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Research on the Influence Mechanism of Land Tenure Security on Farmers' Cultivated Land Non-Grain Behavior

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Abstract: Cultivated land planting structure is directly related to China's food security. The Central Rural Work Conference in 2021 pointed out that to ensure food security, attention should be paid to the adjustment of planting structure. Therefore, it is necessary to explore whether land tenure security has an impact on farmers' cultivated land non-grain behavior. Based on the micro survey data of 550 farmers in the Guanzhong Plain, this paper explores the impact of land tenure security on farmers' cultivated land non-grain behavior with the help of the OLS model and the Binary Probit model, and further explores its internal transmission mechanism through the mediation effect model. It is found that land tenure security significantly promotes farmers' cultivated land non-grain behavior. After replacing model estimation, core variables for robustness tests, and solving endogeneity problems, the research conclusion is still valid. The analysis of the influence mechanism shows that land tenure security affects farmers' cultivated land non-grain behavior by increasing land transfer and agricultural productive investment. Among them, agricultural productive investment has the greatest impact, followed by land transfer. In addition, the study also found that land tenure security can promote their cultivated land non-grain behavior by strengthening their credit availability for farmers with low fragmentation. Heterogeneity analysis results show that off-farm employment and social services can effectively alleviate the impact of land tenure security on farmers' cultivated land non-grain behavior. This paper provides a new research perspective for analyzing the incentives of cultivated land non-grain from the micro-mechanism. At the same time, it revealed the inner root of the government's predicament in the governance of cultivated land non-grain. It provided a new reference for the government to formulate new policies for managing non-grained cultivated land.

Keywords: land tenure security; cultivated land non-grain; land transfer; productive investment; credit availability

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1. Introduction

Ensuring food security is the "ballast" to maintain social stability. As the most important carrier of food production, cultivated land is an important resource guarantee for the realization of national food security. According to the data of the United Nations Food and Agriculture Organization from 1970 to 2005 to analyze the changes in cultivated land resources in various countries, it is found that the growth rate of cultivated land resources lags behind the population growth rate. In addition, due to the relatively low returns from growing grains, the use of cultivated land in various countries has been shifting to non-grain crops. Under the dual threats of the relative reduction of cultivated land resources and the non-grain utilization of cultivated land, food security has become an urgent problem for countries to solve. As of 2018, China's cultivated land area was 1,432,960 square kilometers, but the per capita cultivated land area was only 0.00093 square kilometers, ranking 126th in the world. Although China's grain production capacity has steadily improved in recent years. However, due to the combined effects of upgrading

residents' consumption structure, the adjustment of the agricultural industry structure, the rising cost of agricultural production, and the increasing impact of climate change [1], China's food security still faces severe challenges. As the most crucial carrier of food production, cultivated land is a vital resource guarantee for the realization of national food security. The loss of cultivated land in China accounts for a quarter of the world's total loss [2], and the non-grain rate of cultivated land is about 27%, which is gradually expanding [3]. In addition, although cultivated land non-grain does not substantially change the agricultural use of cultivated land, it has led to a significant increase in the application of fertilizers and pesticides on cultivated land and caused severe damage to the agricultural ecosystem. Therefore, under the strategic background of "basic self-sufficiency of grains and absolute security of food rations", continuously strengthening the dynamic monitoring and management of the quantity and quality of cultivated land and curbing the phenomenon of non-grain of cultivated land plays a key role in ensuring China's food security [4].

The cultivated land non-grain is generally regarded as an adjustment to cultivated land use. That is, the transition from the cultivation of food crops to the cultivation of cash crops also includes the abandonment of cultivated land and the planting of trees and other non-food cultivation practices [5]. In recent years, scholars have conducted extensive and in-depth discussions on the issue of non-grain of cultivated land. From a macro perspective, scholars have mainly researched the temporal and spatial evolution characteristics and influencing factors of non-grain cultivated land from the national and regional levels. For example, Meng et al. [5] found that the "non-grain" level of China's overall cultivated land showed a fluctuating trend in time series, and generally showed a trend of gradually increasing from northeast to southwest in space. Zhang et al. [6] found that the non-grain rate of cultivated land in Guangdong Province showed a fluctuating upward trend. Some scholars have pointed out that many factors, such as economic benefits, labor force characteristics, technical level, policy environment, and resource endowment, will significantly impact cultivated land non-grain. From a microscopic perspective, some scholars have discussed why cultivated land is non-grain at the farmer level. Studies have found that land transfer, farmland rent, and land fragmentation can impact the non-grain status of cultivated land. Gao et al. [7] found that farmland transfer-in significantly promoted the non-grain adjustment of the planting structure, and the risk preference of farmers would strengthen the impact of farmland transfer-in on the non-grain of the planting structure. However, Zeng et al. [8] found an inverted U-shaped relationship between the area of land transfer and the planting ratio of non-grain crops, and the land transfer does not necessarily lead to the problem of non-grain crops. Luo et al. [9] believed that the phenomenon of non-grain is strictly context-dependent, and compared with large-scale farmland transfer-in households, small-scale farmland transfer-in households tend to have non-grain production.

