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# The Impact Mechanism and Spatial Effects of Land Transfer on the New Productive Forces in Agriculture

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## Abstract

**To clarify the intrinsic relationship between land transfer and new agricultural productive forces and explore its impact mechanisms, this study utilizes panel data from 30 provinces (autonomous regions and municipalities) in China from 2005 to 2023, employing threshold effects and dynamic SDM models to investigate their interplay. The findings reveal: (1) A significant positive correlation exists between land transfer and new agricultural productive forces. (2) Land transfer primarily promotes the development of new agricultural productive forces by enhancing land resource allocation efficiency. (3) Green technology innovation significantly moderates the relationship between land transfer and new agricultural productive forces. (4) The impact of land transfer on new agricultural productive forces exhibits nonlinear characteristics. (5) The effects of land transfer on new agricultural productive forces demonstrate regional heterogeneity. (6) Compared to long-term spatial effects, land transfer's short-term spatial spillover effects are more pronounced.**

## Keywords

**Land Transfer; New Agricultural Productive Forces; Efficiency of Land Resource Allocation; Green Technology Innovation; Spatial Durbin (SDM) Model.**

## 1. Introduction

Developing new high-quality agricultural productivity is a strategic key to solidifying the foundation of the national economy and leading the construction of an agricultural powerhouse. At the end of 2022, a symposium on rural work articulated a foundational principle: the pursuit of national strength must begin with strengthening agriculture, as a robust agricultural sector is essential for a strong nation. Without agricultural power, the goal of comprehensive modernization cannot be achieved; similarly, in the absence of agricultural and rural modernization, the overall modernization process would remain incomplete. In 2025, the first officially issued document of the year introduced, for the first time, the concept of "leveraging scientific and technological innovation to drive the agglomeration of advanced production factors and fostering agricultural new quality productive forces in accordance with local conditions." This official marker signifies that agricultural new quality productive forces have become a strategic priority in the pursuit of building a strong agricultural nation. The fragmented land pattern formed under long-term pressure from population and land constraints severely restricts the introduction of large-scale operations, advanced technologies, and skilled labor, leading to obstacles in the transformation of technological innovations and low productivity per unit area. Therefore, exploring how to break through these bottlenecks has become an urgent task for unleashing new drivers of agricultural growth.

In the context of a new round of technological and industrial revolution, land transfer has broken through the bottleneck of fragmented land, paving a crucial path for the effective

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conversion of advanced agricultural technologies and the sustained improvement of land productivity. Drawing on previous literature, land transfer primarily addresses land fragmentation through two key pathways: land resource allocation efficiency and green technological innovation. On one hand, land transfer promotes the optimal allocation of land factors, giving rise to a large number of agricultural producers. Dmitry I. Rukhovich et al. (2025) [1] propose that land use behavior, as a critical link, not only directly correlates with the proportional relationship between abandoned farmland scale, soil fertility changes, and land degradation levels but ultimately constrains the cultivation and development of new agricultural productivity. Bouchra El Houda Lamhamedi et al. (2025) [2] argue that a comprehensive understanding of the interaction between land ownership and renewable energy initiatives is the key prerequisite for optimizing resource allocation through land transfer, fostering new agricultural producers, and advancing new agricultural productivity. Kong et al. (2025) [3] demonstrated through household survey data from Jiangsu Province that organized land transfer significantly improves agricultural land allocation efficiency by reducing land fragmentation and transaction costs, thereby facilitating the transition toward moderate-scale farming and injecting momentum into the development of new agricultural productivity. Chantal Kierdorf et al. (2025) [4] suggest that agricultural photovoltaics, as an efficient land use model, enhances land productivity and economic benefits, providing a feasible pathway for land transfer to drive green technological innovation and cultivate new agricultural productivity. Amani Michael Uisso et al. (2024) [5] contend that land transfer promotes productivity transformation through green technological innovation, thereby optimizing spatial layout, improving facilities, and safeguarding community rights, ultimately pointing toward the formation and development of new agricultural productivity. Pradeep Kumar Badapalli et al. (2024) [6] argue that remote sensing analysis of LULC changes from 2000 to 2020 reveals the intrinsic mechanism by which land transfer and green technology synergistically drive spatial restructuring, thereby nurturing new agricultural productivity. Therefore, land transfer creates operational space and feasibility for technological innovation and resource integration, thereby injecting core momentum into the development of new agricultural productivity through dimensions such as technological penetration, land factor integration, and improved resource allocation efficiency [7].

