of family farmland property rights, family agricultural production and income, which has certain representativeness and stability, and provides

effective data support for the empirical research of this paper. In addition, it should be noted that the sample data did not include data of Hong Kong, Macao, Taiwan, Tibet, and Hainan. In 2018, the cultivated land area of these five regions accounted for less than 0.2% of the country. The lack of data in Hong Kong, Macao, Taiwan, Tibet, and Hainan has not impacted on the overall research conclusion.

This paper takes the family as the research object, and mainly adopts the data set at the family level, supplemented by the relevant characteristic information at the individual and village level. The 2018 CLDS survey data involved a sample of 16,537 labor force individuals, 13,501 households, and 368 communities. After excluding non-rural residents and samples with serious missing key variables, the household questionnaire, individual questionnaire, and village questionnaire were matched and combined to obtain 2126 household samples.

3.2. Variable Selection

3.2.1. Explained Variables

The dependent variable of this paper is agricultural production efficiency. In this paper, pure technical efficiency calculated by the DEA-BCC model is also the dependent variable. In order to statistically analyze the differences of farmers under different agricultural land property rights, this study conducts a mean test of agricultural production efficiency according to whether farmland has been adjusted since 2003, as shown in Table 1. Table 1 shows that the average agricultural productivity of farmers without farmland adjustment is 0.875, and that of farmers with farmland adjustment is 0.694. The difference between the two is 0.181, which is significant at the 1% level. It indicates that the agricultural production efficiency of farmers with stable property rights is higher than that of farmers with unstable property rights.

Table 1. Inter-group differences in agricultural productivity of farmers.

Variable	Farmland without Adjustment since 2003 = 1	Farmland with Adjustment since 2003 = 0	Inter-Group Difference	Standard Deviation	T Value
Agricultural productivity of farmers	0.875	0.694	0.181	0.010	26.104 ***

Note: *** denote significance at the 1% levels, respectively.

3.2.2. Explanatory Variable

The explanatory variable of this paper is farmland tenure security, which is measured by whether the agricultural land has been adjusted since 2003. If the agricultural land has not been adjusted, then the value is 1, indicating that the agricultural land property rights are stable. If the agricultural land has been adjusted, then the assigned value is 0, indicating that the agricultural land property rights are unstable.

3.2.3. Intermediary Variable

According to the above theoretical analysis, farmland tenure security impacts agricultural production efficiency through agricultural land transfer, agricultural investment, and household labor allocation. Therefore, this paper selects the three variables of agricultural land circulation, agricultural investment, and household labor division as intermediary variables. The area of agricultural land transfer is used as the measurement index of agricultural land transfer. Household labor division is measured by the proportion of the number of households engaged in agricultural production for more than three months in a year. The total cost of household agricultural production input in a year is used as the measurement index of agricultural investment. In regression, this paper makes a dimensionless treatment for intermediary variables and takes a natural logarithm treatment for agricultural land circulation and agricultural investment.

3.2.4. Control Variable

In order to improve the credibility of the fitted regression, and referring to the existing literature, this paper introduces three control variables of household head characteristics, household characteristics, and village characteristics. In terms of the characteristics of household head, four variables are selected: age, education level, political status, and health status of household head. The younger and more educated farmers are, the stronger they are in accepting new agricultural technologies, the more conducive they are to change traditional agricultural production mode and adopt mechanization and large-scale production, thus the higher the agricultural labor productivity of farmers. Household heads with Communist Party membership have more information and stronger ability to accept advanced agricultural technology, which is more conducive to improve household agricultural production efficiency. The healthier the householder is, the stronger the agricultural labor ability is, which is conducive to promoting agricultural production.

The family characteristics relate to the social and economic characteristics of the family, and three variables are selected: the number of family members, whether the family has a tractor, and whether the family has other large agricultural machinery and tools. First of all, family size reflects the demographic characteristics of the family. The larger the household size, the more labor inputs available for agricultural production and the more productive it is. Secondly, the use of agricultural machinery is not only beneficial to achieve agricultural economies of scale but also to improve agricultural production efficiency. Therefore, two variables, whether a family has a tractor and whether a family has other large agricultural machinery, are used to reflect the mechanical conditions of the sample family agricultural production. The use of agricultural machinery reduces cost of agricultural production and improves the efficiency of agricultural production. Therefore, farming households with agricultural machinery have higher agricultural production efficiency.

In terms of village characteristics, four variables are selected: whether there is a non-agricultural economy, whether farmers are organized to carry out agricultural production technology training, whether mechanical tillage services are provided, and whether the village land is expropriated or rented by the government or enterprises. Whether village has an off-farm economy reflects the development level of secondary and tertiary industries of the village. Villages with an off-farm economy have a better economic development level and more off-farm employment opportunities, which may induce farmers with low agricultural production income to give up agricultural production and engage in higher-income off-farm work, which is not conducive to agricultural production. Whether village land is requisitioned or rented by the government or enterprises affects farmers' expected returns on the land, reduces farmers' enthusiasm for agricultural production, and thus has an adverse impact on agricultural production efficiency. The service conditions of agricultural production in a village will affect the efficiency of farmers' agricultural production. The better the service conditions of agricultural production, the higher the efficiency of farmers' agricultural production. This paper uses whether to organize farmers to train production technology, and whether to provide machine tillage service to express these.

In addition, with different levels of regional economic development, farmer agricultural production efficiency will also be different. Therefore, the east region, west region, and central region of China are selected as regional variables in this study to control the impact of regional variables on agricultural production efficiency. See Table 2 for details.

Table 2. Definition of variables and descriptive statistical analysis.