As the essential condition that China's agricultural production has always relied on, the property rights of agricultural land are the core of the optimal allocation of resources [10]. The land rights system with clear ownership is the cornerstone of agricultural development [11]. In addition, ensuring land tenure security is of great significance to promoting moderate-scale agricultural operations, achieving effective allocation of production factors, and promoting agricultural modernization. A large number of scholars have found that land tenure security has a significant impact on farmland investment [12], cultivated land quality [13], production efficiency [14], and green production [15]. The stability of farmland property rights will lead to changes in agricultural investment and land factor input, ultimately affecting households' decisions to pursue grain and non-grain planting by affecting farmers' income. However, few scholars have studied the influence of land tenure security on cultivated land non-grain. Based on this, this paper uses the survey data of micro-farmer households in the main grain-producing areas of the Guanzhong Plain to construct a theoretical analysis framework of "land tenure security—non-grain". It uses OLS, the mediation effect model, and other econometric models to assess the relationship

between land tenure security and cultivated land non-grain. The specific research purposes are: (1) To explore the impact mechanism of the land tenure security on the cultivated land non-grain, in order to provide a reference for preventing excessive control in the management and control of cultivated land use. (2) To provide a new perspective for the study of cultivated land non-grain. (3) To provide decision-making reference for ensuring regional food security.

2. Theoretical Analysis and Research Hypotheses

As a reflection of the grass-roots government's implementation of the national will, the confirmation and issuance of agricultural land rights have legal effects and can effectively improve land tenure security. It is an essential manifestation of land tenure security. Improving land tenure security can strengthen the exclusivity of agricultural land use rights and ensure the exclusive right to benefit [16]. First, from the perspective of strengthening the exclusive right to use, stabilizing land rights can reduce vicious disputes caused by the blurring of cultivated land boundaries due to village collectives' adjustment of cultivated land and strengthen farmers' actual farmland management rights [17]. Because the planting of commercial crops often has the characteristics of sizeable initial input and extended output period. When land rights are unstable, farmers are more inclined to plant food crops with short production cycles, worrying that their initial investment will be wasted. Land tenure security has dramatically alleviated the risk of farmland use. Due to the goal decision-making mechanism of maximizing benefits, in the absence of rigid regulations, planting commercial crops has become a more rational choice for farmers, leading to the non-grain choice of family farmland. The area continued to increase. Second, from the perspective of guaranteeing the exclusive right to enjoy income, land tenure security is conducive to improving farmers' future income expectations [18] and enhancing farmland's intrinsic value. Based on the expectation of higher income value in the future and the improvement of the intrinsic value of land, farmers are more willing to plant higher-yielding cash crops, thus promoting the trend of non-grain-based cultivated land resources. Therefore, this paper proposes Hypothesis 1:

Hypotheses 1 (H1). *The increase in land tenure security will promote farmers to produce cultivated land with non-grain behavior*.

Confirming farmland property rights can promote farmland transfer-in by stimulating agricultural production [19] and reducing transaction costs [20]. The new round of confirmation of agricultural land rights further clarifies the boundary of property rights, alleviates the loss of agricultural income caused by problems such as public domain and rental value dissipation caused by blurred boundaries, and stimulates farmers to expand agricultural production and increase farmland transfer-in. Moreover, land ownership is a dominant and absolute right enjoyed by the state or peasant collectives on the land owned by them according to law. The method of legal empowerment of agricultural land rights confirmation strengthens the stability expectation of agricultural land use rights. On the one hand, land tenure security can reduce the frequency of village collective adjustment of farmland and thus reduce cost losses. On the other hand, land tenure security can reduce the information asymmetry between the transaction parties. It can alleviate the problem of increased costs caused by the transferee in the process of pre-information search, negotiation, coordination and signing, and post-contract implementation and maintenance due to incomplete farmland information [21]. Luo et al. [9] believed that the phenomenon of non-grain is strictly context-dependent. Under the closed management conditions of abundant agricultural labor and lack of agricultural socialization services, small-scale farmland transfer-in households are required to improve their labor and land utilization. It will expand the planting scale of economic crops, and is more inclined to expand the cultivated land non-grain area. Therefore, this paper proposes Hypothesis 2:

Hypotheses 2 (H2). *The increase of land tenure security can promote farmers' behavior of transferring farmland, thus increasing the cultivated land's non-grain behavior*.

Confirming farmland property rights will enhance the future tradability of farmland [19], and strengthen the stable expectation that farmers can increase investment in farmland at the current stage and recover costs due to the appreciation of farmland in the future [22]. In addition, farmland has the status symbol of farmers, and confirmation of rights will strengthen the emotional dependence and survival dependence of farmland to bring about an "agriculture complex" and "cherishing soil" [23]. At this time, the stability of land rights will further stimulate farmers' protective investment in agricultural land. In addition, farmland ownership can facilitate soil fertility management through more diverse and soil-friendly cropping practices [24], thereby increasing investment in farmland. As family farmland investment increases, it is easy to lead to investment lock-in and sunk costs, and the income of food crops with relatively low returns cannot support the increased investment costs. Therefore, farmers are more rationally willing to choose to plant commercial crops, reducing the planting and operation cycle and obtaining higher income. Therefore, this paper proposes Hypothesis 3:

Hypotheses 3 (H3). *The increase of land tenure security can promote farmers to increase agricultural productive investment, thus increasing the cultivated land non-grain behavior*.

Information asymmetry and lack of adequate collateral are the main barriers for farmers to obtain loans [6,25]. De Soto believes that property rights reform can suppress the problem that factors cannot be capitalized due to unclear property rights and eventually become sleepy capital [26]. As an important measure for the reform of agricultural land property rights, the confirmation of agricultural land rights helps to form a formal property rights expression mechanism for agricultural land [27], thereby improving the value, liquidity, and liquidity of agricultural land. At this time, farmers can Increase their credit availability through farmland mortgages. On the one hand, for farmers, obtaining loans can increase household disposable funds, strengthen farmers' confidence in agricultural production, and increase their enthusiasm for investment in agricultural production. Therefore, after obtaining a loan, farmers are more willing to choose cash crops with high initial costs but high future income to obtain higher household income. On the other hand, borrowing funds is also accompanied by the future cost pressure of repaying funds. In order to reduce the pressure of repaying loans and improve the turnover of funds, farmers are more willing to choose to plant non-food crops with relatively high future returns and short fund recovery periods. Farmers will reduce the acreage of household grain crops at this time, thereby increasing the cultivated land's non-grain area. Therefore, this paper proposes Hypothesis 4:

Hypotheses 4 (H4). *The increase of land tenure security can improve the credit availability of farmers, thus increasing the cultivated land non-grain behavior*.

