frontiers | Frontiers in Sustainable Food Systems

TYPE Original Research
PUBLISHED 18 September 2024
DOI 10.3389/fsufs.2024.1418983

OPEN ACCESS

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RECEIVED 17 April 2024
ACCEPTED 26 August 2024
PUBLISHED 18 September 2024

CITATION
Wang H and Zhao Q (2024) How does the method of farmland transfer affect the "non-grain" of farmland in China? *Front. Sustain. Food Syst.* 8:1418983. doi: 10.3389/fsufs.2024.1418983

How does the method of farmland transfer affect the "non-grain" of farmland in China?

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Introduction: The phenomenon of "non-grain" of farmland poses a major threat to food security. Currently, there is still debate about the relationship between farmland transfer and the "non-grain" of farmland. Currently, there is no consensus on the relationship between farmland transfer and the non-grain use of farmland. This article focuses on the evolution of farmland transfer methods, examines the impact of farmland transfer methods on the non-grain use of farmland, and highlights the importance of effectively promoting farmland transfer, curbing the non-grain use of farmland, and ensuring food security.

Methods: Based on the China Rural Revitalization Survey (CRRS) data, this paper uses probit and ivprobit models to estimate the causal relationship between farmland transfer methods and the "non-grain" of farmland. Grouped regressions are conducted from three dimensions of geographical environment, village governance, and economic development to test the heterogeneity of the impact of farmland transfer methods. Finally, the pathways of action are analyzed from the perspectives of farmers' identity transformation and contract signing.

Results: The organized transfer can significantly reduce the degree of "non-grain" of farmland, and its effect is stronger when the village party secretary has a higher level of education and also serves as the village head. This effect is mainly manifested through increasing the probability of farmers becoming new agricultural operators, joining cooperatives, signing formal contracts, and determining the lease term.

Discussion: The policy implications of this study emphasize that to curb the "non-grain" of farmland and ensure food security, it is important not only to increase the rate of farmland transfer but also to promote the organization of farmland transfer transactions. This includes facilitating the transfer of farmland from inefficient smallholders and cultivating new agricultural operators. Simultaneously, leveraging the supervisory and management role of village collectives can encourage farmers to sign more formal written contracts, clarify the purpose of farmland transfer, and supervise and manage the use of farmland during the subsequent contract execution stage. A limitation of this study is that it relies on cross-sectional data and does not observe the time variation of farmland transfer methods for the same farmers or their long-term impact on the "non-grain" of farmland.

KEYWORDS

"non-grain" of farmland, method of farmland transfer, organized transfer, village committee, new type of agricultural operating entity

1 Introduction

Food security stands as a pivotal concern in the trajectory of China's agricultural development. The conversion of farmland from grain production, known as "non-grain" emerges as a formidable adversary to this security. Amidst the relentless march of urbanization, industrialization, and the modernization of agriculture and rural landscapes, there is a marked exodus of rural labor to urban sectors. This migration has driven up the opportunity cost of labor, eroding the financial viability of grain cultivation and catalyzing the spread of "non-grain" in numerous districts. In an economic bid to bolster their income, many farmers have turned to alternative land uses, such as the construction of greenhouses, livestock facilities, and the establishment of vegetable gardens and fruit-picking enterprises on farmland. These transitions, while economically motivated, present a critical menace to China's food security framework. Consequently, a strategic emphasis on thwarting the encroachment of "non-grain" and preserving the expanse of land committed to grain cultivation is imperative. Such endeavors are fundamental to the safeguarding of China's food security, necessitating a nuanced approach that harmonizes the imperatives of agricultural advancement with the preservation of grain-based agriculture.

Within the framework of China's foundational national context as a vast nation with predominantly smallholder agriculture, the government has endeavored to aggregate farmland through centralized land transfer pathways. This strategy is designed to augment the economic viability of grain crops via scaled operations, with the ultimate goal of bolstering the cultivation of grain and underpinning food security. In furtherance of this objective, the "Rural Land Contracting Law of the People's Republic of China" was revised in 2003, instituting a tripartite division of land rights into ownership, contracting, and management rights. This delineation affirms collective ownership of farmland, while bestowing farmers with the contracting and management prerogatives, thus enabling the conveyance of management rights through leasing arrangements. The impact of these measures has been the acceleration of farmland transfer among farmers. According to a decade-long assessment by the Ministry of Agriculture and affiliated organizations, the annual compounded growth rate of China's farmland transfer rate achieved 22.53% between 2006 and 2016. By 2017, the aggregate extent of transferred farmland had reached 512 million mu, with the transfer rate escalating to 37% (equivalent to 667 square meters per mu), as reported by Liu et al., 2018. This progression underscores the government's commitment to land reform and its influence on agricultural consolidation and food security.

The ongoing increase in the proportion of transferred farmland has not effectively mitigated the "non-grain" of farmland, the enthusiasm of farmers for grain cultivation has always been difficult to improve (Zhong et al., 2024; Liu et al., 2014; Yu and Niu, 2023). This has led to a burgeoning interest within the academic sphere regarding the dynamics between farmland transfer and "non-grain" (Otsuka et al., 2016; Zhang and Du, 2015; Gan et al., 2024). Yet, a cohesive view on this relationship remains elusive. A faction of researchers suggests that farmland transfer is linked to "non-grain" (Pan, 2024), with economic factors such as low grain prices and the financial burden of land transfer costs potentially steering recipients towards "non-grain" agricultural activities (Cheng and Lin, 2014; Zeng, 2015). Conversely, other scholars offer a contrasting viewpoint, indicating that farmland transfer may not predispose land to "non-grain" but could indeed foster an increase in grain cultivation (Liu et al., 2018), with higher transfer rates purportedly amplifying this "trend towards grain" (Hong, 2024). The complexity is further compounded by studies suggesting a "U-shaped" correlation between the rate of farmland transfer and "non-grain" (Ma and Guangsi, 2023; Yao et al., 2024), which implies that the nature of the impact is conditional upon the degree of land transfer. Additionally, there is a contentious debate on the planting strategies of principal entities acquiring farmland, including family farms and other large-scale operators (Chen and Tang, 2023), this point has been confirmed to be due to the promotion of policies and industrial and commercial capital, resulting in different planting structures of family farms (Gao and Du, 2022). Discrepancies are observed in the preferences of family farms, with some studies indicating a propensity for "non-grain" production (Zhang et al., 2014), while others reveal a positive association between the scale of leased farmland and the extent of grain cultivation by these farms, that is, there are differences among farmers of different scales in the transfer and management decisions of farmland (Zhang and Du, 2015).

The ongoing debate regarding the nexus between farmland transfer and the escalation of "non-grain" cultivation is largely due to a significant gap in the current research—namely, the disregard for the potential variability in outcomes based on different farmland transfer methodologies. The predominant mode of farmland transfer, often occurring within familial and social circles (Chen et al., 2017; Tan et al., 2023), is typically marked by the informality of the agreements, with a notable absence of formal documentation. The lease arrangements are commonly left undefined, and the rent, both in terms of quantity and mode of payment, is subject to negotiation and can be highly adaptable. In some instances, rent is paid not in currency but in kind, such as providing care for the elderly in the transferring family or offering gifts during festive seasons (Wang et al., 2015; Gao et al., 2019). This informality results in a lack of regulatory oversight, which can lead to the arbitrary alteration of land use by farmers, frequently in favor of cash crops that offer higher operational returns (Liu and Lv, 2024). To accurately assess the impact of farmland transfer on "non-grain" cultivation, it is imperative to differentiate between these diverse transfer methods, thereby providing a more nuanced understanding of their effects on agricultural practices.