Variable		Definition	Standard Deviation	Mean	Minimum Value	Maximum Value
Output indicators	Gross household income from farming	Total income of households from selling grain and cash crops (Yuan/year)	21,037.09	14,681.41	0	500,000
Input indicators	Agricultural production time input	Total time spent by family farmers in agricultural production (days/year)	174.345	319.507	0	1550
	Agricultural material input	Total input of household operating grain and cash crops (Yuan/year)	26,980.65	14,589.24	0	250,000
	Scale of farmland management	Total area of cultivated land, orchards, and vegetable fields (mu/year) after household contracts and leases are deducted	69.378	31.24198	0	1201.5
Dependent variable	Agricultural production efficiency	Integrated technical efficiency of agriculture	0.0899	0.755	0.586	1
Independent variables	Farmland tenure security	Whether farmland has been adjusted since 2003; No = 1, Yes = 0	0.484	0.655	0	1
	Division of labor at home	Percentage of households engaged in agricultural production (%)	0.264	0.398	0	1
Intervening variable	Investment in agriculture	Total cost of agricultural production (Yuan)	24,988.26	16,001.86	0	200,000
	Rural land circulation	Transfer area of cultivated land (mu)	39.01	15.98	0.3	500
Householder characteristics	Householder age	Age of head of household (age)	9.877	51.61	15	78
	Education level of householder	Years of education	0.899	2.619	1	7
	Political status of householder	Communist = 1, masses = 2	0.261	1.927	1	2
	Health status of householder	Very healthy = 1, healthy = 2, fair = 3, relatively unhealthy = 4, very unhealthy = 5	0.939	2.398	1	5
	Size of household	Size of household	1.759	4.449	1	15
Family characteristics	Have a tractor at home	Do you have a tractor? Yes = 1, No = 0	0.501	0.447	0	1
	There are large farm machines and implements at home	Are there any large farm machinery? Yes = 1, No = 0	0.307	0.0986	0	1
Village characteristics	Village non-agricultural economy	Is there an off-farm economy? Yes = 1, No = 0	0.329	0.132	0	1
	Village agricultural production technology training	Whether to provide unified agricultural production technology training? Yes = 1, No = 0	0.454	0.734	0	1
	Village mechanical farming service	Does it provide mechanical tillage service? Yes = 1, No = 0	0.478	0.366	0	1
	Land acquired by governments or leased by businesses	Is the land expropriated or leased by the government or business? Yes = 1, No = 0	0.479	0.365	0	1
Regional variables	East region	Yes = 1, No = 0	0.468	0.401	0	1
	Central region	Yes = 1, No = 0	0.398	0.165	0	1
	West region	Yes = 1, No = 0	0.545	0.401	0	1

3.3. Model Specification

3.3.1. Data Envelopment Analysis

As for the measurement of agricultural production efficiency, this study adopts DEA to comprehensively measure agricultural production efficiency in a multi-input and multi-output environment. This method does not need a known production function and can avoid model setting errors. Moreover, it is not disturbed by the dimension of relevant indices and has no requirement on the weight of indices, and so it has certain objectivity. In this paper, according to the actual agricultural production situation of farmers, the

variable return to scale model (BCC) is adopted to measure the production efficiency of farmers [57–62]. The specific model is as follows:

$$\begin{cases} \max\alpha \\ s.t. \sum_{j=1}^{n} \lambda_j x_j + s^- = x_0 \\ \sum_{j=1}^{n} \lambda_j y_j - s^+ = a y_0 \\ \sum_{j=1}^{n} \lambda_j = 1 \\ s^+ \geq 0,\ s^- \geq 0,\ \lambda_j \geq 0,\ j = 1, \ldots, n \end{cases} \tag{1}$$

Here, α is the relative efficiency measurement index of DMU; λ_j is the combination proportion of the j^{th} decision-making unit; x_j and y_j are the input and output vectors of the j^{th} decision-making unit; s^- and s^+ represent the relaxation variables of input and output, respectively; and x_0 and y_0 represent the input and output of the DMU, respectively.

3.3.2. Mediating Effect Model

This study uses the mediating effect model to test the mechanism of farmland property rights' stability affecting agricultural production efficiency. The established mediating effect model is as follows:

$$Y_i = w_0 + w_1 Title + \sum_{n=1} w_{2n} X_{ni} + e_1 \tag{2}$$

$$MED_i = g_0 + g_1 Title + \sum_{n=1} g_{2n} X_{ni} + e_2 \tag{3}$$

$$Y_i = f_0 + w' Title + f_1 MED_{\text{i}} + \sum_{n=1} f_{3n} X_{ni} + e_3 \tag{4}$$

Here, *Title* is whether farmland is adjusted; Y_i is the efficiency of agricultural production; MED_i is the mediating variable, including household labor input, farmland transfer, and agricultural investment as the three mediating variables; w_1, g, and f are the parameters to be estimated; X_{ni} is the control variable; and e_1, e_2, and e_3 are random interference terms.

3.3.3. Discussion of Endogeneity

There may be endogeneity between farmland tenure security and agricultural production efficiency, which leads to biased regression results. First, important omitted variables could affect both farmland tenure security and agricultural production efficiency, leading to regression coefficient bias. Second, there may be reverse causality between farmland tenure security and agricultural production efficiency. Stable agricultural land property rights can improve the production enthusiasm of the management body, optimize the allocation of agricultural resources, and improve production efficiency. However, villages with high agricultural production efficiency have better agricultural management and a lower probability of agricultural land adjustment. Finally, the household characteristics of farmers and village characteristics affect the adjustment of village farmland. Therefore, there may be endogeneity problems caused by sample self-selection in the comparative analysis of household samples with unadjusted farmland and households with adjusted farmland.

This paper adopts the following two methods to solve the endogeneity problem. First, the instrumental variable method is used to overcome the endogeneity problem caused by omitted variables or reverse causality. In this paper, the mean of different agricultural land adjustment situations in other villages in the same province is selected as the instrumental variable of agricultural land adjustment. The reasons are as follows. First, rural land adjustment is carried out by the village as a unit. The implementation process of the policies in the same province in different villages is relatively consistent, which meets the relevance conditions. At the same time, the agricultural production efficiency of farmers is usually determined by the agricultural land adjustment of the village, which is not

affected by external villages and satisfies the erogeneity condition. Second, Propensity Score Matching (PSM) is used to overcome the bias of systematic results' estimation caused by sample selection bias.