Based on the above analysis, the analysis framework is shown in Figure 1.

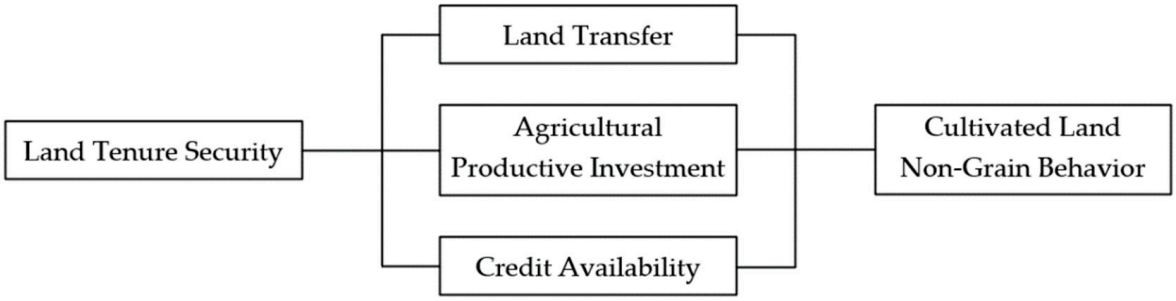


Figure 1. Analysis framework.

3. Materials and Methods

3.1. Data Sources

The data in this article comes from a questionnaire survey of farmers conducted by the research group in Guanzhong Plain from January to February 2020. The main reasons for choosing the Guanzhong Plain for research are: Guanzhong Plain is a substantial grain production base in China. According to the results of a special spot check on non-grain carried out by the Shaanxi Survey Team in 74 administrative villages in 20 cities across the province, the cultivated land non-grain ratio in this region is 35.1%, which is significantly higher than the national average of 27%. Therefore, selecting the plain as the study area is of great significance. The specific sampling process is as follows: First, based on careful consideration of the level of grain production and regional economic development, the research team selected Xingping, Jingyang, Pucheng, and Fuping to form a first-level sampling frame; secondly, based on considering the grain production situation within the county and the feasibility of investigation, 2–3 townships are selected, and 3–4 administrative villages are selected from each township; finally, each village randomly selects 10–20 farmers who can represent the overall characteristics of the region. The research group distributed 600 questionnaires in this survey, outliers and invalid questionnaires were excluded, and 550 valid questionnaires were finally obtained, with an effective rate of 91.67%. The farmer questionnaire survey mainly adopts the one-to-one interview method, which mainly includes the family population structure, income and expenditure status, crop input and output status, farmland property rights allocation, and land transfer status of wheat farmers. The village questionnaire mainly conducts interviews with village cadres who know the village's situation, including the village's population structure, the structure of grain planting, and the village's economic development.

3.2. Variable Description

3.2.1. Explained Variable: Non-Grain Behavior

In the related studies on the non-grain transformation of cultivated land, scholars often use "whether to plant grain" [28], "the proportion of food crops planted" or "the proportion of commercial crops planted area to the cultivated land area" to characterize non-grain crops. This paper refers to the existing research and adopts "(arable land area—grain planting area)/arable land area" to characterize cultivated land non-grain behavior.

3.2.2. The Core Independent Variable: Land Tenure Security

Regarding the measurement of land tenure security, existing scholars have primarily characterized it from the perspectives of land contracts, whether the rights are confirmed, and whether they have undergone adjustments [29–32]. The land contract certificate has the national will and legal effect, so this paper uses whether the farmer has obtained a new round of land contract certificates to measure the stability of land rights [21].

3.2.3. Mediating Variables: Land Transfer, Agricultural Productive Investment, Credit Availability

Mediating variables: land transfer, agricultural productive investment, credit availability. In order to test the mechanism by which the stability of land rights affects non-grain, this study selects "whether there is land transferred" in the questionnaire to identify the land transfer variable, and "whether to increase agricultural productive investment" to identify the agricultural productive investment variable. In addition, the credit availability variable is identified by "Whether there are formal or informal channels for loan".

3.2.4. Control Variables

Control variables. This paper draws on the research of scholars such as Xie [33], Liu and Zhang [28] selects the control variables based on the actual conditions of the research area. There are six main aspects: individual characteristics of farmers, family characteristics, plot characteristics, policies, villages, and region variables. Among them,

individual characteristic variables of farmers include three variables: age, education level, and annual farming time; family characteristic variables mainly include three variables of the labor force, share of off-farm household income and cooperative hire machinery; plot characteristic variables mainly include cultivated land quality, water conservancy Conditions and the convenience of mechanized operation are three variables; the policy variable is food policy satisfaction; the village variable is the road of tractors in villages. The selection of these variables can better control the impact of social capital, human capital, physical capital, and resource endowment on farmers' behavioral decision-making. Finally, to weaken the external interference caused by the study area selection, such as the natural geographical environment and the level of economic development, this paper intends to introduce a city dummy variable for control. Table 1 shows all the variables used in the study and the descriptive statistics.

