

Article

The Impact of Rural Centralized Residence on Land Transfer: Evidence from Sichuan, China

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Abstract

Exploring the impact of rural centralized residence (RCR) policies on land transfer behavior is crucial for promoting scaled agricultural operations in rural China. However, empirical scrutiny of RCR's effects on land transfer remains limited, as existing evaluations focus primarily on income and social outcomes. Using primary survey data from 2860 rural households in Sichuan Province, this study employs an instrumental variable (IV) approach to examine the causal effect of RCR on household land transfer decisions. This study contributes by providing the first systematic evaluation of RCR's impact on land transfer, distinguishing between opportunity-enhancing and pressure-based mechanisms while addressing endogeneity through a novel IV strategy. The results indicate that RCR significantly increases the probability of land transfer-out. Mechanism analysis reveals that this effect is driven by increased non-agricultural employment, enhanced internet usage, and increased agricultural production costs. Heterogeneity analysis further shows that the impact is more pronounced among small-scale farmers, households with highly fragmented land, female-headed households and elderly headed households. These findings suggest that RCR should be designed to promote voluntary land transfer through opportunity-enhancing mechanisms rather than pressure-based ones, offering significant implications for rural revitalization and food security.

Keywords: rural centralized residence; land transfer; urban–rural integration; non-agricultural employment



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1. Introduction

Optimizing the allocation of rural land resources is critical for ensuring food security, achieving rural modernization, and promoting rural revitalization [1]. However, rapid industrialization and urbanization have driven the continuous expansion of urban boundaries. The rigid demand for land resources has necessitated the requisition of vast amounts of rural arable land, resulting in a sustained reduction in cultivated area [2]. Concurrently, the superior development opportunities in cities have generated a “siphon effect,” triggering a massive rural exodus [3]. This dual depletion of human and land resources has not only exacerbated rural labor shortages but also induced land idleness and disorderly utilization, leading to sluggish rural development, widening urban–rural gaps, and even

rural decline [4]. Consequently, how to effectively allocate land resources to foster rural economic development has become a focal point for both academia and policymakers.

Land transfer essentially involves the restructuring of contractual management rights among different entities, serving critical functions including reshaping urban–rural spaces, facilitating the migration of surplus rural labor, ensuring food security, and maximizing resource utilization efficiency [5]. According to the Ministry of Agriculture and Rural Affairs, by the end of 2023, the total area of rural land transferred in China reached 39.4 million hectares, accounting for 37.76% of the total contracted land. Nevertheless, China’s rural land transfer market still faces significant challenges regarding insufficient and unbalanced development.

Drawing on international precedents from countries like the UK, Japan, and the US, which pioneered rural centralized residence (RCR) policies guided by growth pole and central place theories to address rural hollowing [6], China has been actively exploring localized RCR practices nationwide since 2004 to alleviate urban–rural land imbalances and improve the rural living environment [7]. RCR refers to the voluntary relocation of geographically dispersed village households to uniformly planned township communities or central villages, with the aim of alleviating fragmented land management, improving farmers’ living environments, and accelerating urbanization [8]. An important objective of the RCR policy is to facilitate the scaled transfer and efficient, concentrated utilization of land, thereby achieving moderate-scale agricultural operations. Specifically, by guiding rural households to reside in centralized communities, the policy promotes rural construction land consolidation. The consolidated construction land is subsequently utilized by village collectives to attract investment and establish local enterprises or industrial parks, thereby vigorously advancing the transformation and development of the local rural employment structure. As households increasingly engage in non-agricultural employment, their dependence on cultivated land weakens, enhancing their willingness to transfer land [9]. Furthermore, RCR facilitates the flow of capital and labor through the mobility of land factors, fostering a more market-oriented land management regime. In practice, however, whether RCR effectively promotes rural land transfer remains an empirical question requiring rigorous verification.

Sichuan, a major agricultural province with inadequate rural infrastructure and significant urban–rural disparities, has progressively implemented the RCR policy since 2004, providing an ideal “natural experiment” setting for evaluating the impact of RCR on rural land transfer. Against this backdrop, this paper utilizes household survey data from Sichuan Province to empirically examine the specific impact of the RCR policy on farmers’ land transfer behavior. It is important to emphasize that land transfer is not automatically a socially desirable outcome. When land transfer is driven by expanded off-farm employment opportunities, improved information access, and enhanced household capabilities, it reflects voluntary household choices and can be considered welfare-enhancing. However, when land transfer is induced by increased farming distances, rising agricultural costs, and deteriorating farming conditions—factors that effectively pressure households to exit agriculture—it may represent a loss of livelihood options rather than a genuine choice. Accordingly, this study not only examines whether RCR increases land transfer but also identifies the mechanisms through which this effect operates, distinguishing between opportunity-enhancing mechanisms and pressure-based mechanisms.

The existing literature on RCR predominantly revolves around three strands: the driving forces and implementation mechanisms of the policy [9]; the determinants of farmers’ participation decisions [10,11]; and the evaluation of its multi-dimensional policy effects [12]. Within the realm of policy effects, a wealth of studies has examined the impact of RCR on diverse outcomes, including out-migration [8], social interactions [13], residents’

health [14], and energy poverty [7]. However, scholarship addressing how RCR influences farmers' land transfer behavior—a critical dimension of rural development—remains relatively scarce. To date, only a handful of studies have preliminarily discussed the nexus between RCR and land transfer. Most of these are confined to theoretical deduction or typical case analyses, with a notable paucity of rigorous empirical research identifying causal relationships using micro-level household survey data. For instance, Wang and Chen (2023) theoretically posit that RCR facilitates large-scale rural land transfer, drives the reconstruction of rural production and living spaces, and enables the redistribution of land value increments [15]. Similarly, Liu et al. (2018), based on a case study in Chongqing, China, found that RCR promotes farmers' land transfer-out behavior to a certain extent [3], although the external validity of these findings warrants further verification. Crucially, these studies have not adequately addressed endogeneity issues, thereby precluding a robust identification of the causal relationship between the two variables.