4. Empirical Analysis

4.1. Analysis of DEA Calculation Results

This study adopts the DEA-BCC model to measure the technical efficiency of sample farmers, and the results are shown in Table 3. Pure technical efficiency and scale efficiency of all farmers are 0.819 and 0.874, respectively. In terms of samples, comprehensive technical efficiency, pure technical efficiency, and scale efficiency of farmers without farmland adjustment are higher than those of farmers with farmland adjustment. This shows that the agricultural technology of farmers and the scale of agricultural land management have improved. However, from the perspective of overall farmers, pure technical efficiency is lower than scale efficiency, indicating that the former is the key to improve comprehensive technical efficiency, and the technical level of agricultural production should be improved.

Table 3. Average agricultural production efficiency of each type of farmer.

Peasant Household Type	Integrated Technical Efficiency	Pure Technical Efficiency	Scale Efficiency
Farmers without farmland adjustment	0.855	0.875	0.933
Farmers with farmland adjustment	0.632	0.775	0.801
All the farmers	0.755	0.819	0.874

4.2. Benchmark Regression of the Influence of Farmland Tenure Security on Agricultural production Efficiency

According to formula (2), the results of OLS regression appear in Table 4. Table 4 shows that farmland tenure security has a positive impact on agricultural production efficiency. The improvement of farmland tenure security increases agricultural production efficiency. Hypothesis 1 is thus supported. This may be because, against the background of China's increasing economic development, there is a lack of a formal land property rights system, and farmers do not fully enjoy the right of free transfer of land contracts, which reduces their enthusiasm in farming production. Improvement in the security of agricultural land property rights will give farmers more rights to freely allocate production factors, mobilize their enthusiasm in farming production, optimize the allocation of agricultural resources, and improve the efficiency of agricultural production. As far as the control variables are concerned, the physical health of the household head has a positive impact on the agricultural productivity of the farmers. Having a tractor at home has a positive effect on agricultural productivity at a significance level of 5%. Village non-agricultural economy has a positive effect on agricultural production efficiency, and it is significant at the 5% level. Finally, village agricultural production technology training has a positive impact on agricultural production efficiency.

Table 4. Regression results of the influence of farmland tenure security on agricultural production efficiency.

Variable	Agricultural Production Efficiency
Farmland tenure security	0.2139 ***
	(22.40)
Householder age	0.0018
	(0.54)
Education level of householder	0.0012
	(0.39)
Political status of householder	0.0060
	(0.51)
Health status of householder	−0.0035 **
	(−2.01)
Size of household	0.0021
	(0.96)
Have a tractor at home	0.0165 **
	(2.56)
There are other large farm tools in the home	0.0138
	(1.56)
Village non-agricultural economy	0.0321 **
	(2.85)
Village agricultural production technology training	0.0037 *
	(1.68)
Village mechanical farming service	0.0123
	(1.84)
Land acquired by governments or leased by businesses	−0.0065
	(−0.93)
Regional variables	Controlled
_cons	0.8115 ***
	(22.21)
N	2126
F	37.75
r2	0.612

Note: *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

4.3. Treatment of Endogenous Problems

4.3.1. Estimated Results of Instrumental Variables

As mentioned above, there may be reverse causality between farmland tenure security and agricultural production efficiency, which may lead to a bias of the original regression results. Therefore, this paper uses instrumental variables and adopts the IV-2SLS method for estimation, and the results are shown in Table 5. In the first stage, the weak instrumental variable statistic F is 44.863, which passes the weak instrumental variable test—that is, there is no weak instrumental variable. The under-identification test indicates that it is significant at the 1% level, meaning there is no problem of under identification of instrumental variables. Therefore, the instrumental variables selected in this paper are effective. Finally, a more robust Durbin–Wu–Hausman test is used to test the endogeneity of agricultural land ownership confirmation. The P value of DWH is 0.2730, which cannot reject the null hypothesis of the exogenous variable, indicating no endogeneity in farmland tenure security. Combined with the second-stage regression results of VI-2SLS, the regression coefficient of farmland tenure security is significantly positive at the 1% level, indicating that farmland tenure security has a significantly positive impact on agricultural production efficiency, which is consistent with the results of the benchmark regression model.

Table 5. Regression results of instrumental variables.

Variable	Phase One	Phase Two
	Farmland Tenure Security	Agricultural Production Efficiency
Mean values of different agricultural land adjustment situations in other villages in the same province	0.4510 *** (6.93)	
Farmland tenure security		0.1621 *** (5.81)
Control variables	Controlled	Controlled
N	2126	2126
F	6.708	5.969
r2	0.1589	0.5985
Identify deficiencies	34.979 ***	
Weak instrumental variable F	44.863	

Note: *** denote significance at the 1% levels, respectively.

4.3.2. Estimation Results of Propensity Score Matching

PSM should satisfy the assumption of common support and balance. In order to ensure the validity of matching, the two hypotheses need to be tested. Figure 2 shows the distribution effect diagram of the propensity score value before and after matching. It can be seen intuitively that the probability distribution of the propensity score of the two samples after matching is closer, showing the observable characteristics of the two groups of samples are more similar. Moreover, the observed values of the vast majority of samples fall within the common value range, which fully indicates that the matching effect is good and the common support hypothesis is supported.