Table 1. Variable meaning and description statistics.

Variables	Definition	Mean	SD
Non-grain behavior	(Area of cultivated land—area of food crops)/Area of cultivated land	0.205	0.338
Land tenure security	Whether to obtain a new round of confirmed land contract certificate	0.755	0.431
Land transfer	whether to transfer the land	0.176	0.381
Agricultural productive investment	Whether to increase agricultural productive investment	0.707	0.455
Credit availability	Whether the loan is made through formal or informal channels	0.304	0.460
Age	Age of agricultural decision-makers when surveyed (year)	60.589	9.940
Education level	The actual years of education of agricultural decision makers (year)	7.164	3.293
Annual farming time	Time spent by agricultural decision-makers on farming in a year (month)	8.662	4.196
Labor force	Number of the household labor force (person)	3.485	1.244
Share of off-farm income	Household off-farm income/Total household income	0.801	0.216
Cooperative hire machinery	Whether to jointly employ machinery with farmers in adjacent plots: No = 0; Yes = 1	0.513	0.500
Cultivated land quality	Fertility of operating land: Fertile = 3; Average = 2; Barren = 1	2.278	0.691
Water conservancy conditions	Whether there are drainage ditches, canals, etc. in the field: No = 0; Yes = 1	0.778	0.416
The convenience of mechanized operation	The degree of convenience of mechanized operation on the operating plot: very convenient = 5; relatively convenient = 4; general = 3; not very convenient = 2; very inconvenient = 1	4.109	0.901
Food policy satisfaction	Satisfaction with the relevant food policies issued by the state: very satisfied = 5; somewhat satisfied = 4; general = 3; not very satisfied = 2; very dissatisfied = 1	3.089	1.021
Farming machinery roads in villages	Is there a farming machinery road in the village: No = 0; Yes = 1	0.507	0.500

3.3. Methods

3.3.1. Benchmark Regression Model

This paper mainly discusses the influence of land tenure security on the non-grain of cultivated land. Since the explained variable is mainly the proportion of the non-grain area of cultivated land, its value is a continuous variable from 0 to 1, so this paper chooses the least squares method. (OLS) is used to estimate the benchmark regression model, so the benchmark model is set as follows:

$$Y_i = \beta_0 + \beta_1 X_i + \beta_2 Control_i + \varepsilon_i \quad (1)$$

In Formula (1), Y_i represents farmer i's non-grain behavior, X_i represents farmer i's land tenure security, and $Control_i$ represents the control variables, including individual characteristics of farmers, family characteristics, plot characteristics, policies, villages, and regions. The dummy variable has five parts. β_0 are constant terms, β_1 and β_2 are coefficients to be estimated, and ε_i are random disturbance terms.

3.3.2. Mediation Effect Model

To test whether land tenure security will affect the farmers 'cultivated land non-grain behavior by affecting farmers' land transfer behavior, agricultural productive investment behavior, and farmers' loan credit availability. Drawing on the research of Wen et al. [34] and Hayes [35], this paper constructs the following mediation effect model:

$$Y_i = \theta_0 + \theta_1 X_i + \theta_2 Control_i + \delta_i \quad (2)$$

$$M_i = \alpha_0 + \alpha_1 X_i + \alpha_2 Control_i + \varphi_i \quad (3)$$

$$Y_i = \chi_0 + \chi_1 X_i + \chi_2 M_i + \chi_3 Control_i + \sigma_i \quad (4)$$

In the above model, M_i is an intermediary variable, representing the land transfer, agricultural productive investment, and credit availability of I farmers. θ_0, α_0 and χ_0 are constant terms. θ_1, θ_2, α_1, α_2, χ_1, χ_2, and χ_3 are the coefficients to be estimated. δ_i, φ_i and σ_i are random disturbance terms. Other variables related to model (1) are consistent. The steps to test whether there is a mediation effect are as follows: First, test whether the regression coefficient θ_1 in Formula (2) is significant. If it is significant, test the coefficients α_1 and χ_2 to determine whether they are notable. If both coefficients are significant, the mediation test has passed, and you can continue to test χ_1 whether it is significant. Significant means that there is a partial mediating effect, and non-significant implies a complete mediating impact. If at least one of the two coefficients is not significant, the Sobel test needs to be used to judge the existence of the mediating effect. The specific judgment process is shown in Figure 2.