To reinforce the regulatory oversight of farmland utilization post-transfer, the Chinese government has executed a comprehensive set of measures to systematize the previously informal domain of farmland transactions. The initiatives are twofold: (1) Village Committee Engagement: The government is encouraging village committees to play a proactive role in farmland transfer transactions. By mobilizing their managerial prerogatives over collective land, these committees are tasked with consolidating fragmented landholdings into unified, larger plots (Chen and Yi, 2023), forming cooperatives, and managing contract reversals and lease agreements. This approach seeks to elevate the organizational integrity of land transfers and amplify the supervisory pathways governing land use post-transfer. (2) Development of Trading Platforms: A significant thrust has been placed on constructing platforms that specialize in facilitating farmland transfer transactions. These platforms are intended to bring formality and transparency to the process, ensuring compliance with agricultural policies and the broader goal of safeguarding food security. These measures reflect a strategic pivot towards more organized and accountable land management practices, underscoring the government's commitment to aligning farmland transactions with

sustainable development and food security imperatives. Under the platform-based transfer model, farmers must initially consult the platform's website for transfer information. They then proceed to pay a security deposit and, within a specified timeframe, secure their transfer intentions through online or offline bidding and auction processes. Subsequently, an offline contract is executed, which meticulously delineates the farmland's designated uses, thus mitigating the incidence of "non-grain" farmland practices (Feng, 2021; Cheng and Lin, 2014).

In theory, organized land transfer transactions can help to curb the "non-grain" of farmland. Compared to the traditional informal transfer model, under an organized transaction model, a large number of small farmers transfer out their land, while larger farmers choose to acquire more land, becoming new type of agricultural operating entity such as family farms, agricultural cooperatives, or leading enterprises (Pei and Xu, 2014; Feng, 2017). These new type of agricultural operating entity differ from small farmers in that they can make substantial long-term investments, thereby achieving economies of scale and avoiding the low grain profit issues caused by short-term investment difficulties and lack of economies of scale faced by small farmers (Li and Qin, 2022). For these new agricultural operators, although economic crops may yield higher profits in the short term, they differ from grain crops in that the pricing power is held by the government, ensuring price stability. In contrast, the prices of economic crops fluctuate more with market changes, leading to greater long-term market risks. Therefore, larger farmers who transfer land through organized transactions are more inclined to make long-term investments in farmland and engage in the cultivation of grain crops (Geng and Luo, 2021). Furthermore, under an organized land transfer transaction system, village committees and land transfer trading platforms can more easily supervise the parties involved in land transfers to sign formal written contracts. This facilitates easier monitoring of the planting behavior of the transfer-in households, thereby reducing the likelihood of "non-grain" in their operations (Zuo et al., 2021).

However, the aforementioned analysis is purely theoretical. In practice, when compared to traditional farmland transfer methods, do these two forms of organized land transfer truly curb the phenomenon of "non-grain" of farmland? If the organized transaction modes can indeed restrict "non-grain" of farmland, what is the pathway at play? Existing research has been unable to answer this question. In order to address these issues, this paper examines the impact of organized farmland transfer transaction modes on "non-grain" of farmland and analyzes their pathways and heterogeneity. The innovation of this paper lies in two aspects: firstly, it focuses on the evolution of farmland transfer transaction modes, focusing on organized transfer, providing a supplement to the existing relationship between farmland transfer and "non-grain." Secondly, it analyzes the pathway of organized transfer transaction modes from the perspective of changes in farmers' identities and the signing and supervision of contracts, which has strong policy implications. The research conclusions of this paper can provide decision-making references for promoting the transformation of farmland transaction modes and curbing "non-grain" of farmland.

2 Institutional background and research hypothesis

The "Rural Land Contract Law of the People's Republic of China," which came into effect in March 2003, officially granted farmers the right to transfer in and out of contracted farmland. In the following years, the government carried out land contract operation rights confirmation and the "separation of three rights" reform, separating the operation rights from the contracting rights, further defining the rights of farmers to land contract and the rights to transfer farmland operation rights, aiming to increase farmers' enthusiasm for grain production through stabilizing land rights. During the reform process, the methods of transferring farmland operation rights also underwent evolution.

The earliest form of farmland transfer in rural areas was characterized by spontaneous transfers among households. This type of transaction often occurred between relatives and acquaintances (Chen et al., 2017). In this transfer mode, informal contracts were prevalent, sometimes based on verbal agreements for rent, sometimes in the form of physical goods as rent, and sometimes even transacted with zero rent (Liu, 2018). Under spontaneous transfers, formal transfer contracts were usually not signed, and the lease period and rent amount and form were flexible. Rent payment could sometimes be made in the form of grain, or in the form of "relationship rent" such as taking care of the elderly in the transferring household or giving gifts during holidays (Wang et al., 2015; Gao et al., 2019). However, this model brought about two major issues: firstly, it made it difficult to achieve contiguous farmland management, leading to fragmented transfers, which hindered achieving economies of scale in grain production (Ji et al., 2017); secondly, the lack of formal written contracts made it challenging for the government and village committee to effectively supervise the farmland use (Tan et al., 2023). Through spontaneous farmland transfer, farmland not only served as a means of production in agriculture but also as a form of unemployment insurance and a vehicle for interpersonal exchanges among households. According to data from the Ministry of Agriculture and Rural Affairs, the proportion of farmland transfer within villages accounted for 55.18% in 2016. Based on a survey conducted in 29 provinces nationwide, Qiu and Luo (2022) found that the proportion of farmland transferred to relatives, friends, or local farmers was as high as 71.01%. Currently, spontaneous transfers remain the predominant mode of farmland transfer in rural areas (Jiao and Zhou, 2016).

With the development of the farmland transfer market in rural areas, the scale of farmland transfers has gradually expanded. The shortcomings of traditional informal transfer transactions, such as lack of supervision and high transaction costs, have become increasingly prominent (Yang and Sun, 2024). The Chinese government believes that under the current institutional arrangements, to completely solve the "non-grain" issue, reliance on the village committee is still necessary (Bian et al., 2023). Leveraging China's unique collective economic system and grassroots autonomous system in rural areas, village committee have gradually become involved in farmland transfer transactions (Gong and Zhang, 2023). Following the initiation of a new round of farmland tenure clarification, the level of village committee participation has increased. However, the methods of village committee participation vary in different regions, with three typical approaches. In the first approach, village committee act as guarantors. For example, in Donghai County, Lianyungang City, Jiangsu Province, both parties involved in farmland transfer first negotiate privately, and once they reach an agreement, they sign a tripartite contract with the village committee acting as the guarantor for the transferee of the farmland. The tripartite contract also specifies

the obligation of the village committee to regulate the behavior of both parties in the farmland transfer. The second approach involves farmers conducting transfers through farmland cooperatives established by village committee. For instance, in Tangyue Village, Anshun City, Guizhou Province, farmers join a farmland cooperative established by the village committee through equity participation in the contracted farmland (Xie, 2020). The village committee then reallocates the farmland through the farmland cooperative. Similar transaction methods have appeared in other regions, such as in Shaoxing City, Zhejiang Province, where this approach is referred to as "farmland trust" (Yan and Tang, 2015), essentially involving the village committee establishing a farmland cooperative for transfers. The third approach is exemplified by the "reverse rental and sublease" model in Zouping County, Shandong Province (Xu, 2012). In this model, farmers sign a farmland transfer intention letter authorizing the village committee to pay rent in advance. The village committee acts as an intermediary organization for farmland transfers, consolidating the village's farmland for unified planning and layout before transferring it to professional farmers, family farms, and other New type of agricultural operating entity (This refers to the large-scale operating entities that the Chinese government is actively supporting, including professional large households, family farms, agricultural cooperatives, and agricultural enterprises). This transaction model involves two transfer processes: farmers renting the farmland back to the village committee, which then transfers the farmland operation rights to large-scale operators.