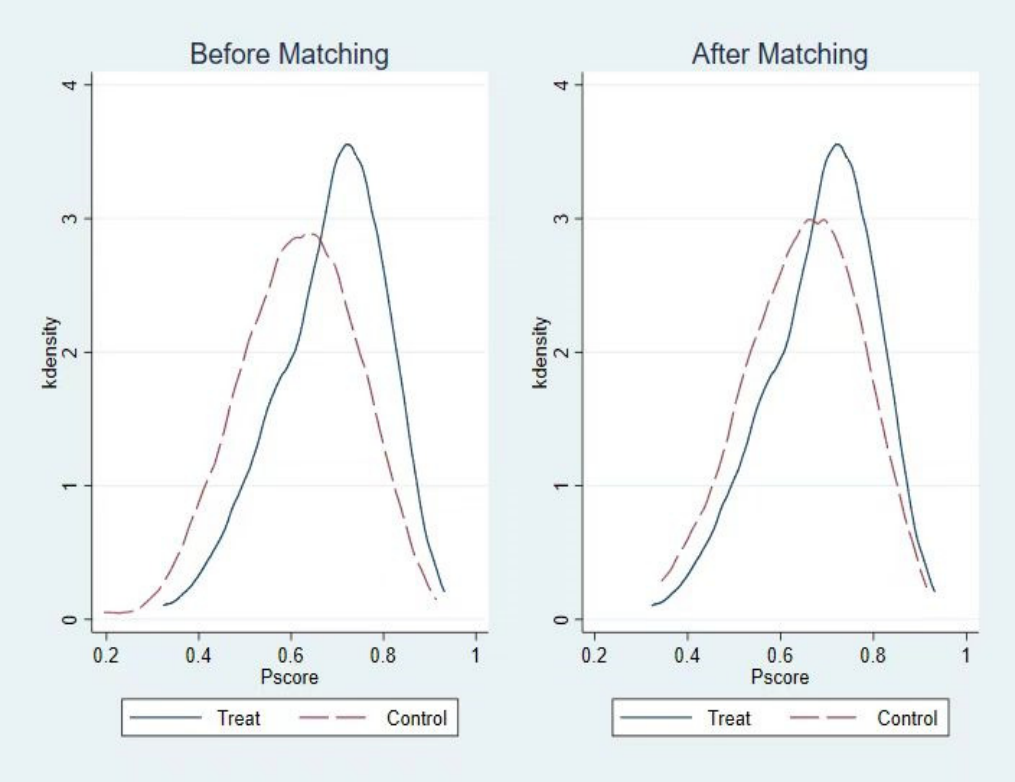

Figure 2. Probability density diagram.

The balance test is further conducted on the data of propensity score matching, and the results are in Table 6. Compared with before matching, the standard deviations of each covariate after matching are all less than 10%, indicating that matching effectively reduces

the difference between families in the confirmed group and those in the unconfirmed group. In addition, according to the *t*-test, after matching, the *p*-values of each variable are all greater than 0.05, indicating no coefficient difference between the treatment group and the control group. Therefore, the matching results can better balance the distribution of control variables of the two groups of samples, the matching is effective, and the balance hypothesis is supported.

Table 6. Balance test results.

Variable		Mean		Standard Deviation %	Standard Deviation Reduction	T Test	
		Treatment Group	Control Group			T Value	*p* Value
Householder age	Before matching	52.34	53.13	−7.900	40.30	−0.810	0.421
	After matching	52.31	51.83	5.100		0.620	0.535
Education level of household	Before matching	2.715	2.517	24.10	80.80	2.400	0.017
	After matching	2.689	2.695	4.790		0.600	0.546
Political status of householder	Before matching	1.913	1.954	−16.70	51.20	−1.600	0.110
	After matching	1.916	1.936	−8.100		−0.940	0.348
Health status of householder	Before matching	2.339	2.543	−21.70	86.70	−2.180	0.030
	After matching	2.338	2.311	2.900		0.350	0.728
Size of household	Before matching	4.379	4.608	−12.90	85.20	−1.300	0.195
	After matching	4.378	4.345	1.900		0.230	0.817
Have a tractor at home	Before matching	0.497	0.353	29.30	97.60	2.930	0.004
	After matching	0.493	0.497	−0.700		−0.0800	0.935
Village non-agricultural economy	Before matching	0.114	0.157	−12.50	36.80	−1.280	0.200
	After matching	0.115	0.142	−7.900		−0.980	0.326
Village agricultural production technology training	Before matching	0.762	0.641	26.60	80.50	2.730	0.007
	After matching	0.76	0.784	−5.200		−0.680	0.494
Village mechanical farming service	Before matching	0.346	0.431	−17.60	88.20	−1.78	0.075
	After matching	0.348	0.338	2.100		0.260	0.795
Land acquired by governments or leased by businesses	Before matching	0.366	0.392	−5.400	−28	−0.550	0.585
	After matching	0.365	0.399	−6.900		−0.850	0.398

The average treatment effect (ATT) of property rights' stability on agricultural production efficiency is next further estimated, and the specific results are shown in Table 7. All three methods show that the agricultural productivity of households with unadjusted farmland increased after matching. Taking the nearest neighbor matching as an example, the ATT value is 0.1798, which is significant at the 5% level, indicating that enhancement of farmland tenure security improves agricultural production efficiency. Therefore, it can be considered that farmland tenure security still has a significantly positive impact on agricultural production efficiency after the PSM method is used to correct any possible selective bias in the model.

Table 7. PSM inspection results.

Matching Type	Nearest Neighbor Matching	Caliper Matching	Kernel Matching
ATT (Average treatment effect)	0.1848 ***	0.1731 ***	0.1698 ***
	(16.29)	(20.03)	(19.32)

Note: *** denote significance at the 1% levels, respectively.

4.4. Grouped Estimation of the Influence of Farmland Tenure Security on Agricultural Production Efficiency

According to the above analysis, farmland tenure security improves agricultural production efficiency on the whole. However, the impact of farmland tenure security on agricultural production efficiency may be different depending on the region where the village is located and the agricultural mechanization conditions faced by the agricultural production. Therefore, in order to further analyze the relationship between farmland tenure security and

agricultural production efficiency, this paper conducts heterogeneity analysis according to different regions and agricultural mechanization conditions. The results are in Table 8.

Table 8. Group regression results of the influence of farmland tenure security on agricultural production.

Variable	Plain	Hill	Mountain	Fully Mechanized	Partial Mechanization	Traditional Farming
Farmland tenure security	0.1726 ***	0.1169 ***	0.1054	0.1735 ***	0.1410 ***	0.1300
	(19.69)	(8.55)	(3.89)	(15.21)	(8.98)	(3.89)
Control variables	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled
_cons	0.8112 ***	0.6541 ***	0.6999 ***	0.6500 ***	0.6801 ***	0.7986 ***
	(20.37)	(6.98)	(6.21)	(11.11)	(7.65)	(7.87)
N	1342	435	349	1076	667	383
r2	0.6838	0.6426	0.3522	0.6187	0.5447	0.6093

Note: *** denote significance at the 1% levels, respectively.