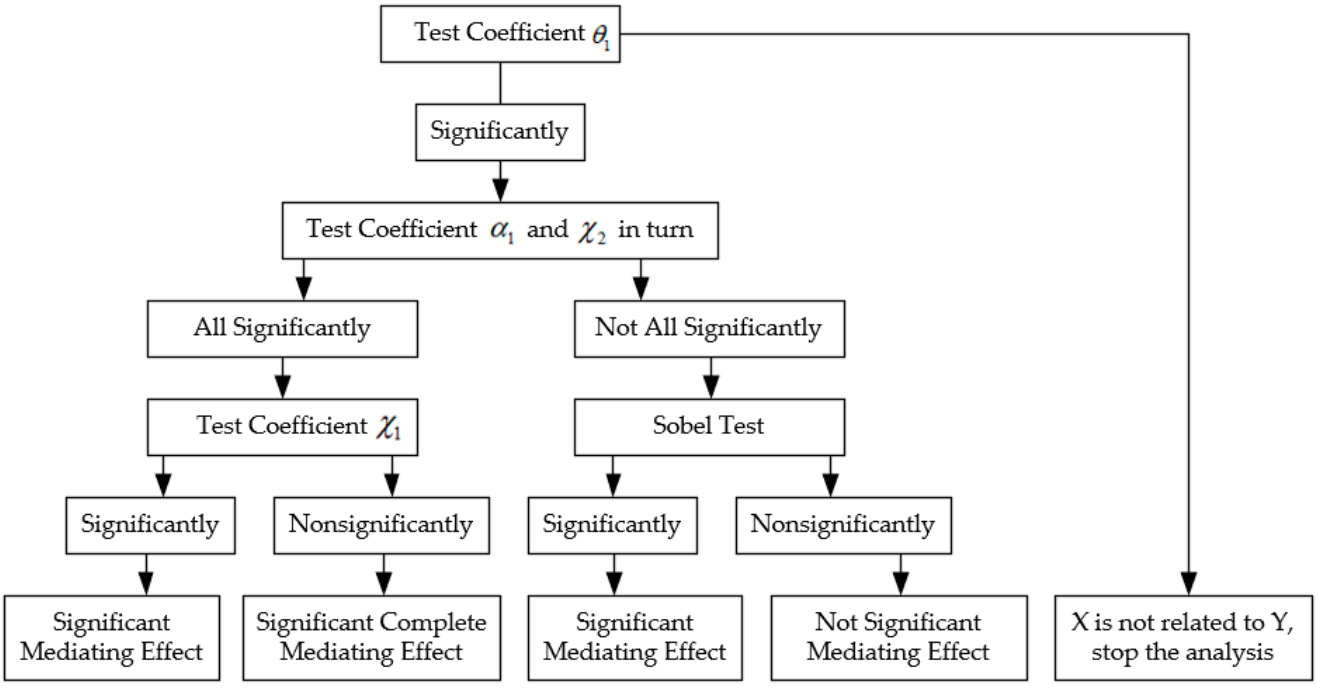


Figure 2. Mediation Effect Test Program.

4. Results

4.1. Benchmark Regression

Before performing the benchmark regression, the multicollinearity diagnosis was performed first, and the test results showed that the VIF values of all variables were less than 1.8, and the average value was 1.43 and less than 10, so there was no multicollinearity problem between the variables. In this study, stata16.1 was used for fitting, and the regression results are shown in Table 2. The results of regression 1 show that land tenure security, characterized by a new round of confirmation and issuance of certificates, has a

positive impact on farmers' non-grain behavior at a significant level of 1%. This shows that the more stable land rights are, the more farmers are inclined to plant cash crops in the decision-making of planting choices. Hypothesis 1 was initially verified. The reason may be that land tenure security will strengthen the exclusivity of its use rights. The emotional value and security value brought by the enhancement of ownership perception will prompt farmers to increase the protection of cultivated land, resulting in an increase in their cost input. Due to the burden of increased costs, farmers will choose to grow cash crops with higher yields. Moreover, land tenure security will also ensure the exclusiveness of its income. It is a rational choice for farmers to choose economic crops with higher income rather than food crops.

Table 2. Land tenure security and cultivated land non-grain.

Variables	Regression 1: OLS	Regression 2: OLS	Regression 3: Probit	
	Baseline Regression	Substitute Independent Variable	Substitute Dependent Variable	
	Coefficient	Coefficient	Coefficient	Marginal Effect
Land tenure security	0.129 *** (0.031)		1.01 *** (0.188)	0.276
Number of land adjustments		−0.078 ** (0.035)		
Age	−0.005 *** (0.001)	−0.005 *** (0.001)	−0.022 *** (0.008)	−0.006
Education level	0.000 (0.004)	0.002 (0.004)	0.012 (0.02)	0.003
Annual farming time	0.012 *** (0.003)	0.012 *** (0.003)	0.065 *** (0.018)	0.018
Labor force	0.027 ** (0.011)	0.026 ** (0.011)	0.137 ** (0.059)	0.038
Share of off-farm income	−0.174 *** (0.064)	−0.163 ** (0.065)	−1.215 *** (0.325)	−0.332
Cooperative hire machinery	−0.095 *** (0.026)	−0.094 *** (0.026)	−0.348 *** (0.129)	−0.095
Cultivated land quality	0.009 (0.019)	0.008 (0.019)	−0.02 (0.094)	−0.006
Water conservancy conditions	0.047 (0.032)	0.056 * (0.032)	0.341 ** (0.164)	0.093
The convenience of mechanized operation	−0.067 *** (0.015)	−0.071 *** (0.015)	−0.229 *** (0.075)	−0.063
Food policy satisfaction	−0.01 (0.016)	−0.008 (0.016)	−0.097 (0.079)	−0.027
Road of tractors in villages	−0.118 *** (0.033)	−0.123 *** (0.033)	−0.434 *** (0.162)	−0.119
County area	control	control	control	control
Constant term	0.695 (0.14)	0.808 (0.138)	1.068 (0.712)	
Adj R^2/Pseudo R^2	0.252	0.235	0.23	-
Sample size	550	550	550	550

Note: Regression 1 and 2 dependent variables are the behavior of non-grain of cultivated land; regression 3 dependent variable is whether non-grain transformation; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$; Robust standard error in brackets.

Among the personal characteristics, age has a negative impact on "non-grain-oriented" behavior at a significant level of 1%. On the one hand, older farmers have a lower level of labor endowment, and they can only choose to grow food crops with low labor requirements; poor. The annual farming time is significantly positive, indicating that the farmers who spend less time farming in a year have a worse non-grain situation. Most of these farmers are part-time households. To avoid idle land, they choose to plant the most convenient food crops, but most of them focus on extensive management, and the efficiency of food production is low.