To address this gap, this paper utilizes micro-level household survey data and employs an instrumental variable (IV) approach to empirically identify the causal effect of RCR on farmers' land transfer, systematically dissecting the underlying transmission mechanisms.

Relative to existing literature, this study makes contributions in three respects. First, regarding research content, this paper utilizes large-scale micro-level household survey data to empirically examine the impact of the RCR on farmers' land transfer, providing direct evidence for evaluating the land effects of the policy. Existing evaluations of the RCR have focused primarily on farmers' income, social interactions, and employment status, while paying insufficient attention to land transfer. The limited studies that address the link between RCR and land transfer are predominantly theoretical or rely on descriptive statistics, lacking rigorous micro-level empirical testing. By providing robust empirical evidence to clarify the causal relationship between RCR and land transfer, this study represents a significant supplement to the existing literature. Second, regarding theoretical mechanisms, this study provides an in-depth analysis of the specific channels through which RCR promotes land transfer. The findings reveal that RCR significantly facilitates land transfer through multiple pathways, including enhancing households' propensity for non-agricultural employment, increasing internet adoption among rural households, and raising the relative costs of agricultural production, thereby furnishing rich micro-level evidence for understanding the economic effects of RCR policies. Third, in terms of research design, this study employs an instrumental variable approach to address potential endogeneity concerns, thereby ensuring the reliability of the estimation results. By introducing expected lump-sum housing subsidies as an instrumental variable, this study more precisely estimates the causal effect of RCR on land transfer, overcoming the limitations of prior research in this regard.

2. Policy Background and Conceptual Links Between the RCR and Land Transfer

2.1. Policy Background

In its capacity as the globe's most prominent developing nation, China is characterized by significant inequality in development between its urban and rural regions. In recent years, to revitalize scarce rural land resources and rejuvenate rural areas, governments at various levels in China have actively promoted the RCR policy, guiding rural households to relocate to centralized communities or central villages [14]. Policy practice has deepened continuously, starting from the national proposal of the "linkage between the increase of urban construction land and the decrease of rural construction land" in 2004, and continuing to the initiation of pilot projects in Sichuan and other provinces in 2005.

Economic viability is key to farmers' decision-making; although they bear construction costs, a one-time government subsidy—calculated based on household size and the original homestead area—effectively offsets part of the expenditure. Theoretically, the higher the expected government housing subsidy a household anticipates, the greater the probability that they will move into an RCR community.

2.2. Conceptual Links Between the RCR and Land Transfer

Since the reform and opening-up, promoting land transfer among rural households has been regarded as an effective approach to mitigating land fragmentation and achieving moderate-scale agricultural operations. Currently, China faces considerable challenges of fragmented and dispersed land management, as well as significant cultivated land abandonment in rural areas, resulting in low agricultural productivity [3]. These conditions remain substantially inconsistent with the requirements of agricultural and rural modernization. The construction of rural centralized residential communities can effectively activate the substantial stock of idle homestead land in rural areas, accelerate land transfer, and promote the intensive utilization of land [6]. The RCR policy may influence land transfer among rural households through three principal channels. First, RCR promotes the consolidation and comprehensive utilization of idle rural homestead land; the construction land thus saved can be used to attract investment, generating more non-agricultural employment opportunities and significantly increasing households' non-agricultural income [7]. This reduces rural households' dependence on land and, in turn, enhances their willingness to transfer land. Second, the implementation of RCR relocates rural households away from the cultivated land surrounding their former dwellings, thereby expanding the radius of agricultural production, leaving agricultural machinery without storage space, and increasing the costs of agricultural production for rural households [16]. This, in turn, raises their willingness to transfer land. Third, centralized residence promotes the popularization of the rural internet, reduces the cost for farmers to search for information, lowers information asymmetry, and facilitates the matching of information between the two parties in land transfer, thus increasing the probability of farmers transferring land.

To provide a rigorous theoretical foundation for our analysis, we draw on spatial justice theory [17,18], which emphasizes that spatial reorganization policies such as RCR should be evaluated not merely in terms of efficiency gains but also through the lenses of distributive justice, procedural justice, and recognition justice. Distributive justice concerns the allocation of costs, benefits, employment opportunities, infrastructure, compensation, and accessibility across different groups. Procedural justice focuses on participation, transparency, informed consent, negotiation, and access to remedies. Recognition justice addresses the specific needs of vulnerable groups, including small-scale farmers, elderly households, women, poorer families, and households strongly dependent on agriculture. This tripartite framework provides a unified analytical lens for understanding the three mechanisms through which RCR affects land transfer—non-agricultural employment, internet usage, and agricultural costs. Specifically, the first two mechanisms (non-agricultural employment and internet usage) represent opportunity-enhancing pathways that align with principles of distributive and recognition justice by expanding household choices and improving access to information and alternative livelihoods. In contrast, the agricultural cost mechanism reflects a pressure-based pathway that raises concerns about procedural justice and the protection of vulnerable households who may wish to continue farming but face deteriorating accessibility and rising costs. Guided by this framework, we develop three hypotheses regarding the mechanisms through which RCR promotes land transfer, and we return to the spatial justice dimensions in interpreting our findings and formulating policy recommendations.