4.4.1. Regional Difference

This study divides the terrain of villages into plain, mountainous, and hilly areas and investigates the heterogeneity effect of farmland tenure security on the productivity of farmers in different regions. The results show that farmland tenure security has a significantly positive impact on agricultural production efficiency for farmers in plain and hilly areas. However, farmland tenure security has no effect on agricultural production efficiency for farmers in mountainous areas. This may be because villages are located in varied terrain, leading to differences in the allocation of farmland, labor force, machinery, and the perception of farmland property rights in regions that have different effects on agricultural production efficiency.

4.4.2. Differences in Agricultural Mechanization Condition

The study divides the farming methods of farmer grain production into three types: fully mechanized, partially mechanized, and traditional farming. The regression results show that farmland tenure security has a significantly positive impact on agricultural production efficiency for farmers who adopt fully and partially mechanized grain farming methods. However, the stability of land property rights has no effect on production efficiency for farmers who adopt traditional farming. This means that the stable property rights of farmland and the external conditions of agricultural production match each other, making it more conducive to the development of the policy effect of farmland property rights. Villages with better mechanization conditions are more likely to give play to the comparative advantage of agricultural machinery replacing labor, reduce agricultural production costs, and promote agricultural production.

4.5. The Effect Mechanism of Farmland Tenure Security on Agricultural Production

We next adopt the mediating effect model to empirically study the mechanism of farmland tenure security on agricultural production efficiency. The regression results (1) and (2) in Table 9 report the mediating effect of farmland tenure security on agricultural production efficiency through the division of household labor. Regression result (1) shows that farmland tenure security has no significant impact on the division of labor in the family. According to the stepwise test method, the Sobel test is needed. The p value of Sobel test is 0.7391, which does not pass the significance test, indicating that the mediating effect of family division of labor is not valid, and that farmland tenure security does not impact agricultural production efficiency through family division of labor.

Table 9. The effect mechanism of farmland tenure security on agricultural production.

Variable	(1) Family Division of Labor	(2) Agricultural Production Efficiency	(3) Investment in Agriculture	(4) Agricultural Production Efficiency	(5) Rural Land Circulation	(6) Agricultural Production Efficiency
Farmland tenure security	−0.0082	0.1988 ***	0.1799 **	0.1498 ***	−0.8133	0.1988 ***
	(−0.37)	(24.52)	(2.12)	(22.87)	(−0.21)	(24.65)
Family division of labor	—	−0.0095	—	—	—	—
		(−0.81)				
Investment in agriculture	—	—	—	0.1613 *	—	—
				(−1.72)		
Rural land circulation	—	—	—	—	—	−0.0001 *
						(−1.89)
Control variables	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled
_cons	0.8101 ***	0.6986 ***	8.5858 ***	0.8110 ***	29.8778 **	0.7888 ***
	(7.53)	(20.11)	(14.56)	(18.76)	(2.19)	(21.46)
N	2126	2126	2126	2126	2126	2126
r2	0.3789	0.6094	0.1968	0.612	0.09276	0.6122
Sobel	0.7391				0.8624	
p-value						

Note: *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Regression results (3) and (4) denote the mediating effect of farmland property rights' stability on agricultural production efficiency through agricultural investment. Regression result (3) presents that farmland tenure security positively affects agricultural investment at a significant level of 10%. By substituting farmland tenure security and the intermediary variable agricultural investment into Equation (4), regression result (4) is obtained. The regression result implies that agricultural investment has a positive impact on agricultural production efficiency at the significance level of 10%. Furthermore, after the mediating variable is added, the coefficient of the influence of farmland tenure security on agricultural production efficiency decreases from 0.2139 in regression result (1) to 0.1498. The significance remains unchanged, indicating that agricultural investment has a partial mediating effect on agricultural production efficiency. This result is consistent with the analysis in Section 3. Hypothesis 3 is thus supported—that is, farmland tenure security improves the agricultural production efficiency of farmers by promoting their agricultural investment.

Regression results (5) and (6) show the mediating effect of farmland property rights' stability on agricultural production efficiency through farmland transfer. Empirical result (5) shows that farmland tenure security has no significant impact on farmland transfer, and so the Sobel test is needed. The *p* value of the Sobel test is 0.8624, which does not pass the significance test, indicating that the mediating effect of agricultural land transfer does not exist.

5. Conclusions and Suggestions

This research takes 2018 as the starting point, which is the last year of agricultural land ownership confirmation, registration, and certification work, builds an analysis framework of farmland tenure security agricultural production factors and agricultural production efficiency, and adopts 2018 data of CLDS. The linear regression model, propensity score matching model, instrumental variable method, and mediating effect model help analyze the influence of farmland tenure security on agricultural production efficiency and the influence of the internal transmission mechanism under the background of farmland ownership confirmation. The main conclusions are as follows: First, the stability of farmland property rights plays a significant role in promoting agricultural production efficiency. Considering the possible endogenous problems of the model, the instrumental variable method was used to solve endogenous problems caused by reverse causality, and the propensity score matching method was used to overcome bias of the regression results caused by sample

self-selection. The stability of farmland property rights remained robust, which had a significant positive impact on agricultural production efficiency

Secondly, study on influence mechanism of farmland property stability on agricultural production efficiency found that agricultural investment is a partial intermediary variable, that is, stability of farmland property rights not only has a direct impact on agricultural production efficiency, but also indirectly affects agricultural production efficiency through the intermediary variable of agricultural investment. However, it was not found that household division of labor and farmland transfer played a similar role. First of all, stability of farmland property rights did not affect agricultural production efficiency through household division of labor. This may be because the influence of stability of farmland property rights on agricultural production efficiency through the family division of labor is the result of comprehensive effects of both positive and negative aspects. On the one hand, by improving security of farmland property rights, stability of farmland property rights stabilizes income expectations of farmers in agricultural production, stimulates enthusiasm of farmers in agricultural production, promotes families to increase labor input in agricultural production, and improves the efficiency of agricultural production. On the other hand, stability of farmland property rights improves security of farmland property rights, reduces the cost of farmland protection for rural households, and encourages rural households with non-agricultural comparative advantages to go out for work. However, rural households' out-migration for work adversely affects agricultural production efficiency through the labor drain effect. Secondly, the stability of farmland property rights did not affect agricultural production efficiency through farmland transfer. It may be because stability of farmland property rights both promotes and inhibits the transfer of farmland, which is the final result of the combined action of the two aspects. Therefore, the influence direction of farmland property rights' stability on agricultural production efficiency through farmland transfer is not significant.