Building upon this model, a new mode of farmland transfer through trading platforms has emerged. The platform-based transfer model is characterized by a distinct top-down, institution-building feature, evolving from pilot projects to widespread adoption. In 2008, the Rural Property Rights Exchange in Chengdu, Sichuan Province was established, becoming China's first comprehensive rural property rights market platform (Ren, 2008). The following year, numerous cities such as Wuhan, Chongqing, Ezhou, and Zaozhuang also established rural property rights trading platforms to explore the platform-based transfer model and supporting policies (Zhu and Lirong, 2014). In 2015, the General Office of the State Council issued the "Opinions on Guiding the Healthy Development of Rural Property Rights Transfer Trading Markets," initiating transaction platform construction nationwide. Currently, trading platforms in over 10 provinces across the country have been put into operation. Farmers engage in farmland transfer through trading platforms by first viewing transfer information on the platform's website, then paying a deposit, and finally reaching a transaction agreement within a specified time through online or offline bidding. Subsequently, contracts are signed offline, and the entire transaction process is overseen by the platform. As a third-party credit institution, the platform has the responsibility and obligation to regulate the behavior of the parties involved in the transaction and ensure their performance. Compared to the previous two transaction models, the platform-based transfer process has the highest level of standardization, with significant advantages in terms of information dissemination and contract signing.

The two organized transaction methods of village committees participating in farmland transfer and utilizing trading platforms differ significantly from spontaneous transfers among farmers. Under organized transaction methods, the costs for the transferring party to post transfer information and the receiving party to search for transfer information are reduced (Yang et al., 2024). Additionally, the receiving party avoids the high negotiation costs and potential issues of extortion associated with individually communicating with each small parcel of farmland from the transferring party, thus lowering negotiation communication costs. In the organized farmland transfer model, village committees and government-established trading platforms, leveraging their authority, facilitate the signing and execution of farmland transfer contracts, reducing the transaction costs for farmers to enter into and fulfill contracts. With the reduction of transaction costs, farmers' willingness to transfer farmland increases, leading to a higher probability of farmland transfer. Small farmland holders may choose to transfer more farmland, while large farmland holders may opt to acquire more farmland. The decrease in transaction costs also facilitates a more formalized transaction process, increasing the likelihood of both parties in the farmland transfer signing official written contracts and long-term agreements. The evolution of farmland transfer transactions from personalized transactions in a free market to a higher level of organized transactions expands the scope of the farmland transfer market. The farmland transfer market within villages transitions from closed to open, allowing strangers to participate in farmland transfer transactions.

The impact of organized farmland transfer transactions on the "non-grain" of farmland differs. Firstly, under the traditional transfer model, when smallholders acquire farmland, due to the lack of economies of scale, they are more prone to opportunistic behavior and are motivated to cultivate cash crops to increase short-term profits. In fact, against the backdrop of the continuous transfer of labor, a large number of small farmers want to leave agriculture, which has also led to academic discussions on the issue of "who will farm in the future." However, under the organized transaction model, both issues can be alleviated to some extent. A large number of small farmers transfer their arable land, leaving agriculture, while larger landowners choose to acquire more land, becoming new type of agricultural operating entity such as family farms, agricultural cooperatives, or leading agricultural enterprises (He et al., 2024). These new type of agricultural operating entity differ from small farmers in that they can make substantial long-term investments, thereby achieving economies of scale and avoiding the low grain profit issues caused by short-term investment difficulties and lack of economies of scale faced by small farmers. For these new agricultural operators, although economic crops may yield higher profits in the short term, they differ from grain crops in that the pricing power is held by the government, ensuring price stability. In contrast, the prices of economic crops fluctuate more with market changes, leading to greater long-term market risks. Therefore, larger farmers who transfer land through organized transactions are more inclined to make long-term investments in farmland and engage in the cultivation of grain crops. Furthermore, under an organized land transfer transaction system, village committees and land transfer trading platforms can more easily supervise the parties involved in land transfers to sign formal written contracts. This facilitates easier monitoring of the planting behavior of the transfer-in households, thereby reducing the likelihood of "non-grain" in their operations. Based on these observations, this paper proposes the research hypothesis:

> *Hypothesis 1*: Organized transactions can reduce the phenomenon of "non-grain" of farmland and increase the likelihood of farmers cultivating grain crops.

The potential pathways through which organized transactions reduce the "non-grain" of farmland are twofold. Firstly, organized transactions can facilitate a transformation of farmers' identities. Under

the traditional farmland transfer transaction mode, both acquiring and transferring farmers are smallholders, which may lead to opportunistic behavior. Organized transaction modes promote a shift in the identities of acquiring farmers, enabling them to become New type of agricultural operating entity. This transition allows for increased profits from grain crop cultivation through economies of scale and long-term investments, thereby reducing the likelihood of "non-grain." Secondly, organized farmland transfer transactions are conducted through village committees or government-established farmland transfer transaction platforms. Both the village committees and transaction platforms encourage the signing of formal written contracts between the parties involved in the transfer, which better define lease terms and prices. These written contracts typically utilize templates provided by the Chinese government, which require the specified land use. The village committees and transaction platforms can more effectively monitor land use through these contracts, thereby reducing the "non-grain" behavior of acquiring farmers. Based on this, the paper proposes the research hypothesis:

> *Hypothesis 2*: Organized transactions can reduce the "non-grain" of farmland through two pathways: firstly, by increasing the likelihood of farmers becoming New type of agricultural operating entity, and secondly, by increasing the likelihood of farmers entering into formal written contracts.

The above analysis framework is illustrated in Figure 1. Based on the analysis of the transformation of farmland transfer transaction modes and their impact on the "non-grain" of farmland, this paper identifies the main research content. The first is to identify the impact of farmland transfer transaction modes on the "non-grain" of farmland, and the second is to analyze the pathways through which the farmland transfer transaction modes affect the "non-grain" of farmland from the perspectives of identity transformation and the signing of written contracts.