2.2.1. Non-Agricultural Employment

The first potential channel through which RCR affects land transfer is by increasing the probability of rural households engaging in non-agricultural employment. RCR can effectively activate the substantial stock of idle rural homestead land and attract social capital toward the construction of agricultural production bases and agricultural product distribution centers. This not only creates more non-agricultural employment opportunities but also accelerates the transfer of rural labor to non-agricultural sectors. Moreover, local infrastructure improves significantly in both quantity and quality following the implementation of RCR; for example, public infrastructure in many RCR communities, such as network facilities and road infrastructure, undergoes considerable improvement [3]. These infrastructure enhancements significantly reduce the search costs and transportation costs for rural households seeking non-agricultural employment. A growing body of literature evaluating RCR policies has confirmed that RCR may provide rural households with greater employment opportunities, thereby facilitating their transition from agriculture to non-agricultural employment [19]. For instance, Liu and Zhou (2023) demonstrated that RCR significantly increases the probability of rural households engaging in commercial activities [7]. When rural households shift from agriculture to non-agricultural employment, they have less time and energy to devote to land cultivation, leading to a higher willingness to transfer out their land in exchange for rental income. A series of studies on land transfer have found that non-agricultural employment significantly increases the probability of land transfer among rural households [20,21]. For example, Xu et al. (2022) found that non-agricultural employment exerts a significant positive effect on land transfer-out among rural households [22]. In summary, we propose the following hypothesis:

H1. *RCR increases the probability of land transfer among rural households by raising their likelihood of non-agricultural employment.*

2.2.2. Internet Usage

The second potential channel through which RCR affects land transfer is by increasing internet connectivity. Rural centralized residence is not merely a unilateral relocation of farmers but rather a comprehensive process in which the government plays a guiding role and provides financial support. In this process, the government not only directly invests a portion of funds but also prudently and conditionally introduces capital to jointly participate in the construction of rural infrastructure, including road construction and the laying of network communication pipelines, to ensure that rural areas have adequate infrastructure following centralization [6]. Therefore, RCR significantly increases internet connectivity rates among rural households and promotes their use of the internet [8]. Internet usage, on the one hand, enables rural households to more conveniently access land transfer information, overcoming temporal and spatial constraints, broadening the scope of information sources, and enhancing the timeliness and reliability of information, thereby alleviating information asymmetry and improving market efficiency [23]. On the other hand, the internet also helps rural households expand their interpersonal networks, consolidating “strong ties” with friends and relatives while creating opportunities to establish “weak ties” with strangers, thereby enriching rural households’ social resources and improving the efficiency of land transfer contract formation [24]. In summary, we propose the following hypothesis:

H2. *RCR increases the probability of land transfer among rural households by enhancing their internet usage.*

2.2.3. Agricultural Cost

The third potential channel through which RCR affects land transfer is by increasing the costs of agricultural activities for rural households. Traditional rural housing is highly dispersed, with rural households' cultivated land generally located in close proximity to their dwellings, as farmers prefer to reclaim cultivated land adjacent to their homes or directly build new houses near their fields [25]. Under this traditional settlement pattern, the radius of agricultural production for rural households is relatively short, confining agricultural activities to cultivated land near their residences and resulting in lower agricultural production costs. However, RCR communities are typically built in areas with favorable transportation or geographic conditions and may even involve relocation to townships or adjacent urban areas. Consequently, RCR communities are situated far from rural households' original residences and, by extension, their cultivated land, elongating the farming radius and leaving agricultural machinery without adequate storage [16]. This increases commuting time, the cost of transporting agricultural products [26], and the production investment costs associated with land reclamation, significantly raising the costs of agricultural production for rural households [27]. Liu et al. (2020) found that RCR causes rural households to be distant from their cultivated and forested land, thereby increasing the costs of their agricultural activities [12]. The increase in agricultural costs significantly reduces rural households' willingness to engage in agricultural production, thereby increasing the probability of land transfer. In summary, we propose the following hypothesis:

H3. *RCR increases the probability of land transfer among rural households by raising the costs of their agricultural activities.*

3. Data and Identification Strategy

3.1. Data Sources

This study draws on a household-level survey conducted across Sichuan Province in 2017. The survey involved interviews with households across 20 counties and 105 villages, with 30 to 40 households randomly selected from each village. The questionnaire covered household demographic composition, RCR participation, household economic conditions, and village-level geographic and economic attributes. After excluding observations with missing or anomalous values for core variables, the final analytical sample comprises 2860 rural households.

3.2. Variable Definitions and Descriptive Statistics

3.2.1. Dependent Variable

The dependent variable in this study is the land transfer status of rural households. One of the primary objectives of RCR is to guide land transfer toward more efficient farmers, thereby achieving moderate-scale agricultural operations. This study therefore focuses on the situation of households transferring out their land. Following Gao et al. (2020), land transfer is defined as whether a household transfers its contracted land to others [2]. The variable takes a value of 1 if the household transfers out its land to another household and 0 otherwise.

3.2.2. Independent Variable

The core explanatory variable is rural centralized residence (RCR). As discussed in the theoretical analysis above, a household's decision to move into an RCR community has significant implications for its production and daily life. This study focuses on the effect of RCR on land transfer. Compared with non-RCR households, RCR households have a

higher probability of non-agricultural employment and are thus more likely to transfer out their land. Following Liu and Zhou (2023), RCR is defined as whether a household has moved into an RCR community [7]: the variable takes a value of 1 if the household has moved into an RCR community and 0 otherwise.