Thirdly, sample regression of farmers by plain, mountain, and hilly areas shows that stability of farmland property rights can improve agricultural production efficiency of farmers in plain and hilly areas but has no impact on farmers in mountainous areas. In addition, from the perspective of influence strength, there are differences in influence strength on stability of farmland property rights for farmers located in different terrains. The influence of stability of farmland property rights on agricultural production efficiency of farmers in plain areas is stronger than that in hilly areas. In addition, subsample regression of farmers' food production methods into fully mechanized farming, partially mechanized farming, and traditional farming shows that stability of farmland property rights can improve agricultural production efficiency of farmers using fully mechanized farming and partially mechanized farming but has no effect on farmers using traditional farming. Moreover, from the perspective of influence strength, influence of land property stability on agricultural production efficiency of fully mechanized farmers is stronger than that of partially mechanized farmers. It shows that stability of farmland property rights and external conditions of agricultural production match each other and will be more conducive to the play of the farmland property rights effect. This may be because villages with better mechanized conditions are more likely to give play to comparative advantages of agricultural machinery replacing the labor force, reducing agricultural production costs and improving crop yields. In villages with higher mechanized conditions, with improvement of land property stability and mechanical conditions, the agricultural production link that originally required a large amount of labor force can be replaced by machinery, which is not easily affected by labor force constraints, and can greatly promote farmers' enthusiasm for agricultural production.

Based on the research conclusions, the following policy recommendations are put forward.

First, in the actual game of rural farmland property rights, the readjustment of farmland should be strictly controlled to achieve farmland tenure security.

Second, China's government should deepen the reform of the rural factor market and develop diversified rural financial institutions. The effect of property rights' stability

for farmland on agricultural production efficiency needs the transmission of agricultural investment. This means that agricultural land property rights need to complement the cultivation of factor markets, so that they can play a role in optimizing resource allocation and promoting sustainable agricultural development. Therefore, the relevant authorities should further open the rural financial market, accelerate the development of new rural financial organizations, encourage private capital to participate in the reform of local financial institutions, form diversified rural financial institutions, and broaden the financing channels of farmers.

Third, the government can actively promote small farmers to get involved in the social public economy and improve the service level of agricultural machinery. Farmland tenure security significantly improves the agricultural efficiency of farmers in villages with a fully mechanized farming mode of grain production. This implies that stable property rights of agricultural land match the external conditions of agricultural production, and that the effect of property rights of agricultural land can be brought into full play. Under the background of a large amount of off-farm labor transfer, farmers with better agricultural mechanization conditions can take better comparative advantage of mechanical labor replacement, reduce agricultural production costs, and improve agricultural production efficiency and household income. For this, all levels of government should promote socialized agricultural machinery operation services and improve the agricultural machinery service level and production mechanization conditions. Doing so can strengthen preferential subsidies to the main suppliers of large-scale agricultural machinery operation services, which is beneficial to the scale and industrialization of agricultural machinery operation services. The government can also focus on guiding and supporting the development and growth of local agricultural machinery service providers in policy selection, which is not only conducive to reducing the transaction costs of providing agricultural machinery services to farmers but is also conducive to the scale economy effect of agricultural machinery operation services.

Fourth, relevant authorities should guide the development of the tertiary industry in non-plain areas and reduce the effect of farmers' land endowment. Farmland tenure security in plain areas can better execute the optimal allocation of agricultural production factors and resources and promote agricultural production. Therefore, the government should increase policy publicity in mountainous and hilly areas to enhance farmer awareness of agricultural land property rights. Mountainous areas can also apply their ecological advantages and drive the development of the tertiary industry. Based on the advantages and limitations of mountainous areas, China's government should stimulate the development of rural tourism, promote the integration of primary and tertiary industries, expand the income channels of farmers, and reduce the survival dependence of farmers on land.

Author Contributions: Conceptualization, methodology, software, validation, formal analysis, investigation, resources, data curation, writing—original draft preparation, writing—review and editing, visualization, J.Z.; supervision, project administration, funding acquisition, Q.C. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: The data sets used or analyzed during the current study are available from the yearbooks or the corresponding author on reasonable request.