The marginal contribution of this article mainly lies in three aspects: (1) In terms of theoretical application, the application of diseconomies of scale theory enriches the theoretical foundation of institutional economics and provides materials for interdisciplinary research. (2) In terms of research content, the role and effect of land resource allocation efficiency and green technology innovation level on the impact of land transfer on agricultural new quality productivity were explored. (3) In terms of empirical methods, the dynamic SDM model was applied to identify the mechanism of land transfer on agricultural new quality productivity in both spatial and temporal dimensions.

## 2. Theoretical Mechanisms and Research Hypotheses

### 2.1. The Direct Impact of Land Transfer on Agricultural New Quality Productivity

Land transfer not only provides necessary policy prerequisites for the development of new agricultural productivity, but also constructs spatial carriers for the aggregation and reorganization of production factors, thus becoming a key cornerstone for the development of new agricultural productivity. Land transfer mainly has a direct impact on agricultural productivity through the following methods. Firstly, land transfer provides policy prerequisites for agricultural new quality productivity. Land transfer provides policy support for the infiltration and integration of new production factors by breaking down policy barriers to

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factor flow, thereby forming the policy cornerstone for the development of new quality agricultural productivity. Secondly, land transfer is a spatial carrier for the aggregation and restructuring of advanced production factors. Land circulation overcomes the obstacles of land fragmentation to the application of advanced production factors by changing the spatial form of land, and provides a spatial carrier for the advanced production factors on which agricultural new quality productivity relies. Thirdly, the stable management rights granted by land transfer directly shape the green development path of agricultural new quality productivity. Land transfer extends the decision-making time dimension of agricultural producers, encourages them to adopt green production measures, and thus drives the green development of agricultural new quality productivity. Based on the above mechanism analysis, this article proposes the following hypotheses:

Assumption 1: Land transfer can positively promote agricultural new quality productivity.

## 2.2. Indirect Impact of Land Transfer on Agricultural New Quality Productivity

### 2.2.1. Land Transfer, Land Resource Allocation Efficiency, and Agricultural New Quality Productivity

Land transfer is a key means to enhance the new quality productivity of agriculture, with land resource allocation efficiency as the key intermediary, ultimately achieving the development of new quality productivity in agriculture. The transfer of land has an indirect impact on the efficiency of land resource allocation and the productivity of new agricultural products in the following aspects. On the one hand, land transfer drives the concentration of land resources from agricultural producers with low planting willingness and efficiency to those with capital, technology, and market advantages, achieving the upgrading and resetting of production factors, thereby directly affecting the development of new agricultural productivity. On the other hand, land transfer improves resource allocation efficiency, guides the optimization of agricultural production structure from traditional grain crops to high value-added economic crops, and promotes a significant increase in the output value of unit land, thereby injecting development momentum into the new quality productivity of agriculture. Therefore, the improvement of land resource allocation efficiency is not only reflected in the flow of land resources to the main body with high production efficiency, but also in the transition of land resources from low value to high value, thus forming the inherent foundation for the development of new agricultural productivity. Based on the above logic, this study proposes the following hypotheses:

Assumption 2: Land transfer can improve agricultural productivity by optimizing the efficiency of land resource allocation.

### 2.2.2. Land Transfer, Green Technology Innovation, and Agricultural New Quality Productivity

Scale operation is an inherent requirement of agricultural new quality productivity, and land transfer is a prerequisite for achieving scale operation. Land transfer is the core driving force for the development of agricultural new quality productivity. Land transfer integrates scattered and fragmented land into large-scale operations, providing a basic guarantee for the widespread application of green technology innovation [8], and ultimately driving fundamental changes in agricultural production methods, achieving a new leap in agricultural productivity with new qualities [9]. The indirect impact of land transfer on agricultural new quality productivity through green technology innovation is as follows. On the one hand, by developing scale operations and applying new technologies such as drones and the Internet of Things [10], not only have labor and management costs been significantly reduced, but agricultural production has also been promoted to transform towards smart agriculture [11]. On the other hand, land transfer incentivizes green technology innovation centered around data elements, enabling data elements to transform information and drive practice, ultimately becoming the

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core engine for the development of new agricultural productivity. Therefore, the integration of elements achieved through land transfer and the technological core laid by green technology innovation have jointly built a solid foundation for the development of new agricultural productivity. Based on the above logic, this study proposes the following hypotheses:

Assumption 3: Land transfer can improve agricultural productivity by promoting green technology innovation.