Among household characteristics, the number of laborers significantly positively impacts the non-grain situation. It may be because a large number of laborers means that the household's daily expenses are too large. Understanding how to maximize the benefits under the limited land is the key to alleviating the cost of household living and production. Therefore, farmers' cultivated land non-grain behavior intensified. The share of off-farm household income negatively affects non-grain behavior. The possible reason is that the family's work focus has shifted from agriculture to off-farm employment, so choosing the food crops that occupy the least amount of family labor in agriculture is inevitable. The co-employment mechanistic variable significantly negatively affects "grain-free" behavior at the 1% level. It shows that cooperative purchasing social services such as machine farming

among farmers in adjacent plots can significantly alleviate the "non-grain" behavior. This behavior can alleviate the difficulties in implementing social services caused by land fragmentation in my country and is conducive to allowing small farmers to enjoy scale effect dividends. Among the plot characteristics, the convenience of mechanized operation significantly negatively affects the behavior of non-grain at the level of 1%. The high degree of comfort of mechanized operation means that the land is relatively flat, and the area is considerable. On the one hand, it is convenient to realize the scale effect, thus increasing the probability of farmers choosing to grow food crops. Among the policy variables, although the food policy satisfaction is negative, it is not significant, indicating that the current grain policy still lacks a certain degree of strength in alleviating the non-grain of cultivated land. Among the village variables, the road of tractors in villages negatively affects the behavior of non-grain at a significant level of 1%, indicating that establishing and improving modern rural infrastructure can alleviate the non-grain of cultivated land.

4.2. Robustness Check

To further verify the impact of land tenure security on cultivated land non-grain behavior, this paper uses the method of replacing critical independent and dependent variables to ascertain the robustness of the benchmark regression. Drawing on the research of Yu et al. [36], the stability of land rights is represented by the number of land adjustments. The more frequent land adjustments are, the more unstable the land rights are. The results of regression 2 show that the number of land adjustments negatively affects the behavior of non-grain at a significant level of 5%, indicating that the more stable land rights are, the more intensified the non-grain behavior, which is consistent with the benchmark regression results.

In order to enhance the robustness of the benchmark regression results, the dependent variable was replaced again, and the "non-grain" status was replaced by whether the cultivated land was non-grain. Then, use the Probit method to regress again. Since the Probit regression coefficient has no practical significance, the paper further calculates its marginal effect. The results show that the significant level and sign of land tenure security are consistent with the benchmark regression. Compared with the farmers who have not confirmed the right and issued the certificate, the probability of the farmers who have obtained the land contract certificate choosing to plant economic crops has increased by 27.6%. The influence of land tenure security on cultivated land non-grain behavior is verified again, and Hypothesis 1 is verified.

4.3. Analysis of Endogenous Problems

Since many factors affect land tenure security and the non-grain of cultivated land, although some main factors are controlled in this paper, there may still be the problem of missing variables. In this paper, we try to construct the "proportion of other sample farmers in the village except for the farmer in the new round of confirmation and issuance of certificates" as an instrumental variable to solve the endogeneity problem to avoid the deviation of the estimated results caused by missing variables. This instrumental variable reflects the status of village ownership confirmation and certification and satisfies the correlation requirement with the explanatory variable for the stability of land ownership. At the same time, this variable will not directly affect farmers' planting decisions and meet exogenous requirements. The results in Table 3 show that the DWH test is significant at the 1% significance level, indicating that the model does have an endogeneity problem. The F value of the first stage is 18.092 (greater than 10), indicating no problem with weak instrumental variables in selecting instrumental variables [37]. After solving the endogenous problem, the influence coefficient of land tenure security on the non-grain behavior is still significantly positive, which indicates that the stability of land tenure still positively promotes farmers' cultivated land non-grain behavior. Hypothesis 1 was verified again.

Table 3. Instrumental variable test.

Variable	Land Tenure Security	Non-Grain Behavior
The proportion of other farmers in the same village except the farmer confirming rights and issuing certificates	0.536 *** (0.126)	
Land tenure security		0.561 *** (0.191)
Control variable	control	control
F value of the first stage	18.092	
Wald's test		188.62 ***
DWH test	7.467 ***	
Sample size	550	550

Note: *** $p < 0.01$; The standard error of robustness is in brackets; The control variables are consistent with Table 2.

4.4. Examination of the Mechanism of Action

The above theoretical analysis shows that land tenure security may affect cultivated land non-grain behavior through farmers' land transfer, agricultural productive investment, and credit availability. In this paper, the mediation model of teacher Wen Zhonglin is used for verification, and then the Bootstrap method is used for confirmation. The results are shown in Table 4.

Table 4. Mechanism of action test.

Mediation Model	Land Transfer Intermediary Inspection		Agricultural Productive Investment Intermediary Inspection		Credit Availability Intermediary Test	
	Regression 1	Regression 2	Regression 3	Regression 4	Regression 5	Regression 6
	Land Transfer	Non-Grain Behavior	Agricultural Productive Investment	Non-Grain Behavior	Credit Availability	Non-Grain Behavior
Land tenure security	0.125 *** (0.037)	0.109 *** (0.031)	0.422 *** (0.044)	0.082 ** (0.033)	0.020 (0.045)	0.125 *** (0.029)
Land transfer		0.157 *** (0.036)				
Agricultural productive investment				0.110 *** (0.030)		
Credit availability						0.212 *** (0.028)
Constant term	0.486 (0.167)	0.619 (0.139)	0.695 (0.140)	0.711 (0.198)	1.069 (0.205)	0.469 (0.136)
Control variable	control	control	control	control	control	control
Sobel test	0.020 *** (0.007)		0.047 *** (0.014)		0.004 (0.010)	
Bootstrap test	95% confidence interval					
	lower limit	upper limit	lower limit	upper limit	lower limit	upper limit
Indirect effect	0.004	0.035	0.023	0.070	−0.015	0.023
Direct effect	0.058	0.161	0.024	0.141	0.071	0.178
Sample size	550		550		550	

Note: ***$p < 0.01$, **$p < 0.05$; The standard error of robustness is in brackets; The control variables are consistent with Table 2.