Acknowledgments: The authors are grateful to the editor and the anonymous reviewers of this paper.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Ma, L.; Long, H.; Tang, L.; Tu, S.; Zhang, Y.; Yi, Q. Analysis of the spatial variations of determinants of agricultural production efficiency in China. *Comput. Electron. Agric.* **2021**, *644*, 105890. [CrossRef]
2. Gollin, D.; Parente, S.; Rogerson, R. The Role of Agriculture in Development. *Am. Econ. Rev.* **2002**, *92*, 160–164. [CrossRef]
3. Caselli, F. Accounting for Cross-Country Income Differences. *Handb. Econ. Growth* **2005**, *1*, 679–741. [CrossRef]
4. Rada, N.; Liefert, W.; Liefert, O. Evaluating Agricultural Productivity and Policy in Russia. *J. Agric. Econ.* **2020**, *71*, 96–117. [CrossRef]
5. Qin, Q.Z.; Yang, X.Y. Exploring the comprehensive value of rural areas to promote urban-rural integration. *People's Forum* **2019**, *34*, 76–77. [CrossRef]
6. Zhang, Y. Influence of frequent flood disaster on agricultural productivity of rice planting and structural optimization strategy. *Microprocess. Microsyst.* **2021**, *82*, 109–121. [CrossRef]
7. Tilt, B. Smallholders and the 'Household Responsibility System': Adapting to Institutional Change in Chinese Agriculture. *Hum. Ecol.* **2008**, *36*, 189–199. [CrossRef]
8. Colin, A.; Catter Chen, J.; Chu, B. Agricultural productivity growth in China:farm level versus aggregate measurement. *China Econ. Rev.* **2003**, *14*, 53–71. [CrossRef]
9. Lin, J.Y. The Household Responsibility System Reform in China: A Peasant's Institutional Choice. *Am. J. Agric. Econ.* **1987**, *69*, 410–415. [CrossRef]
10. Luo, B.L. Introduction: Perspective on the economic effect of agricultural land right confirmation. *Res. Financ. Econ. Issues* **2022**, *6*, 1–3. [CrossRef]
11. Feng, L.; Jiang, Y.; Ye, J.P.; Zhu, K.L. Farmer's attitude in the change of rural land adjustment system in China: An empirical analysis based on the survey of 17 provinces from 1999 to 2010. *J. Manag. World* **2013**, *7*, 44–58. [CrossRef]
12. Geng, P.P. "Scale Realization" or "Technology Dissipation": How the stability of land rights affects the efficiency of farmers' agricultural production. *J. Nanjing Agric. Univ.* **2021**, *21*, 108–120. [CrossRef]
13. Hu, W.; Zhang, J.H.; Chen, Z.J. Property rights, factor allocation and investment incentives of rural households: "Short-term" or "long-term"? *Res. Financ. Econ.* **2020**, *2*, 111–128. [CrossRef]
14. Besley, T. Property Rights and Investment Incentives: Theory and Evidence from Ghana. *J. Political Econ.* **1995**, *103*, 903–937. [CrossRef]
15. Deininger, K.; Jin, S. Securing Property Rights Intransition: Lessons from Implementation of China's Rural Land Contracting Law. *J. Econ. Behav. Organ.* **2009**, *70*, 22–38. [CrossRef]
16. Brasselle, A.-S.; Frédéric, G.; Platteau, J.P. Land Tenure Security and Investment Ince-ntives: Puzzling Evidence from Burkina Faso. *J. Dev. Econ.* **2002**, *67*, 373–418. [CrossRef]
17. Newman, C.; Tarp, F.; Van Den Broeck, K. Property Rights and Productivity: The Case of Joint Land Titling in Vietnam. *Land Econ.* **2015**, *91*, 91–105. [CrossRef]
18. Ghebru, H.; Holden, S. Technical Efficiency and Productivity Differential Effects of Land Right Certification: A Quasi-experimenta Evidence. *Q. J. Int. Agric.* **2015**, *4*, 1–31. [CrossRef]
19. Qin, M.; Lin, W.; Li, J.; Wachenheim, C. Impact of land registration and certification on land rental by Chinese farmers. *Land Use Policy* **2020**, *99*, 104–121. [CrossRef]
20. Gebrie, T.; Mengistu, D. The role of rural land registration and certification program for land tenure security in Hulet Eju Enese District, Amhara National Regional State, Northwest Ethiopia. *J. Agric. Ext. Rural Dev.* **2017**, *9*, 215–222. [CrossRef]
21. Ji, X.X. Research on the Impact of Land Property Structure on Agricultural Performance. Master's Thesis, Xiangtan University, Xiangtan City, China, 2020. [CrossRef]
22. Zhuang, J.; Xie, L. Agricultural land adjustment experience, labor force non-agricultural transfer and agricultural production performance. *Res. Financ. Issues* **2022**, *8*, 22–32. [CrossRef]
23. Jin, S.; Deniniger, K. Lang Rental Markets in the Process of Rural Structural Transformat on Productivity and Equity Impacts from China. *J. Comp. Econ.* **2009**, *37*, 629–646. [CrossRef]
24. Luo, B. The market logic of rural land transfer—The analysis clue and case study of "property right intensity—Endowment effect—Trading device". *South. Econ.* **2014**, *5*, 1–24. [CrossRef]
25. Heltberg, R. Property Rights and Natural Resource Management in Developing Countries. *J. Econ. Surv.* **2002**, *16*, 339–363. [CrossRef]
26. Carter, M.R.; Olinto, P. Getting Institutions "Right" for Whom? Credit Constraints and t-he Impact of Propertyrights on the Quantity and Composition of Investment. *Am. J. Agric. Econ.* **2003**, *85*, 173–186. [CrossRef]
27. Jacoby, H.G.; Minten, B. Is Land Titling in Sub-Saharan Africa Cost-effective? Evidence From Madagascar. *World Bank Econ. Rev.* **2007**, *21*, 461–485. [CrossRef]
28. Hombrados, J.G.; Devisscher, M.; Martinez, M.H. The Impact of Land Titling on Agricultural Production and Agricultural Investments in Tanzania: A Theory-based Approach. *J. Dev. Eff.* **2015**, *7*, 530–544. [CrossRef]
29. Toulmin, C. Securing Land and Property Rights in Sub-Saharan Africa: The Role of Local Institutions. *Land Use Policy* **2008**, *26*, 10–19. [CrossRef]
30. Roy, S. Land reforms and social unrest: An empirical investigation of riots in India. *Econ. Lett.* **2012**, *115*, 249–251. [CrossRef]
31. He, X.F. Homestead withdrawal should be delayed. *Land China* **2014**, *6*, 16–17. [CrossRef]