3.2.3. Instrumental Variable

The instrumental variable is the natural logarithm of the expected lump-sum housing subsidy. This subsidy amount is determined by the government based on pre-determined characteristics—specifically, household size and original housing area—and is disclosed to farmers prior to their relocation decisions. Conditioning on these pre-determined characteristics, the instrumental variable meets the conditional independent assumption [28,29].

3.2.4. Control Variables

Following existing related studies, in addition to controlling for the pre-determined household characteristics that determine the instrumental variable, this study also controls for three sets of variables: household head characteristics, other household characteristics, and village-level characteristics, as detailed in Table 1. Household head characteristics include the age, gender, and educational attainment of the household head. Household characteristics include household size, the number of children under 6 years of age, the number of elderly aged 65 and above, the scale of contracted land, the degree of land fragmentation, the housing area before RCR, and the homestead land area before RCR. Village characteristics include whether the village is located in a mountainous area, whether the village has scenic attractions, and whether the village has roads at or above the county level.

Table 1. Variable definitions, coding, and descriptive statistics.

Variable	Definition	Full Sample (1)	RCR (2)	Non-RCR (3)	Column (2)–(3) (4)
land transfer	Transfer out land: yes = 1, no = 0	0.276	0.284	0.272	0.013
RCR	Moved into RCR community: yes = 1, no = 0	0.307	-	-	-
Lump-sum housing subsidy	Expected lump-sum housing subsidy (10,000 RMB)	3.906	10.32	5.518	4.803 ***
Age of household head	Age of household head (years)	54.55	53.92	54.84	−0.920 *
Gender of household head	Gender of household head: male = 1, female = 0	0.513	0.504	0.516	−0.012
Education of household head	Education of household head: junior high or above = 1, below junior high = 0	0.441	0.454	0.435	0.019
Household size	Number of household members	3.829	3.610	3.927	−0.317 ***
Children under 6	Number of children under 6 years old	0.266	0.274	0.262	0.012
Elderly above 65	Number of elderly aged 65 and above	0.708	0.664	0.728	−0.064 *
Contracted land area	Cultivated land area of household (hm ²)	0.246	0.236	0.250	−0.014 **
Land fragmentation	Number of land plots contracted by household	7.615	7.113	7.837	−0.725 **
Housing area before RCR	Household housing area before RCR	5.185	5.141	5.205	−0.064 ***
Homestead area before RCR	Homestead land area before RCR	5.599	5.562	5.616	−0.055 **
Mountainous area	Village located in mountainous area: yes = 1, no = 0	0.406	0.488	0.370	0.119 ***
Scenic attractions	Village has scenic attractions: yes = 1, no = 0	0.093	0.149	0.068	0.081 ***
County-level road or above	Village has county-level road or above: yes = 1, no = 0	0.567	0.569	0.566	0.003
Observations		2860	879	1981	2860

Notes: The variables “Contracted land area,” “Lump-sum housing subsidy,” “Housing area before RCR,” and “Homestead area before RCR” are log-transformed in subsequent regressions. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Due to missing data for some variables, the final analytical sample consists of 2860 rural households. Table 1 reports the definitions, coding, and descriptive statistics for these variables. Column (1) reports the statistics for the full sample, while Columns (2) and (3) present the descriptive statistics for households that chose RCR and those that did not, respectively. Column (4) displays the differences in means between the two groups. Regarding the dependent variable, the mean of “land transfer” is 0.276, indicating that 27.6% of households in the total sample have transferred out their land. For the core explanatory variable, the mean of “RCR” is 0.307, indicating that 30.7% of households in the total sample have moved into RCR communities. Column (4) shows that in terms of unconditional mean differences, RCR appears positively correlated with households’ land transfer, although the difference is not statistically significant. Regarding the instrumental variable, RCR households received higher housing subsidies than non-RCR households. This provides preliminary evidence that expected housing subsidies can predict a household’s decision to accept RCR.

3.3. Identification Strategy

If the decision of rural households to participate in RCR were a randomly assigned treatment, the causal effect of RCR on land transfer could be identified using the following OLS model (Linear Probability Model):

$$y_{ijk} = \beta_0 + \beta_1 RCR_{ijk} + \beta_2 X_{ijk} + \beta_3 W_{jk} + \omega_k + \varepsilon_{ijk} \quad (1)$$

where i , j , and k denote the household, village, and township, respectively; y_{ijk} indicates whether the household has transferred out its land (1 if transferred, 0 otherwise); RCR_{ijk} indicates whether the household has chosen to participate in RCR (1 if moved into an RCR community, 0 otherwise); X_{ijk} represents household demographic characteristics, such as the age and gender of the household head and household size; W_{jk} represents village-level characteristics, such as whether the village is located in a mountainous area, road conditions, and whether the village has scenic attractions; ω_k denotes township fixed effects; and ε_{ijk} is the random error term.

However, the decision to move into an RCR community may be a self-selection behavior. For example, some households may have a stronger preference for non-agricultural work, which increases their probability of land transfer. Such preferences may also motivate them to move into RCR communities, as these communities offer more non-agricultural employment opportunities. Furthermore, households that have not transferred their land may be less willing to move into RCR communities, as RCR generally distances them from their cultivated land. Additionally, endogeneity may arise from omitted variables.