3 Materials and method

3.1 Data source

The data source used in this article is the China Rural Revitalization Survey conducted by the Rural Development Institute, Chinese Academy of Social Sciences. This survey is based on the major economic and social survey project of the Chinese Academy of Social Sciences, "Comprehensive Survey of Rural Revitalization and Establishment of China Rural Survey Database." It focuses on important aspects of rural development such as "rural population and labor force," "rural industrial structure," "farmers' income and social welfare," "rural residents' consumption," "rural governance," and "comprehensive rural reform." The research team conducted the survey in 10 provinces (regions) including Guangdong, Zhejiang, Shandong, Anhui, Henan, Heilongjiang, Guizhou, Sichuan, Shaanxi, and Ningxia Hui Autonomous Region in August–September 2020. The distribution of surveyed provinces is shown in Figure 2. The survey data were obtained through stratified sampling. Firstly, considering factors such as economic development level, regional location, and agricultural development, one-third of the provinces were randomly selected from the eastern, central, western, and northeastern regions. Subsequently, within each province, all counties were ranked by *per capita* GDP and divided into five groups: high, relatively high, medium, relatively low, and low levels. One county was then randomly selected from each group, resulting in a total of 50 sample counties being surveyed. Following this, within each county, three townships (high, medium, and low economic development) were selected using the same method, and two villages with relatively good and relatively poor economic development were chosen from each township. Finally, based on the roster provided by the village committee, surveyors first ranked the households residing in the village, then selected 14 households at equal intervals using systematic random sampling, with 2 households serving as backups. The survey data covered 50 counties (cities) and 156 townships (villages) nationwide, obtaining a total of 306 village questionnaires and over 3,819 household questionnaires. Through stratified sampling, the CRRS data covers different types of agricultural development areas in China and holds representative significance. In addition, the database includes variables such as household characteristics, agricultural production behavior, land transfer behavior, and operational varieties, which meet the requirements of this study.

3.2 Variables

This article uses whether the household only operates grain crops to represent the "non-grain" of farmland, which is calculated based on

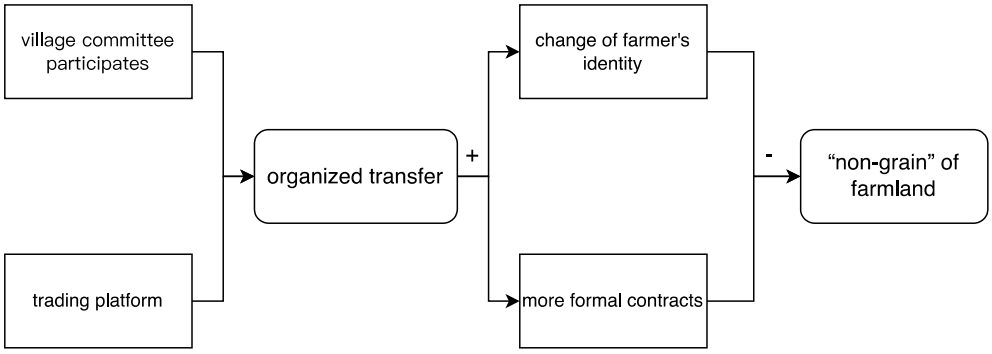

FIGURE 1
The impact pathway of organized transfer trading on "non-grain" of farmland.

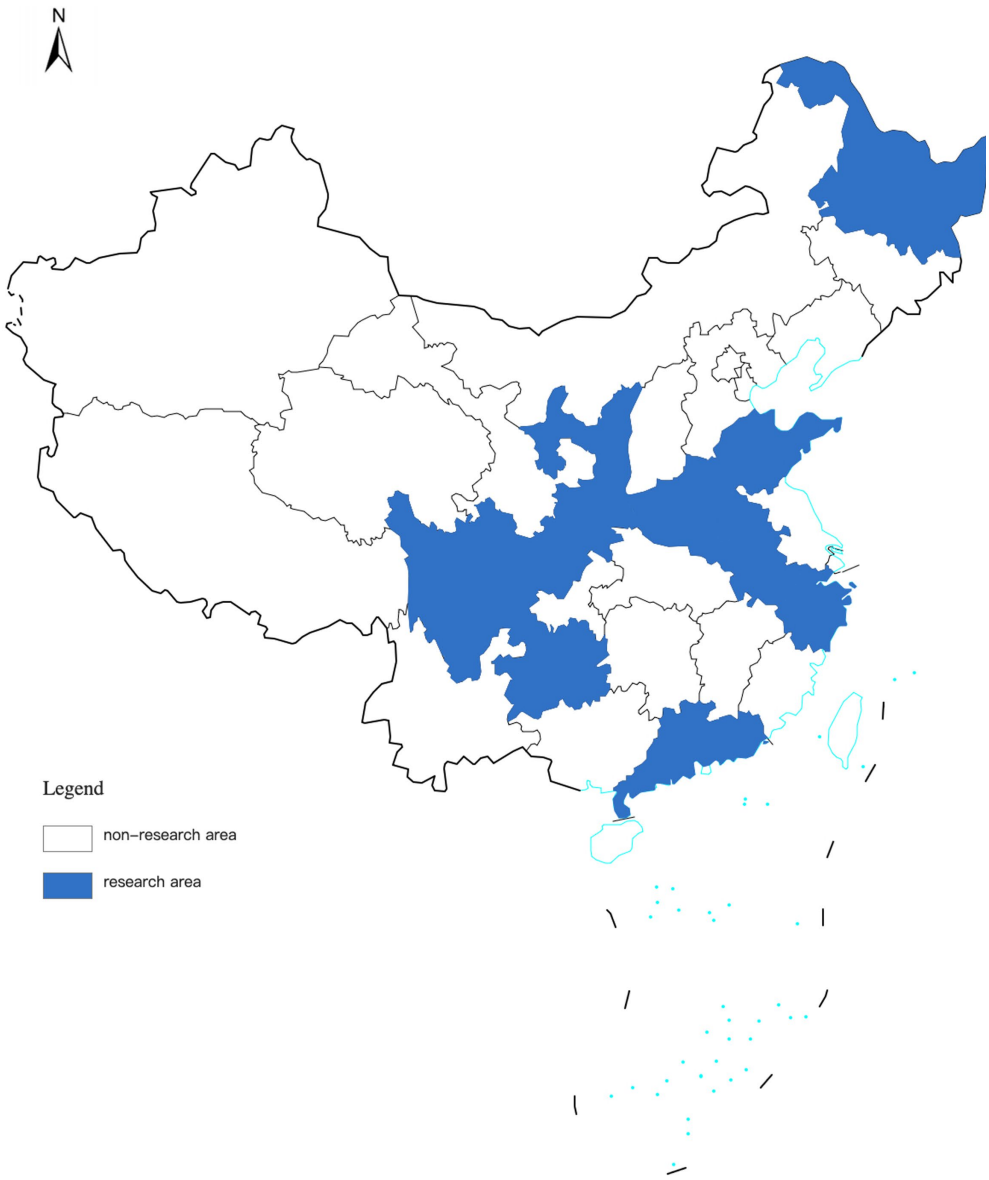

FIGURE 2
The distribution of sample data.

the questions in the household survey regarding the planting structure. The farmer questionnaire inquired in detail about the types of crops planted by each farmer. The crop code table provided by the database includes three categories: the first category is grain crops, the second category includes crops such as cotton and peanuts, and the third category consists of vegetables and fruits. As this article focuses on the "non-grain" of farmland, the second and third categories are not grain crops. Therefore, these two types of crops are combined into one category. The classification of crops managed by households is divided into grain crops and non-grain crops. The specific variable setting is as follows: if economic crops are planted, the value is set as 1, and if only grain crops are operated, the value is set as 0. In the sample, 75.7% of households planted economic crops, while the remaining 24.3% of households only operated grain crops.

The explanatory variable in this study is the mode of farmland transfer in rural areas. In reality, due to organized collective land transfer being conducted on a village-wide basis, the usual method of land transfer is unified within the village. This means that when the village committee participates in land transfer, the entire village's land is transferred through the village committee, and private land transfer transactions by individual households are prohibited. Conversely, if the village committee is not involved in farmland transfer transactions or if there is no farmland transfer platform established locally, all farmland transfer transactions are carried out through private transactions among farmers. Therefore, this study constructs the explanatory variable at the village level based on two questions: "Whether the village committee participates in farmland transfer through intermediaries, reverse leasing, etc." and "Whether the village uses a farmland transfer trading platform." If either of these questions is answered affirmatively, the farmland transfer mode in that village is classified as organized transaction; otherwise, it is classified as 0.