32. Luo, M.Z.; Wan, P. How does confirmation of farmland rights affect farmland utilization? *Res. Agric. Mod.* **2019**, *40*, 984–992. [CrossRef]
33. Qian, L.; Miao, S.C.; Lu, H.L. The impact of a new round of right confirmation on farmers' farmland quality protection behavior: Empirical evidence from Guangxi. *J. Huazhong Agric. Univ.* **2020**, *1*, 28–37+162-163. [CrossRef]
34. Geng, P.P. How does the stability of land rights affect farmers' income?—From the perspective of factor allocation. *J. Econ. Manag. Agric. For.* **2020**, *19*, 611–623. [CrossRef]
35. Ji, X.Q.; Qian, Z.H. How to promote the transfer of agricultural land management right?–Empirical analysis based on the survey data of 99 villages and 896 households in Jiangsu, Guangxi, Hubei and Heilongjiang provinces (autonomous regions). *Manag. World* **2018**, *34*, 87–97+183–184. [CrossRef]
36. Ma, X.; Heerink, N.; Ierland, E.; Shi, X. Land tenure insecurity and rural-urban migration in rural China. *Pap. Reg. Sci.* **2016**, *95*, 383–406. [CrossRef]
37. Zhu, W.Y.; Luo, B.L. Agricultural land transfer, endowment effect and object discrimination: An empirical analysis based on IV-Tobit model in the context of right confirmation. *J. Agric. Tech. Econ.* **2019**, *5*, 4–15. [CrossRef]
38. Chen, H.; Lin, H.; Zou, W. Research on the Regional Differences and Influencing Factors of the Innovation Efficiency of China's High-Tech Industries: Based on a Shared Inputs Two-Stage Network DEA. *Sustainability* **2020**, *12*, 3284. [CrossRef]
39. Liu, Y.X.; Xu, H.Z. Research on the impact of rural land right confirmation on rural land transfer: From the perspective of farmer differentiation. *J. Arid. Land Resour. Environ.* **2016**, *30*, 25–29. [CrossRef]
40. Galiani, S.; Schargrodsky, E. Property Rights for the Poor: Effects of Land Titling. *J. Public Econ.* **2010**, *94*, 700–729. [CrossRef]
41. Lin, W.S.; Yang, C.F.; Wang, Z.G. Analysis of the effect of farmland right confirmation on the transfer of farmland management rights in China:an empirical analysis based on the data of H Province from 2009 to 2014. *J. Hunan Agric. Univ.* **2016**, *17*, 15–21. [CrossRef]
42. Alchian, A. Some Implications of Recognition of Property Right Transactions Costs. In *Economics Social Institutions*; Springer: Dordrecht, The Netherlands, 1979; Volume 1, pp. 233–254. [CrossRef]
43. Zhou, Q.R. Rural Reform in China: Changes in the relationship between state and ownership (Part 1): A review of the history of economic system changes. *Manag. World* **1995**, *3*, 178–189+219–220. [CrossRef]
44. Yami, M.; Snyder, K.A. After All, Land Belongs to the State: Examining the Benefits of Land Registration for Smallholdersin Ethiopia. *Land Degrad. Dev.* **2016**, *3*, 465–478. [CrossRef]
45. Jin, S.; Jayne, T.S. Land Rental Markets in Kenya: Implications for Efficiency, Equity, Household Income, and Poverty. *Land Econ.* **2013**, *89*, 246–271. [CrossRef]
46. Li, M.Y. The impact of labor transfer on regional farmland use efficiency: An econometric analysis based on provincial panel data. *Land Sci. China* **2011**, *25*, 62–69. [CrossRef]
47. Feng, S.; Heetink, N. Are Farm Households' Land Renting and Migration Dicisions Inter-related in Rural China? NJAS-Wageniggen. *J. Life Sci.* **2008**, *55*, 345–362. [CrossRef]
48. Janvry, A.; Emerick, K.; Gonzalez-Navarro, M.; Sadoulet, E. Delinking Land Rights from Land Use: Certification and Migration in Mexico. *Meet. Pap.* **2015**, *105*, 3125–3149. [CrossRef]
49. Valsecchi, M. Land property rights and international migration: Evidence from Mexico. *J. Dev. Econ.* **2014**, *110*, 276–290. [CrossRef]
50. Zhang, L.; Jin, J.; He, J.; Liu, K.W. Does farmland right confirmation promote labor transfer?—Empirical analysis based on CLDS data. *Rev. Ind. Econ.* **2018**, *5*, 88–102. [CrossRef]
51. Schweigert, T.E. Land Title, Tenure Security, Investment and Farm Output: Evidence for Guatemala. *J. Dev. Areas* **2006**, *40*, 115–126. [CrossRef]
52. Deininger, K. Moving off the Farm: Land Institutions to Facilitate Structural Transformation and Agricultural Productivity Growth in China. *World Dev.* **2014**, *59*, 505–520. [CrossRef]
53. Deininger, K.; Ali, D.A.; Alemu, T. Impacts of Land Certification on Tenure Security, Investment, and Land Market Participation: Evidence from Ethiopia. *Land Econ.* **2011**, *87*, 321–334. [CrossRef]
54. Zhao, K.; Liu, L. Understanding and thinking on perfecting rural land contract management system and developing agricultural moderate scale management. *Chin. Agric. Abstr.-Agric. Eng.* **2017**, *29*, 3–6. [CrossRef]
55. Chen, H.; Shi, Y.; Xu, M.; Xu, Z.; Zhou, W. China's industrial green development and its influencing factors under the background of carbon neutrality. *Environ. Sci. Pollut. Res.* **2022**. [CrossRef] [PubMed]
56. Chen, H.; Shi, Y.; Zhao, X. Investment in renewable energy resources, sustainable financial inclusion and energy efficiency: A case of us economy. *Resour. Policy* **2022**, *77*, 102680. [CrossRef]
57. Chen, H.; Yang, Y.; Yang, M.; Huang, H. The impact of environmental regulation on China's industrial green development and its heterogeneity. *Front. Ecol. Evol.* **2022**, *10*, 967550. [CrossRef]
58. Xu, Y.; Li, S.; Zhou, X.; Shahzad, U. How environmental regulations affect the development of green finance: Recent evidence from polluting firms in China. *Renew. Energy* **2022**, *189*, 917–926. [CrossRef]
59. Zhao, X.; Ma, X.; Shang, Y.; Yang, Z.; Shahzad, U. Green economic growth and its inherent driving factors in Chinese cities: Based on the Metafrontier-global-SBM super-efficiency DEA model. *Gondwana Res.* **2022**, *106*, 315–328. [CrossRef]
60. Liu, P.; Zhang, L.; Tarbert, H.; Yan, Z. Analysis on Spatio-Temporal Characteristics and Influencing Factors of Industrial Green Innovation Efficiency—From the Perspective of Innovation Value Chain. *Sustainability* **2022**, *14*, 342. [CrossRef]

61. Zhang, L.; Ma, X.; Ock, Y.-S.; Qing, L. Research on Regional Differences and Influencing Factors of Chinese Industrial Green Technology Innovation Efficiency Based on Dagum Gini Coefficient Decomposition. *Land* **2022**, *11*, 122. [CrossRef]
62. Chien, F.; Ajaz, T.; Andlib, Z.; Chau, K.Y.; Sharif, A. The role of technology innovation, renewable energy and globalization in reducing environmental degradation in Pakistan: A step towards sustainable environment. *Renew. Energy* **2021**, *177*, 308–317. [CrossRef]