To address the endogeneity arising from self-selection and omitted variables, this study follows Liu and Zhou (2022) in using the expected lump-sum housing subsidy as an instrumental variable for RCR [8]. The two-stage least squares (2SLS) method is employed to estimate the causal effect of RCR on land transfer. The first-stage and reduced-form equations are as follows:

$$RCR_{ijk} = \alpha_0 + \alpha_1 Sub_RCR_{ijk} + \alpha_2 X_{ijk} + \alpha_3 W_{jk} + \delta_k + \sigma_{ijk} \quad (2)$$

$$y_{ijk} = \gamma_0 + \gamma_1 Sub_RCR_{ijk} + \gamma_2 X_{ijk} + \gamma_3 W_{jk} + \pi_k + v_{ijk} \quad (3)$$

where Sub_RCR_{ijk} denotes the expected lump-sum housing subsidy; δ_k and π_k denote township fixed effects; and σ_{ijk} and v_{ijk} are random error terms. In this study, the effect of RCR on land transfer identified using the IV approach represents the Local Average Treatment Effect (LATE).

4. Results

4.1. Benchmark Result Analysis

Table 2 reports the regression results for the effect of RCR on land transfer among rural households. Column (1) of Table 2 presents the baseline OLS regression results, which show that the coefficient on RCR is significantly positive, indicating that RCR significantly increases the probability of land transfer among rural households. As discussed above, this study may be subject to endogeneity concerns; therefore, we further employ the instrumental variable (IV) approach to estimate the effect of RCR on land transfer. Column (2) of Table 2 reports the IV estimation results. Consistent with the OLS estimates, the IV results also indicate that RCR significantly increases the probability of land transfer. However, comparing the coefficients between columns (1) and (2), we observe a notable difference in the magnitude of the RCR coefficient, suggesting that the baseline model may suffer from endogeneity. Accordingly, we conducted an endogeneity test, the results which confirm that endogeneity is indeed present in the OLS regression (F-statistic = 3.163; p -value = 0.078). Column (3) of Table 2 reports the first-stage regression results, which show that the coefficient on the lump-sum housing subsidy is significantly positive, indicating that this variable has strong positive predictive power for RCR. Additionally, Column (3) reports the weak instrument test results: the Kleibergen–Paap rk Wald F-statistic is 44.897, far exceeding the critical value of 16.380 at the 10% significance level, confirming that the instrumental variable used in this study is not a weak instrument. In summary, all of the above results consistently demonstrate that RCR significantly increases the probability of land transfer among rural households.

Table 2. Regression results for the effect of RCR on land transfer.

Variable	Land Transfer		RCR
	OLS	IV	First-Stage
	(1)	(2)	(3)
RCR	0.101 *** (0.035)	0.337 *** (0.124)	-
Sub_RCR	-	-	0.036 *** (0.005)
Age of household head	0.000 (0.001)	0.001 (0.001)	-0.001 (0.001)
Gender of HH head (male = 1)	-0.026 * (0.014)	-0.024 (0.014)	-0.015 (0.014)
Junior high education or above	0.007 (0.017)	0.003 (0.017)	-0.005 (0.017)
Household size	-0.011 (0.007)	-0.006 (0.007)	-0.003 (0.007)
Children under 6	0.003 (0.017)	-0.011 (0.020)	0.033 * (0.018)
Elderly above 65	-0.006 (0.009)	-0.009 (0.010)	0.001 (0.009)
Contracted land area	0.145 *** (0.028)	0.149 *** (0.030)	-0.008 (0.026)
Land fragmentation	-0.005 ** (0.002)	-0.005 ** (0.003)	0.001 (0.002)
Housing area before RCR	0.004 (0.019)	0.013 (0.020)	-0.046 * (0.025)

Table 2. Cont.

Variable	Land Transfer		RCR
	OLS	IV	First-Stage
	(1)	(2)	(3)
Homestead area before RCR	−0.012 (0.015)	−0.012 (0.014)	−0.005 (0.018)
Mountainous area	−0.075 (0.057)	−0.024 (0.072)	−0.001 (0.072)
Scenic attractions	0.159 *** (0.057)	0.092 (0.071)	0.212 ** (0.096)
County-level road or above	0.068 (0.059)	0.039 (0.063)	0.007 (0.057)
Township FE	YES	YES	YES
Endogeneity test (<i>p</i> -value)	-	3.163 (0.070)	-
Kleibergen–Paap rk Wald F	-	-	44.897
Observations	2860	2860	2860
Adjusted R ²	0.328	0.287	0.384

Notes: Standard errors clustered at the village level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

4.2. Robustness Checks

4.2.1. Probit and IV-Probit Model Estimation

Given that the dependent variable (land transfer) is a binary (0–1) variable and the baseline regression employs the OLS model, this study further uses Probit and IV-Probit models for robustness testing. Columns (1) and (2) of Table 3 report the results using Probit and IV-Probit models, respectively. The results show that the effect of RCR on land transfer remains significantly positive, indicating that the regression results are not sensitive to different model specifications.

Table 3. Robustness check results.

Variable	(1)	(2)	(3)	(4)	(5)
	Probit	IV-Probit	GMM	IV-Lasso	Excluding Tianfu New Area Samples
RCR	0.112 *** (0.032)	0.487 *** (0.108)	0.337 *** (0.124)	0.354 *** (0.115)	0.301 ** (0.125)
Controls	Yes	Yes	Yes	Yes	Yes
Township FE	Yes	Yes	Yes	Yes	Yes
Observations	2703	2703	2860	2860	2740
Adj. R ²	-	-	0.287	-	0.301

Notes: Standard errors clustered at the village level. *** $p < 0.01$, ** $p < 0.05$. Columns (1) and (2) report average marginal effects for the Probit and IV-Probit methods. The corresponding regression coefficients are 0.466 (variance: 0.136) and 1.736 (variance: 0.268), respectively.