TABLE 1 Descriptive statistics of variables.

Variables	Definition	Num.	Mean	Std.
Cultivated crops	Planted cash crops = 1; Only cultivated grain crops = 0	2,378	0.757	0.429
Trading methods	Organized trade = 1; Free trade = 0	2,378	0.665	0.472
Located in the suburbs	Suburb = 1; Rural = 0	2,378	0.212	0.408
Distance to the county government	The distance between the village and the county government (km)	2,378	5.530	5.529
Village Terrain	Flat = 1; Hilly = 2; Mountainous = 3	2,378	1.925	0.910
Village Secretary's Age	The age of the Secretary of the Village Party Committee	2,378	49.947	8.567
Cultivated land area	The logarithm of the total cultivated land area of the village	2,378	7.949	1.224
Contracted land area	The logarithm of the total contracted land area (including cultivated land) of the village	2,378	8.388	1.731
Transfer area	The contracted land transfer area in the village	2,378	2.996	3.575
Area of the village cooperative	The logarithm of the total operating area of the village agricultural professional cooperative	2,378	2.789	3.340
Agricultural wages	Average wages in the village during the busy agricultural season (RMB/day)	2,378	140.075	55.492
Irrigable area of farmers	Irrigable area within the cultivated area of farmers	2,378	10.845	61.583
New agricultural management entities	New agricultural management entity = 1; Not a new agricultural management entity = 0	2,378	0.255	0.436
Agricultural cooperative	Join agricultural cooperative = 1; Not joined cooperative = 0	2,378	0.235	0.424
Contract signing	Signing formal written contract = 1; Not signing written contract = 0	1,223	0.632	0.482
Rental period	Defined rental period = 1; Undefined rental period = 0	1,220	0.575	0.495

The mechanical variables in this paper are the identity of farmers and contract characteristics. Specifically, the identity of farmers is measured using two variables: whether the farmer is a professional large household or a family farm, and whether the farmer has joined an agricultural professional cooperative. The reason for using these two variables is that the way China is developing new agricultural management entities varies. In some regions, the focus is on registering large households as family farms, while in other regions, there is encouragement for large households to join agricultural professional cooperatives. The contract characteristics of farmland transfer by households include three variables: whether a contract is signed, whether the transfer lease period is determined, and the amount of rent.

The controlled variables include two aspects. Firstly, at the household level, the family's irrigable area is considered. The primary reason for a household's crop selection is the land quality, with irrigation conditions being an important indicator. Food crops, especially rice, have a high demand for irrigation, and insufficient irrigation conditions are the main reason why households turn to partially drought-resistant cash crops. Secondly, at the village level, we control for topographical features, total farmland area, contracted area, transfer area, and other transfer characteristics, as well as village leader characteristics, cooperative society, and average wages during peak farming seasons, which are variables that may influence a household's crop selection. The village's land characteristics directly impact a household's grain yield, thereby affecting the household's crop selection. Village governance characteristics can influence the supervision intensity of farmland use, and peak season wages are used to represent labor costs, reflecting the motivation for households to change the use of farmland. The descriptive statistics of the above variables are shown in Table 1.

3.3 Identification strategy

Firstly, this study constructs the following econometric regression model to evaluate the impact of farmland transfer transaction modes on farmers' crop management:

$$Y_i = \beta + \alpha G_v + \gamma M_i + \delta V_v + \in_i \quad (1)$$

In Equation 1, $Y_i$represents the crop managed by the farmer, where $Y_i = 1$ indicates the farmer manages food crops, and $Y_i = 0$ indicates the farmer does not manage food crops. G_v represents the farmland transfer transaction mode in village v, where $G_v = 1$ denotes an organized transaction mode and $G_v = 0$ denotes an informal transfer mode in the village. M_i represents the control variables at the farmer level, and V_v represents the control variables at the village level. β is the constant term, $\in_i$ is the error term that includes unobservable factors and random errors. The probit model is used to estimate Equation 1.

It should be noted that there may be endogeneity issues between the farmland transfer transaction modes and the crop management by farmers. On one hand, the farmers' choice of farming and crop cultivation may be a result of self-selection, and the crop management variable may not satisfy random sampling. Equation 1 may suffer from selection bias due to non-random sampling. On the other hand, the factors influencing farmers' crop selection are complex and difficult to fully control in the model. Other unobservable factors may simultaneously affect the village's farmland transfer transaction modes and farmers' crop selection, leading to estimation biases due to omitted variables. Instrumental variable method is a common approach to address endogeneity issues, therefore, before estimating Equation 1, this study first constructs the following econometric model:

TABLE 2 Baseline regression results.

Variables	(1)	(2)
	Cultivated crops	Cultivated crops
Trading methods	−0.074***(0.018)	−0.064***(0.019)
Village Terrain		0.055***(0.010)
Village Secretary's Age		−0.002**(0.001)
Cultivated land area		−0.016 (0.015)
Contracted land area		0.010 (0.012)
Transfer area		−0.003 (0.003)
Cooperative area of the		0.003 (0.003)
Agricultural wages		0.001**(0.001)
Irrigable area of farmers		0.001 (0.001)
Village clustering standard error	YES	YES
Cons	0.855***(0.050)	0.810***(0.304)
Observations	2,378	2,378

Standard errors in parentheses.
* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

$$G_v = \beta + \alpha Z_v + \delta V_v + \in_i \quad (2)$$

In the provided text, it states that Z_v represents the instrumental variables, and α is the main parameter estimated in Equation 2. The study selects two variables as instrumental variables for the village's farmland transfer transaction modes. The first variable is the distance between the village and the county government. The mode of farmland transfer transactions in the village largely depends on the policy constraints of the local government, and the policies implemented by the county government are not expected to have a direct impact on the crops managed by farmers. The second variable is whether the village is located in the outskirts. Villages in the outskirts are closer to cities and are more likely to be influenced by the organized transaction policies implemented by the Chinese government, thus choosing organized transaction modes. The study uses the ivprobit method for instrumental variable regression to address potential endogeneity issues. This method helps in controlling for endogeneity by using instrumental variables that are correlated with the endogenous explanatory variable but not with the error term. By applying the ivprobit method, the study aims to obtain more reliable and unbiased estimates by addressing the endogeneity problem that may exist between the farmland transfer transaction modes and the crop management by farmers.

4 Results

4.1 Baseline regression results

Table 2 presents the baseline regression results. We found that compared to villages engaging in free farmland transfer transactions, the proportion of households planting non-food crops in organized transaction villages decreased by 6.4%, and the result is statistically significant at the 1% level. Our conclusions support the findings of studies by Liu et al. (2018), Hong (2024), and Zhang and Du (2015), which suggest that the transfer of farmland can reduce the "non-grain" of farmland. This result indicates that the organized farmland transfer transaction method can effectively curb the trend of "non-grain" of farmland and increase the likelihood of households engaging in the cultivation of food crops.