4.4.1. Land Transfer Mechanism

Regression 1 shows that land tenure security has a positive impact on land transfer, indicating that land tenure security will promote farmers to transfer land, which is consistent with the existing research results. The results of regression 2 show that land transfer and land tenure security are positively significant to the non-grain behavior, and the Sobel test is significant at the 1% significance level, indicating that the mediating effect of land transfer does exist and is significant. Through further calculation, the proportion of the intermediary effect of land transfer is 15.21%. In order to further test the existence of the mediating effect, this paper uses the Bootstrap method again to verify the results. The results show that the upper and lower limits of the indirect effect and the direct effect do not contain 0, again indicating that the mediating effect of land transfer is significant, and Hypothesis 2 is verified.

4.4.2. Agricultural Productive Investment Mechanism

The results of regression 3 show that land tenure security has a positive and significant impact on agricultural productive investment, indicating that land tenure security can positively promote farmers to increase agricultural productive investment. The results of regression 4 show that land tenure security and agricultural productive investment are positively significant to non-grain behavior. The Sobel test is significant at the 1% significance level, indicating that the mediating effect of agricultural productive investment exists and is significant. The proportion of the intermediary effect obtained after the calculation is 35.95%. The proportion of the intermediary effect is relatively large, indicating that agricultural productive investment is a transmission mechanism that cannot be ignored between land tenure security and the cultivated land non-grain. Bootstrap results show that the upper and lower bounds of the indirect and direct effects do not contain 0, again verifying the existence of hypothesis 3 of the mediating effect of agricultural productive investment.

4.4.3. Credit availability Mechanism

The results of regression 5 show that land tenure security has no significant effect on credit availability. The results of regression 6 show that land tenure security and credit availability are significantly higher than non-grain behavior. The Sobel test is performed to verify the intermediary effect, whether it exists or not, and the result is not significant. The Bootstrap method is used to verify the results again, and the results do not change. It shows that land tenure security does not affect cultivated land non-grain behavior through credit availability, which is inconsistent with the theoretical analysis results. The possible reason for this result is that the current situation of farmland fragmentation in China is relatively apparent. Even if the farmer households confirm the farmland rights and issue certificates, the degree of fragmentation of their plots has not been significantly improved. Even if farmers use farmland for mortgage loans, the excessively high land fragmentation at this time may cause banks to face high unilateral transaction costs when disposing of farmland collateral, which will ultimately significantly reduce the availability of farmers' mortgage loans. This paper classifies farmers according to the sample farmers' mean value of land fragmentation. It conducts the mediation effect test again for the sample farmers lower than the mean value of land fragmentation. The estimation results show that for the sample farmers whose land fragmentation is lower than the mean value, the stability of their land rights has a significant positive impact on their credit availability. It shows that farmers with a low degree of fragmentation land tenure security can promote their loans. At the same time, the estimation results show that credit availability and land tenure security significantly and positively impact farmers' cultivated land non-grain behavior. The Sobel test passes the test at a significant level of 10%. It shows that among the sample farmers whose land fragmentation is lower than the average, the mediating effect of credit availability exists and is significant. Moreover, the Bootstrap test results showed that both the upper and lower bounds of the indirect and direct effects were greater than 0, verifying that the mediating effect was significant.

4.5. Heterogeneity Analysis

4.5.1. Heterogeneity of Socialized Services

As an essential way to "realize the organic connection between small farmers and modern agricultural development" [38], social services profoundly impact small farmers' planting choices. Therefore, this paper intends to group the farmers according to whether they purchase social assistance and describe the heterogeneity effect brought by land tenure security under the scenario of a social service purchase. The results are shown in Table 5. Land tenure security for farmers who purchase social services positively impacts non-grain behavior at a significant level of 1%, and land tenure security for farmers who purchase social services is significant at 5%. The lower level has a positive effect on non-grain behavior. In order to test whether there is heterogeneity, this paper chooses the seemingly uncorrelated test (SUR) to solve the problem of sample size differences between grouped

samples. The results are significant at the 5% significant level, indicating that there are differences. After purchasing socialized services, the coefficient of land tenure security on non-grain behavior decreased from 0.222 to 0.084, indicating that social services can weaken land tenure security's impact on cultivated land non-grain.

Table 5. Heterogeneity analysis of land tenure security on cultivated land non-grain.

	Do Not Purchase Social Services Group	Purchase Social Services Group	Decision-Makers Have No Off-Farm Employment Group	Decision-Makers Have Off-Farm Employment Group
Land tenure security	0.222 ***	0.084 **	0.166 ***	0.070 *
	(0.053)	(0.040)	(0.043)	(0.042)
Constant term	0.395 (0.235)	0.907 (0.182)	1.501 (0.225)	0.516 (0.200)
Control variable	control	control	control	control
R^2	0.285	0.254	0.302	0.261
Sample size	195	355	304	246
SUR	5.76 **		3.28 **	

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$; The standard error of robustness is in brackets; The control variables are consistent with Table 2.