4.2.2. GMM Regression Method

In the baseline regression, this study assumes homoscedasticity of the disturbance term. Here, this assumption is relaxed, and the more heteroscedasticity-robust GMM method is employed for robustness testing. Column (3) of Table 3 reports the GMM regression results, which show that the coefficient on RCR is broadly consistent with the baseline results, indicating that the findings are not affected by heteroscedasticity.

4.2.3. IV-Lasso Machine Learning Estimation

The machine learning literature demonstrates that Post Double Selection Lasso Linear Regression can identify control variables that are highly correlated with both the variable of interest and the outcome variable, thereby avoiding the inference problems associated with including too many controls (which may lead to overfitting) [29]. This study applies the Post Double Selection Lasso Linear Regression method to select control variables from the baseline regression and then re-estimates the model using the selected key variables. Column (4) of Table 3 reports the IV-Lasso results, which are broadly consistent with the baseline findings, confirming the robustness of the results.

4.2.4. Excluding Tianfu New Area Samples

This study further excludes samples from Tianfu New Area, a national-level new district that may be subject to other confounding policies affecting the estimation. Column (5) of Table 3 reports the regression results after excluding the Tianfu New Area samples. The coefficient on RCR remains significantly positive, confirming the robustness of the baseline results.

4.3. Mechanism Analysis

Having confirmed the relationship between RCR and land transfer among rural households, this study further investigates the channels through which RCR influences land transfer behavior.

4.3.1. Non-Agricultural Employments

RCR promotes population agglomeration and concentrated land use, generating more business opportunities and thereby encouraging rural households to shift toward non-agricultural employment. Previous economic studies have confirmed that non-agricultural employment among rural households promotes land transfer [22]. This study defines households whose non-agricultural income exceeds 50% of total income as predominantly non-agricultural employment households. Columns (1) and (2) of Table 4 show that RCR significantly increases the proportion of households engaged primarily in non-agricultural employment. Furthermore, households with business income are defined as engaged in commercial activities. Columns (3) and (4) of Table 4 show that RCR significantly increases the probability of households engaging in commercial activities. These results indicate that RCR enhances the probability of land transfer by facilitating the shift in rural households from agriculture to non-agricultural employment. Thus, H1 is supported.

Table 4. Regression results for the non-agricultural employment mechanism.

Variable	Non-Agri Employment		Business	
	OLS	2SLS	OLS	2SLS
	(1)	(2)	(3)	(4)
RCR	0.076 *** (0.019)	0.105 ** (0.053)	0.055 * (0.030)	0.197 ** (0.095)
Controls	Yes	Yes	Yes	Yes
Township FE	Yes	Yes	Yes	Yes
Observations	2860	2860	2860	2860
Adj. R ²	0.292	0.291	0.145	0.133

Notes: Standard errors clustered at the village level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

4.3.2. Internet Usage

The implementation of RCR programs is necessarily accompanied by significant improvements in the quantity and quality of rural public infrastructure, including substantial enhancements in network facilities. Internet usage reduces rural households' information search costs, greatly facilitates information access and market expansion, and improves the efficiency of land transfer markets. This study uses the internet access rate to measure household internet usage. Columns (1) and (2) of Table 5 show that RCR significantly improves internet usage, promoting household internet adoption and reducing information search costs, thereby enhancing the matching of supply and demand in the land transfer market and increasing the probability of land transfer. These results indicate that RCR enhances household internet usage, which in turn increases the probability of land transfer. Thus, H2 is supported.

Table 5. Regression results for the internet usage and agricultural costs mechanism.

Variable	Internet Usage		Agricultural Costs	
	OLS	2SLS	OLS	2SLS
	(1)	(2)	(3)	(4)
RCR	0.158 *** (0.023)	0.202 *** (0.075)	0.822 ** (0.326)	1.753 ** (0.731)
Controls	Yes	Yes	Yes	Yes
Township FE	Yes	Yes	Yes	Yes
Observations	2860	2860	2857	2857
Adj. R ²	0.220	0.219	0.062	0.049

Notes: Standard errors clustered at the village level. *** $p < 0.01$, ** $p < 0.05$.

4.3.3. Agricultural Cost

Rural cultivated land is generally located near rural households' own dwellings to minimize agricultural production costs. RCR communities, planned uniformly by the government, are typically built far from households' original residences, significantly increasing the time required for rural households to commute between their land and their homes, thereby raising the costs of agricultural production. This study uses the distance from each household to its nearest cultivated land as a measure of agricultural production costs. Columns (3) and (4) of Table 5 show that moving into RCR communities significantly increases the agricultural costs for rural households. However, it is important to interpret this mechanism carefully. While the increased distance may objectively promote land transfer, it may also indicate a deterioration in accessibility and livelihood conditions for households that intend to continue farming. Unlike the non-agricultural employment and internet usage mechanisms, which represent opportunity-enhancing pathways, the agricultural cost mechanism may constitute an indirect form of economic or spatial pressure. Thus, while we confirm that H3 is supported empirically, we caution that this mechanism should not be celebrated as an efficient policy outcome but rather recognized as a potential equity concern that requires policy attention. The policy implications should therefore focus on mitigating these additional costs for households that wish to continue farming, rather than using them as an implicit incentive to exit agriculture.