In terms of controlled variables, the more complex the topography of the village, the greater the likelihood of households engaging in the cultivation of cash crops, which aligns with our intuition and existing research results. Flat terrain can improve the efficiency and economies of scale of food crop cultivation, and reduce the cost of mechanized operations. In addition, the older the age of the village leader, the more likely it is to reduce the likelihood of households engaging in the cultivation of cash crops. This may be because older village leaders are more inclined to intervene in the village's farmland transfer transaction method and household crop selection, encouraging households to engage more in the cultivation of food crops. This is because food crops have lower market risks, stable income, and are more conducive to meeting higher-level assessments of food security. In addition, higher peak season wages in the village increase the likelihood of households engaging in the cultivation of cash crops. The higher the wages, the greater the labor costs, and households are more likely to pursue cash crops with higher short-term profit margins to increase agricultural income.

4.2 Endogeneity

Although the baseline regression controlled for variables at the village and household levels that may affect the types of crops grown by households, the results may still suffer from potential endogeneity issues such as self-selection and omitted variable bias. Therefore, we used "whether the village is located in the suburbs" and "the distance between the village and the county government" as

TABLE 3 Regression results using the instrumental variable method.

Variables	(1)	(2)
	Trading methods	Cultivated crops
Located in the suburbs	0.130***(0.024)	
Distance to the county government	0.009***(0.002)	
Trading methods	–	−0.060**(0.030)
Control variables	YES	YES
Wald test of exogeneity	0.89***	
F value	24.86***	
Village clustering standard error	YES	YES
Cons	0.855***(0.050)	0.810***(0.304)
Observations	2,378	2,378

Standard errors in parentheses.
* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

TABLE 4 Regression results for transferred plots and plain regions.

Variables	(1)	(2)	(3)
	Cultivated crops (ln transferred plots)	Cultivated crops (ln transferred plots)	Cultivated crops
Personal trading method	–	−0.082**(0.038)	
Trading methods	−0.057*(0.032)	–	−0.072**(0.034)
Control variables	YES	YES	YES
Village clustering standard error	YES	YES	YES
Cons	−3.492***(0.609)	−3.514***(0.603)	0.037 (0.436)
Observations	866	866	990

Standard errors in parentheses.
* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

instrumental variables, and conducted a two-stage regression using the ivprobit model, with the results shown in Table 3. The results of the first stage show that the village being located in the suburbs has a significant positive effect on the village conducting farmland transfers in an organized manner, with statistical significance at the 1% level. Similarly, the distance between the village and the county government also has a significant positive effect on the village conducting farmland transfers in an organized manner, also significant at the 1% level, indicating that the instrumental variables meet the relevance condition. Additionally, the Wald test of exogeneity value is 0.89, significant at the 1% level, indicating that there is indeed an endogeneity issue with the village's farmland transfer transaction method. Looking at the results of the second stage regression, after correcting for potential endogeneity bias, the organized transaction method still reduces the likelihood of households engaging in non-food crops by 6%. Furthermore, the model's *F* value is 24.86, significantly greater than 10, and significant at the 1% level, indicating a strong correlation between the instrumental variables chosen and the core explanatory variables, with no weak instrumental variable problem. Compared to the baseline regression, the results of the ivprobit model are more reliable, suggesting that the baseline regression may have slightly overestimated the impact of the farmland transfer transaction method in reducing the likelihood of households engaging in cash crops by 6.4%.

4.3 Robustness

To further validate the robustness of the results, we re-estimated the levels of the explanatory and explained variables by adjusting the sample. The results are presented in Tables 4, 5. Firstly, we retained information for only 866 transferred plots and then estimated the crops cultivated on the transferred plots using the village's farmland transfer transaction method. Although households may cultivate the same or similar crops on contracted and transferred plots to reduce costs, estimating only the transferred plots can help us more accurately identify the impact of the transaction method on crop selection. The results, as shown in the first column of Table 4, indicate that the organized transaction method can reduce the likelihood of households cultivating cash crops on transferred plots. To further precisely measure the organized transaction method, we replaced the transaction method of farmland transfer from the village level to the household level, estimating the transaction method adopted by the household for the transferred plot as the core explanatory variable. The results, as shown in the second column, indicate that adopting an organized transaction method also significantly reduces the likelihood of households cultivating cash crops. Finally, we retained only the samples of villages located in plain areas for the re-estimation, with the results presented in the third column. The results demonstrate that the effect of village farmland transfer transactions in reducing the cultivation of cash crops by households remains highly significant.

TABLE 5 Impact of different organizational trading methods.

Variables	(1)	(2)
	Cultivated crops	Cultivated crops
Involvement of the village committee	−0.066***(0.019)	
Platform transaction	–	−0.009 (0.032)
Control variables	YES	YES
Village clustering standard error	YES	YES
Cons	0.801***(0.305)	0.668**(0.301)
Observations	2,378	2,378

Standard errors in parentheses.
* $p < 0.1$; *** $p < 0.05$; *** * < 0.01.

To further refine the impact of the farmland transfer transaction method, this study further distinguishes the organized farmland transfer transaction method into two categories: transaction through the village committee and transaction through a government-established platform. The results are shown in Table 5: compared with other transaction methods, conducting transactions through the village committee significantly reduces the likelihood of households cultivating cash crops, with a reduction of 6.6%. On the other hand, conducting transactions through the county-established farmland transfer platform has no effect on household crop choice. This indicates that the real reduction in the "non-grain" of farmland within the organized transaction method is attributed to the participation of the village committee.

4.4 Heterogeneity analysis

The above analysis indicates that organized transactions can reduce the probability of households cultivating cash crops. However, this is the average effect at the overall sample level and does not account for differences in geographical, institutional environments, and village types (Ma et al., 2015). In order to obtain more detailed research conclusions, we will group the data according to indicators such as terrain, the educational level of the village party secretary, whether the village party secretary also serves as the village director, and whether the village was classified as a poverty-stricken village before the completion of poverty alleviation, in order to further explore the heterogeneity of the impact of transaction methods on household crop cultivation.

Firstly, the robustness test results in plain areas show that the organized transaction method can reduce the likelihood of households cultivating cash crops by 7.2%, with statistical significance at the 5% level. The results in column (2) indicate that even in non-plain mountainous and hilly areas, the organized transaction method can reduce the likelihood of households cultivating cash crops. Although the impact in mountainous and hilly areas is smaller than in plain areas, the organized transaction method's mitigation of the "non-grain" of farmland is significant under any terrain conditions.

Next, considering different village governance institutional environments. Under different governance conditions, the effectiveness of organized transactions may vary because the level of governance can influence the extent and actual effects of village committees' involvement in farmland transfer transactions, as well as their supervision and management capabilities regarding farmland use. To this end, we grouped the data for regression analysis based on two indicators. The first is the educational level of the village secretary. Grouping was done based on whether the village secretary has a high school education, and the regression results are shown in columns (3) and (4). In the sample where the village secretary has a high school education, the organized transaction method can reduce the likelihood of households cultivating cash crops by 9.3%, with statistical significance at the 1% level. Conversely, in the sample where the village secretary does not have a high school education, the organized transaction method does not have a significant impact on household crop cultivation. This indicates that the human capital of the village secretary limits the governance performance of the village, thereby affecting the effectiveness of organized transactions. The second indicator is whether the village party secretary also serves as the village director. The regression results are shown in columns (5) and (6). In the sample where the village secretary serves as the village director, organized transactions can significantly reduce the likelihood of households cultivating cash crops, while in the sample where the village secretary does not serve as the village director, organized transactions have no effect. This suggests that the village secretary serving as the village director can better concentrate power and improve the governance capacity of the village (He and Wang, 2017).