4.5.2. Heterogeneity of Off-Farm Employment

"Part-time labor and part-farming" is the primary employment mode for farmers at this stage, and the importance of labor gradually surpasses agricultural production. Off-farm employment can directly affect the structure of household income and the distribution of the household labor force [39,40]. Changes in these factors will also impact farmers' planting decisions, so it is necessary to explore whether there is a heterogeneity effect brought about by land tenure security under the off-farm employment scenario. The results are shown in Table 5. The land tenure security of agricultural decision-makers who do not participate in off-farm employment is positively significant at the 1% significance level for non-grain behavior. Moreover, the land tenure security in the group of agricultural decision-makers participating in off-farm employment is positively significant at the 10% significance level. The SUR test results were significant at the 10% significance level, confirming differences between the two groups. From the coefficient of 0.166 to 0.07, it can be judged that participation in off-farm employment can alleviate the impact of land rights stability on the "non-grain" of cultivated land.

5. Discussion

In this paper, we provide a comprehensive empirical analysis to test and elaborate on the impact of land tenure security on farmers' cultivated land non-grain behavior and its impact path. Our research found that the increase in land tenure security will significantly promote the farmers' cultivated land non-grain behavior. The research results are basically consistent with those of Qi and Tang [41] and Li and Qiu [42]. They believe that the confirmation of agricultural land ownership reduces the probability of farmers planting food crops, and significantly improves the probability of farmers planting cash crops and engaging in animal husbandry. In fact, as a kind of government behavior, the confirmation of agricultural land ownership will increase farmers' non-grain behavior. However, this does not mean that we should curb the land tenure security. There are still many positive impacts brought by the land tenure security. What we should consider more is to ensure grain output on the premise of satisfying farmers' non-grain demands.

Secondly, the study is the first to comprehensively discuss the influence mechanism of land tenure security and farmers' cultivated land non-grain behavior. We found that land tenure security can exacerbate the farmers' cultivated land non-grain behavior by increasing farmland transfer behavior [43] and agricultural productive investment. The above research conclusions are not consistent with those of Liu and Zhang [28]. The main reason for this difference is that the area of cultivated land occupied by the object of this

study is small, and it is difficult to form a scale effect. Therefore, in order to maximize their income, farmers choose to plant non-grain crops after transferring agricultural land and increasing investment, which is more in line with the national conditions of China's small-scale farmers.

In addition, we also found that land tenure security cannot increase non-grain behavior by strengthening their credit availability. Generally speaking, land tenure security will increase the possibility of farmers' farmland mortgage [44,45]. Under the dual stimulus of increasing liquidity and increasing loan pressure, it is inevitable to choose non-grain crops with higher comparative income. But in practice, however, due to the high degree of land fragmentation, the collateral threshold may not be met, resulting in reduced credit availability.

Of course, there are still some limitations in this paper that we need to study in the future: First, the scope of our study is only the sample survey data of Guanzhong Plain in China. It may be difficult for the research results to be generally applied in more agricultural production areas and regions. Therefore, in the future, we hope to continue to apply more advanced survey techniques to expand the number of respondents. Second, we cannot use remote sensing data to make the data more accurate due to technical limitations in the measurement of cultivated land non-grain variables. Third, the research data used in this study are cross-sectional data, which only consider farmers' perceptions at one point in time. Obviously, as farmers gain practical experience, their planting decision-making behavior will change over time. Therefore, we need to obtain panel data to evaluate the validity of this study.

6. Conclusions and Implications

The phenomenon of cultivated land non-grain in China is relatively severe. Based on the field research of farmers in the Guanzhong Plain of Shaanxi Province, this paper investigates the impact of land tenure security on the decision-making of farmers' cultivated land non-grain behavior and draws the following conclusions: First, land tenure security has a significant positive impact on farmers' cultivated land non-grain behavior. Further, the research conclusions are still relatively stable after using replacement variables, replacing models, and solving endogeneity problems. Second, land tenure security will lead to non-grain behavior by increasing farmers' land transfer behavior and agricultural land investment, while credit availability has not passed the significance test. Further, the sample households are divided according to the mean value of land fragmentation. The study found that land tenure security can affect cultivated land non-grain behavior by affecting credit availability in the farmer group with a low degree of farmland fragmentation. Third, analyze the heterogeneity from whether to purchase social services and whether to have off-farm employment. The study found that purchasing social services and increasing off-farm employment can effectively alleviate the impact of land tenure security on farmers' cultivated land non-grain.

Based on the above research conclusions, this paper draws the following inspirations. (1) Under the background of the gradual strengthening of farmland property rights and the difficulty of realizing the large-scale operation of land transfer in the short term, land tenure security has exacerbated the phenomenon of farmers' cultivated land non-grain to a certain extent. Therefore, at present, the government needs to face up to the economic demands of small farmers, actively guide rather than strictly prohibit the non-grain phenomenon of cultivated land, and promote the transformation of farmers' management methods and planting structure. (2) Under the background of strict control of the non-grain of the country's cultivated land, on the one hand, the government should continue to increase its support for grain planting, gradually improve the efficiency of grain planting, and increase farmers' enthusiasm for grain planting. On the other hand, the government should strengthen the management and control of land transfer, take reasonable and practical measures, limit and regulate the use of transferred cultivated land to a certain extent, and prevent the loss of fertile land. (3) Purchasing social services and increasing off-farm

employment can effectively alleviate the impact of land tenure security on cultivated land non-grain. Therefore, the government should promote the development of socialized agricultural services through key financial subsidies and support various agricultural business entities to actively participate in the supply of socialized services to achieve large-scale service operations. In addition, the government should induce farmers to choose grain crops that are easier for mechanical operations to significantly increase the proportion of farmers planting grain crops and reduce the phenomenon of farmers' cultivated land non-grain.

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