It is important to recognize that these three mechanisms differ fundamentally in their normative implications. The non-agricultural employment and internet usage channels represent opportunity-enhancing mechanisms: they expand household choices and facilitate voluntary land transfer by improving access to information and alternative livelihoods. By contrast, the agricultural cost mechanism reflects a pressure-based pathway: increased

farming distances raise the costs of continued agricultural activity, potentially forcing households to transfer land even if they would prefer to continue farming. From the perspective of spatial justice, opportunity-enhancing mechanisms align with principles of distributive and recognition justice, whereas pressure-based mechanisms raise concerns about procedural justice and the protection of vulnerable households. We return to this distinction in our conclusions and policy implications.

Moreover, the three mechanisms we identify have distinct sustainability implications. The non-agricultural employment mechanism primarily affects economic sustainability by enhancing household income stability and reducing dependence on agriculture, though its long-term effects depend on the quality and stability of off-farm employment. The internet usage mechanism contributes to both economic sustainability (by reducing information search costs and improving market efficiency) and social sustainability (by expanding social networks and reducing information asymmetry). The agricultural cost mechanism, however, raises concerns across all three sustainability dimensions: it may undermine economic sustainability by increasing production costs for remaining farmers, social sustainability by pressuring land-dependent households to exit agriculture, and environmental sustainability by potentially accelerating land use intensification and landscape simplification.

4.4. Heterogeneity Analysis

Given that different groups exhibit significant differences in resource endowments and willingness to engage in agricultural production, this study further explores the heterogeneous effects of RCR on land transfer across population subgroups.

The cultivated land area of rural households is an important determinant of land transfer. In general, households with more cultivated land resources have a deeper dependence on land, a relatively larger share of agricultural income, and higher opportunity costs of shifting to non-agricultural employment; consequently, their willingness to transfer land is relatively lower. This study divides the sample into large-scale farmers (households with above-median cultivated land area) and small-scale farmers (households with below-median cultivated land area) based on the median cultivated land area. Columns (1) and (2) of Table 6 present the regression results for these two groups. The results indicate that the effect is more pronounced for small-scale farmers. A possible explanation is that small-scale farming households have a relatively lower share of agricultural income and weaker dependence on land. RCR distances households from their original cultivated land, expanding the agricultural production radius and increasing farming costs, which reduces their willingness to engage in agriculture. This, in turn, prompts small-scale farmers, who have lower land dependence, to shift more toward non-agricultural activities, thereby promoting land transfer.

Table 6. Heterogeneity regression results by cultivated land area gender and land fragmentation.

Variable	Small-Scale	Large-Scale	High Frag.	Low Frag.
	(1)	(2)	(3)	(4)
RCR	0.492 *** (0.123)	0.289 * (0.167)	0.392 *** (0.133)	0.267 (0.172)
Controls	Yes	Yes	Yes	Yes
Township FE	Yes	Yes	Yes	Yes
Observations	1433	1427	1452	1408
Adj. R ²	0.227	0.387	0.306	0.337

Notes: Standard errors clustered at the village level. *** $p < 0.01$, * $p < 0.1$.

The degree of land fragmentation significantly affects land transfer among rural households. In general, a higher degree of land fragmentation implies more dispersed land plots, higher agricultural production costs, a greater willingness to shift to non-agricultural production, and a correspondingly higher willingness to transfer land. This study divides the sample into households with high land fragmentation (above-median) and those with low land fragmentation (below-median) based on the median degree of land fragmentation. Columns (3) and (4) of Table 6 present the regression results for these two groups. The results indicate that the effect is more pronounced for households with high land fragmentation. A possible explanation is that households with high land fragmentation face relatively higher agricultural production costs and inherently lower willingness to engage in agriculture. RCR, on the one hand, increases farming costs and, on the other hand, provides more non-agricultural employment opportunities, thereby prompting households with high fragmentation—who already have a lower propensity for agricultural production—to shift more toward non-agricultural activities, promoting land transfer.

The age of the household head serves as a critical proxy for household labor supply capacity and agricultural production propensity. Significant variations in physical health, labor skills, and decision-making preferences across different age cohorts suggest potential heterogeneity in the impact of RCR on land transfer. Using the age of 60 as a threshold, we partition the sample into households with heads aged 60 and above and those with heads under 60 years of age. Columns (1) and (2) of Table 7 report the regression results for these respective age groups. The results indicate a more pronounced effect for the group with heads aged 60 and above. A plausible mechanism is that advancing age is associated with a gradual decline in physical capabilities and agricultural labor productivity, thereby reducing reliance on agricultural production. RCR relocates farmers away from their original arable land, significantly increasing commuting time and physical exertion. Older household heads, facing greater difficulty in adapting to this extended production radius compared to their younger counterparts, are more inclined to transfer their land rights to secure rental income, thereby increasing the probability of land transfer.

Table 7. Heterogeneity regression results by household head gender and age.

Variable	Elder-Headed	Young-Headed	Male-Headed	Female-Headed
	(1)	(2)	(3)	(4)
RCR	0.476 *** (0.140)	0.246 * (0.137)	0.272 ** (0.128)	0.422 *** (0.140)
Controls	Yes	Yes	Yes	Yes
Township FE	Yes	Yes	Yes	Yes
Observations	1062	1798	1466	1394
Adj. R ²	0.275	0.329	0.326	0.266

Notes: Standard errors clustered at the village level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

The gender of the household head reflects the characteristics of intra-household labor division and disparities in resource endowments. Male and female household heads often face distinct constraints regarding participation in agricultural production and access to non-agricultural employment opportunities. Columns (3) and (4) of Table 7 present the regression results by gender. The estimates reveal a more significant effect for female-headed households. A potential explanation lies in the context of massive rural labor outflow, where female-headed households often face more severe agricultural labor constraints. For

these households, which typically lack strong labor forces, the extension of the production radius and the associated increase in farming costs resulting from RCR imply a higher marginal cost of agricultural production. Concurrently, local non-agricultural employment opportunities generated by RCR may hold greater appeal for female household heads. This incentivizes these households to transfer out their land to engage in non-agricultural activities, thereby exhibiting a higher propensity for land transfer.