Finally, we divided the sample into two categories based on whether the poverty alleviation work was completed before. The purpose of this grouping is to consider that poverty-stricken villages may relax their supervision of farmland use in order to improve their economic development and focus on increasing short-term agricultural profits. The results are shown in columns (7) and (8). The impact of organized transactions in reducing the likelihood of households cultivating cash crops is significant in both poverty-stricken villages and non-poverty-stricken villages samples, indicating that the reduction of "non-grain" of farmland by organized transactions is not constrained by the economic development level of the village (Table 6).

4.5 Pathways analysis

To elucidate the impact of farmland transfer transaction methods on the "non-grain" of farmland, this study analyzes from two perspectives: the transformation of household identity and contract characteristics. The results are shown in Table 7. The results in column (1) indicate that the organized transfer transaction method significantly increases the likelihood of households becoming family

TABLE 6 Estimated results of heterogeneity analysis.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Cultivated crops	Cultivated crops	Cultivated crops	Cultivated crops	Cultivated crops	Cultivated crops	Cultivated crops	Cultivated crops
Trading methods	−0.072**(0.034)	−0.051**(0.023)	−0.093***(0.023)	−0.001 (0.040)	−0.075***(0.025)	−0.022 (0.031)	−0.080**(0.032)	−0.064***(0.024)
Control variables	YES	YES	YES	YES	YES	YES	YES	YES
Village clustering standard error	YES	YES	YES	YES	YES	YES	YES	YES
Cons	0.037 (0.436)	2.382***(0.472)	0.912**(0.383)	1.498**(0.721)	0.037 (0.436)	2.382***(0.472)	0.912**(0.383)	1.498**(0.721)
Observations	990	1,382	1793	579	1,398	974	781	1,591

Standard errors in parentheses.
* $p<0.1$; ** $p<0.05$; *** $p<0.01$.

farms or professional large-scale farms, with an increase of 8.2%. The results in column (2) demonstrate that the organized transfer transaction method also significantly increases the likelihood of households joining professional cooperatives, with an increase of 8.4%. This suggests that the organized transfer transaction method can change the identity of households, reducing the likelihood of them engaging in cash crop cultivation by encouraging them to become new types of agricultural operators. This conclusion is similar to that of Zhang and Du (2015). Column (3) presents the regression results for the transaction method's impact on households signing formal written contracts, showing that the organized transaction method significantly increases the probability of households signing formal written contracts by 45.8%. Column (4) presents the results of the transaction method's impact on whether households agree on the lease term, indicating that the organized transfer transaction method significantly increases the probability of households agreeing on the lease term by 41.4%. The above regression results indicate that the organized transfer transaction method can increase the likelihood of households signing formal transfer contracts, thereby restricting private "non-grain" of farmland through improved contracts. This conclusion complements the findings of Li and Qin (2022), whose research discovered that the signing of formal contracts can break the demand dilemma of farmland transfer, thereby expanding the scale of the farmland transfer market.

5 Discussion

5.1 Discussion of findings

The large-scale emergence of "non-grain" land use phenomena poses a threat to China's food security objectives and the process of agricultural modernization (Wong and Huang, 2012; Bishwajit et al., 2013; Ghose, 2015). In response, the Chinese government has actively promoted the transfer of arable land, attempting to concentrate land through land transfer to leverage economies of scale and increase the proportion of grain cultivation. However, the relationship between the transfer of farmland and the phenomenon of "non-grain" of farmland has always been a matter of debate. Macroscopically, this approach has yielded certain benefits. The China Statistical Yearbook indicates that from 2003 to 2016, the proportion of grain sowing area in the total crop sowing area in China increased from 65.22 to 71.42%. However, from a micro perspective, a multitude of scholars have found that the phenomenon of "non-grain" land use has not been alleviated. In areas where regulatory costs are excessively high, the phenomenon of large-scale land abandonment or conversion to cash crops is rampant, and macroeconomic statistical data may have underestimated the extent of "non-grain" land use (Liu et al., 2014; Otsuka et al., 2016; Zeng, 2015). Does the transfer of farmland lead to "non-grain" land use or does it alleviate it? There is ongoing debate within the academic community on this issue, making it essential to explore the causal relationship between the two through empirical research. This paper aims to conduct an empirical analysis of the impact of farmland transfer on the "non-grain" of farmland, which is of significant importance for clarifying this contentious issue and for defining the direction of future policy.

In order to elucidate the impact of farmland transfer on the "non-grain" of farmland, this paper utilizes CRRS data to conduct an

TABLE 7 Estimated results of pathway analysis.

Variables	(1)	(2)	(3)	(4)
	New agricultural management entities	Agricultural cooperative	Contract signing	Rental period
Trading methods	0.082*** (0.016)	0.084*** (0.015)	0.458*** (0.033)	0.414*** (0.037)
Control variables	YES	YES	YES	YES
Village clustering standard error	YES	YES	YES	YES
Cons	0.367	0.291	0.226	−1.334***
Observations	2,378	2,378	1,223	1,220

Standard errors in parentheses.
* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

empirical analysis of the relationship between the two. We categorize the transfer of farmland into two types: one is the private, free transfer transactions between farmers, and the other is the organized transfer transactions through the village committee and the farmland transfer trading platform. The study finds that, compared to villages with free farmland transfer transactions, the proportion of farmers planting non-grain crops in villages with organized transactions decreased by 6.4%. Our conclusion is contrary to the research findings of Chen et al. (2014) and Zeng (2015), whose studies found that the transfer of farmland increased the likelihood of "non-grain" land use. Our conclusion supports the notion that the transfer of farmland reduces the "non-grain" phenomenon of farmland. Our research also differs from the results of Ma and Guangsi (2023) and Yao et al. (2024), whose studies found a U-shaped relationship between the transfer of farmland and the "non-grain" phenomenon of farmland. Similar to our research conclusion, Liu et al. (2018) found that the transfer of farmland reduced the proportion of farmers planting non-grain crops by 1.51%. The reason for the different conclusions lies in the fact that both the studies supporting the increase in "non-grain" land use due to the transfer of farmland, such as those by Chen et al. (2014) and Zeng (2015), and the studies by Liu et al. (2018) that believe the transfer of farmland can reduce the degree of "non-grain" land use, did not distinguish the methods of farmland transfer. In their studies, the treatment group consists of farmers who have transferred their land, while the control group consists of ordinary small farmers who have not transferred their land. Therefore, the reason for their opposite conclusions is likely due to the different proportions of organized transactions in the treatment group, that is, among the farmers who have transferred their land. When the sample includes more farmers who have transferred their land through private transactions, the transfer of farmland may increase "non-grain" land use or have no effect; when the sample includes more farmers who have transferred their land through organized transactions, the transfer of farmland reduces the degree of "non-grain" land use.

In fact, our study is likely a complement and further analysis of the research by Zhang and Du (2015), demonstrating the impact of farmland transfer on "non-grain" in a more general sense. They utilized monitoring data from 1740 family farms in China to analyze the relationship between farmland transfer and "non-grain" finding that the larger the scale of transferred arable land, the higher the proportion of non-grain crops planted. They discovered that the transfer of arable land led to an average decrease of 35.99% in the planting proportion of non-grain crops, a significant reduction likely due to their focus on new types of agricultural operators. Family farms typically transfer land through organized transactions because negotiating with small farmers for a large amount of land through free transactions would be too costly. Our study extends the research subjects from family farms to all types of farmers and finds that organized transactions can reduce the proportion of "non-grain" farmland. Our research also indicates that one of the reasons organized transactions reduce the "non-grain" proportion of arable land is that they promote the transformation of farmers' identities. Small farmers transfer land and leave agriculture, while more capable farmers transfer large amounts of land to become new types of agricultural operators, leveraging economies of scale. Therefore, the evidence we provide on the impact of farmland transfer on "non-grain" is more reliable.