5. Conclusions and Policy Implications

Based on household survey data from rural Sichuan, this study empirically evaluates the impact of RCR on land transfer among rural households. To ensure the reliability of the results, this study employs the expected lump-sum housing subsidy as an instrumental variable for RCR to address potential endogeneity concerns. The findings demonstrate that RCR significantly promotes land transfer among rural households in Sichuan, China, through three mechanisms: non-agricultural employment, internet usage, and increased agricultural costs. Such effects are stronger for households with highly fragmented land, small operational scales, female household heads and elderly household heads. However, we emphasize that RCR should be understood as a potentially beneficial policy only when it is based on substantive voluntariness, meaningful participation, fair compensation, viable livelihood alternatives, environmental safeguards, and an equitable distribution of costs and benefits. The agricultural cost mechanism, in particular, should not be celebrated as an efficient outcome but rather recognized as a potential equity concern that requires policy mitigation. Moving from a narrowly efficiency-oriented interpretation toward a balanced assessment of territorial reorganization, sustainability, and spatial justice, this study contributes to a more nuanced understanding of the conditions under which RCR can contribute to sustainable rural development, rural revitalization, and food security in China.

The conclusions of this study offer important policy implications for optimizing RCR policies, promoting effective land transfer, and achieving rural modernization and rural revitalization:

First, when planning and implementing RCR programs, governments should strengthen local infrastructure—particularly road and internet facilities—to reduce households' information search and transportation costs, expand market depth, promote employment restructuring, and ultimately facilitate land transfer and moderate-scale agricultural operations. This recommendation is directly supported by our mechanism analysis showing that RCR enhances land transfer through improved internet access (which reduces information search costs) and through non-agricultural employment (which is facilitated by better transportation). To achieve effective coordination between technological and economic processes, governments should align infrastructure investment with the spatial distribution of non-agricultural economic activities. For instance, road and internet infrastructure should be prioritized in RCR communities located near industrial parks or service hubs, ensuring that technological upgrades directly support economic diversification rather than being implemented in isolation.

Second, local governments should increase the supply of non-agricultural employment opportunities when advancing RCR programs. This can be achieved through two complementary approaches. On the one hand, governments can integrate rural homestead land resources to attract investment, promoting the development of local industrial and agricultural parks and creating more non-agricultural jobs. On the other hand, improving rural road and telecommunications infrastructure can reduce households' local transportation and information search costs, further increasing their participation in non-agricultural work. These measures collectively reduce households' dependence on agriculture and

thereby promote land transfer. This recommendation is directly supported by our mechanism analysis confirming that RCR promotes land transfer by increasing non-agricultural employment, and that the effect is stronger for households with lower agricultural income dependence and for those with access to non-agricultural employment opportunities—as revealed by our heterogeneity analyses. This coordination should extend beyond physical infrastructure to include skill-training programs, entrepreneurial support, and digital literacy initiatives, ensuring that rural households possess the capabilities needed to access emerging economic opportunities created by technological improvements.

Third, when selecting the location for RCR communities, governments should comprehensively consider both construction costs and the costs that rural households incur in agricultural labor, choosing and designing RCR communities in accordance with local conditions. This recommendation is directly supported by our finding that RCR communities are generally built far from rural households' own cultivated land, which significantly increases agricultural production costs. While this objectively promotes land transfer, it also creates inconveniences for agricultural activities. This is particularly concerning for small-scale farmers and households with high land fragmentation, for whom the effect is more pronounced, as shown in our heterogeneity analysis. Therefore, governments should select residential sites for RCR communities based on local conditions to minimize the disruption to farming activities, and should provide active support for households wishing to continue farming—including agricultural machinery storage facilities, transport support between residences and farmlands, and improved access to cultivated land. These measures would mitigate the cost-increasing effects of RCR and ensure that land transfer, when it occurs, reflects genuine household choice rather than pressure from deteriorating farming conditions.

Fourth, beyond the infrastructure and employment considerations discussed above, governments should pay greater attention to the social welfare transformation associated with RCR. RCR affects community cohesion, intergenerational equity, and the well-being of vulnerable groups. Policy design should incorporate mechanisms to preserve local social networks, ensure equitable access to public services (healthcare, education, and elderly care), and protect the rights of land-dependent households—particularly smallholders, elderly farmers, female-headed households, and low-income families—through targeted compensation, grievance channels, and participatory planning processes. Without these safeguards, the economic gains from land transfer may be achieved at the expense of social justice and community sustainability.

Fifth, governments should systematically address the ecosystem-level welfare implications of RCR. While RCR may reduce dispersed construction land and improve infrastructure efficiency, it can also increase commuting distances, encourage new construction, simplify rural landscapes, intensify agricultural land use, and weaken the ecological connectivity between communities and their surrounding ecosystems. To mitigate these risks, environmental impact assessments should be integrated into the RCR planning process. Measures such as preserving green corridors, protecting soil and water resources, maintaining biodiversity, and limiting impervious surface expansion should be incorporated into community design and monitored over time. A sustainability-oriented approach that balances economic efficiency with ecological integrity will ensure that RCR contributes to long-term rural resilience rather than merely generating short-term land transfer gains.

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