5.2 Policy implications

To curb the "non-grain" of farmland, considering the reality of China's traditional smallholder economy, the Chinese government has chosen a solution that involves concentrating land through the land transfer market. However, the uneven effectiveness in practice has aroused academic attention to this issue. Since the policy goals have not been fully achieved, some scholars believe that land transfer is not the correct policy direction and instead encourage the use of socialized services and the maintenance of dispersed operations, with enhanced regulatory measures to curb the "non-grain" of farmland. Nevertheless, this paper argues that land transfer remains an important means to address the "non-grain" of farmland and ensure food security. The issue lies in how the land transfer is conducted. Specifically, the traditional private transfer between farmers does not help solve the problem of "non-grain" of farmland. What we need is a land transfer with deep involvement from the government and village committees, and the participation of third parties to strengthen the transformation of farmers' identities and reduce the cost of regulating the use of farmland, thereby alleviating the "non-grain" of farmland.

The findings of this paper indicate that the Chinese government's previous policy direction to curb the "non-grain" of farmland was to strengthen regulatory measures and increase the rate of land transfer. However, the increase in the land transfer rate has not been effective, and regulation comes with excessively high costs and a lack of effective means. The policy implications of this paper suggest that limiting the "non-grain" of farmland cannot rely solely on increasing the rate of

land transfer; it also requires the standardization of the land transfer market. By encouraging greater participation of village committees in land transfer, promoting a more organized land transfer transaction process, facilitating the transformation of farmers' identities, cultivating new types of agricultural operators, and leveraging the advantages of economies of scale. Moreover, through the signing and enforcement of contracts in organized transactions, the supervisory and managerial role of the village collective can be utilized to clarify the intended use of transferred land, and through management constraints and technological means such as drones, to monitor and manage the use of farmland in accordance with contract specifications.

5.3 Limits of the study and future research

There are two main limitations in this study. The first limitation is that the CRRS data we used only includes data up to the year 2020, which means we cannot observe the changes in the land transfer transaction methods of the same farmers over time and their long-term impact on the "non-grain" phenomenon of farmland. Moreover, although we employed the ivprobit method to minimize potential estimation biases that might arise from this factor, the cross-sectional nature of the data means we cannot use fixed effects to eliminate the influence of unobservable disturbances that do not change over time. The second limitation is due to the constraints of the variables available in the database, which prevent us from examining the impact of organized transaction methods on the details of farmland transfer contracts. We are unable to observe how village committees and government departments regulate the use of farmland, the frequency of regulation, and other mechanisms that directly affect the "non-grain" phenomenon of farmland. If we could understand how the transaction methods of farmers change over time and how these changes promote the regularization of farmland transfer, it would provide a better explanation of the relationship between farmland transfer and the "non-grain" phenomenon of farmland.

As practice and research continue to deepen, the relationship between the transfer of farmland and the "non-grain" phenomenon of farmland is attracting increasing attention from scholars (Qiu and Luo, 2022). If more detailed farmer survey data become available in the future, providing detailed information on each plot of land transferred by farmers, including the method of land transfer transaction, the crops planted before and after the transaction, the way contracts are signed, the duration, the transaction parties, and whether the village committee and government departments supervise the use of farmland and the methods of supervision, it would be possible to clarify the development process of the farmland transfer market, as well as the relationship between government involvement and agricultural development that accompanies it. At that time, we would be able to better understand the causal relationship between the transfer of farmland and the "non-grain" phenomenon of farmland, and provide some reference for agricultural policies in other developing countries in Southeast Asia and Africa with similar land systems.

6 Conclusion

To clarify the controversial issue of the impact of farmland transfer on the "non-grain" of farmland in academia, this paper systematically analyzes the influence of farmland transfer transaction methods on "non-grain" cultivation using the sample data of 306 villages and 3,819 farmers provided in the CRRS data. It deeply analyzes the mechanisms by which organized transfer transactions affect the "non-grain" status of arable land from two perspectives: the transformation of farmers' identities and the formalization of contracts. It further explores the different impacts of organized transfer transactions under various rural governance systems, providing a new policy perspective for curbing "non-grain" cultivation. Specifically, this paper has three main findings. Firstly, the study found that, compared to villages where farmland transfer transactions are conducted freely, the proportion of farmers in villages with organized transactions planting non-grain crops decreased by 6.4%. After addressing endogeneity using the ivprobit model, changing the levels of the dependent and independent variables, and further distinguishing the methods of farmland transfer transactions, the role of organized transactions in reducing the "non-grain" of farmland remains highly significant. The first research hypothesis of this paper is thus validated.

Secondly, the study found that the method of farmland transfer transactions not only affects the "non-grain" of farmland but also increases the likelihood of farmers becoming family farms and joining cooperatives. By transforming the identity of farmers, it raises the possibility of farmers engaging in the cultivation of grain crops. Moreover, organized transfer transactions can also increase the likelihood of farmers signing formal written contracts and agreeing on lease terms, thereby restricting private "non-grain" behavior of farmland through the perfection of contracts. The second research hypothesis of this paper is also verified.

Finally, considering the differences in village governance systems, this paper examines the role of farmland transfer transaction methods under various institutional environments. The research results indicate that in situations where the human capital of the village committee secretary is higher and the village committee secretary also serves as the village head, the role of organized transaction methods in reducing the "non-grain" of farmland is more pronounced.

This finding suggests that the governance structure and the capabilities of the village leadership can significantly influence the effectiveness of organized farmland transfer transactions. When the village committee secretary possesses higher human capital or holds dual roles, it may enhance the ability to implement and oversee organized land transfer transactions, which in turn can more effectively curb the "non-grain" of farmland. This insight provides a valuable perspective for policymakers and practitioners on how to leverage village governance to support agricultural sustainability and food security.

Data availability statement

The data analyzed in this study is subject to the following licenses/restrictions: the data used in this study is sourced from the Rural Development Institute, Chinese Academy of Social Sciences and is classified as confidential. This data is based on the Major Economic and Social Survey Project of the Chinese Academy of Social Sciences, "Comprehensive Survey of Rural Revitalization and the Construction of the Chinese Rural Survey Database." Access to this data requires application through the website of the Rural Development Institute,

Chinese Academy of Social Sciences. Requests to access these datasets should be directed to http://rdi.cssn.cn/ggl/202210/t20221024_5551642.shtml?eqid=8f49e047000446a000000006643d2baf; crrs_rdi@cass.org.cn.

Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent from the patients/participants or the patients'/participants' legal guardian/next of kin was not required to participate in this study in accordance with the national legislation and the institutional requirements.

Author contributions

HW: Conceptualization, Data curation, Formal analysis, Investigation, Software, Writing – original draft, Writing – review & editing, Methodology. QZ: Formal analysis, Funding acquisition, Methodology, Project administration, Resources, Supervision, Writing – review & editing, Validation, Visualization.

Funding

The author(s) declare that financial support was received for the research, authorship, and/or publication of this article. This work was supported by Soft Science Project of Ministry of Agriculture and Rural Affairs of China 2024 (No.: RKX2024028) Huzhou City 2024 Philosophy and Social Science Planning Project (No.: 24hzghy165).

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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