## 2.3. Nonlinear Impact of Land Transfer on Agricultural New Quality Productivity

As an institutional reform, land transfer does not have a uniform empowering effect on the new quality productivity of agriculture, but rather triggers a series of qualitative changes by changing the key structure within land planning. The level of rural economic development not only positively promotes the development of new agricultural productivity, but also has a negative regulatory effect on land circulation. Specifically, on the one hand, for rural areas with lower levels of economic development, some agricultural producers have a single source of income and are highly dependent on land life, which directly affects the economic income level of agricultural producers. Therefore, land transfer can usually bring significant income growth to agricultural producers and create conditions for large-scale agricultural operation, thereby positively promoting the development of new agricultural productivity; On the other hand, in rural areas with higher levels of economic development, agricultural producers often have more diversified income structures. Due to the existence of multiple alternative income channels and low dependence on land, the opportunity cost for agricultural producers to choose land abandonment is relatively low, resulting in a relatively insufficient internal motivation for land transfer, which has a negative regulatory effect on land transfer. Therefore, promoting land transfer should follow the principle of moderation to prevent excessive scale operations from causing non-linear negative effects [12]. Therefore, it is necessary to accurately measure the key threshold of economic development level and create favorable external conditions to optimize the relationship between rural economic development level and land transfer and agricultural new quality productivity. This is the key to formulating precision agriculture policies and truly cultivating agricultural new quality productivity through land transfer. Based on the above logic, this study proposes the following hypotheses:

Assumption 4: Land transfer has a significant positive impact on agricultural new quality productivity, and the two exhibit nonlinear characteristics.

## 2.4. Spatial Impact of Land Transfer on Agricultural New Quality Productivity

Land transfer, as a key driver, has achieved a transformation from the traditional fragmented production pattern to a new pattern of highly intensive agricultural development. By strengthening the spatial dependence between regions [13], it has laid a spatial foundation for the development of new agricultural productivity [14]. Specifically, on the one hand, the core area of land transfer policy implementation relies on efficient policy implementation and significant scale operation advantages, which can take the lead in forming a "growth pole" of agricultural new quality productivity. With strong factor aggregation ability, it can radiate and drive the surrounding areas through spatial dependence between regions, laying the foundation for the leap of agricultural new quality productivity in the whole region. On the other hand, in the peripheral areas where land transfer policies are implemented, land transfer leads to resource scale effects. Spatial networks can not only reduce the inherent endogenous costs of innovation activities, but also weaken institutional barriers imposed by external environments [15], thereby systematically improving the efficiency of agricultural resource allocation across the region and driving the coordinated development of agricultural new quality productivity between regions [16]. Therefore, land transfer policies should fully

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leverage spatial radiation effects, strengthen the agglomeration and spillover effects of core areas, and drive the development of new agricultural productivity across the entire region. Based on the above logic, this study proposes the following hypotheses:

Assumption 5: Land transfer has a significant spatial spillover effect, which has a significant positive driving effect on the new quality productivity of agriculture in the local and surrounding areas.

# 3. Research Design

## 3.1. Model Design

(1) Benchmark regression model

To explore the impact of land transfer on agricultural new quality productivity, a spatiotemporal bidirectional fixed effects model is constructed. The specific model is as follows:

$$NX_{it} = a_0 + a_1 Land_{it} + a_2 K_{it} + \mu_i + \lambda_t + \varepsilon_{it} \tag{1}$$

Among them, $NX$ represents agricultural new quality productivity, $Land$ represents land transfer, $K$ represents control variable, $a_0$ represents constant term, $a_1$ represents regression coefficient of land transfer, $a_2$ represents regression coefficient of control variable, $\mu_i$ represents individual fixed effect; $\lambda_t$ representing time fixed effects; $\varepsilon_{it}$ represents a random perturbation term. The subscript $i$ , $t$ represents region and time.

(2) Mechanism verification model

To examine the impact mechanism of land transfer and land resource allocation efficiency on agricultural new quality productivity, a transmission effect model is constructed. The specific model is as follows:

$$PZ_{it} = b_0 + b_1 Land_{it} + b_2 K_{it} + \mu_i + \lambda_t + \varepsilon_{it} \tag{2}$$

$$NX_{it} = c_0 + c_1 PZ_{it} + c_2 K_{it} + \mu_i + \lambda_t + \varepsilon_{it} \tag{3}$$

$$NX_{it} = d_0 + d_1 Land_{it} + d_2 PZ_{it} + d_3 K_{it} + \mu_i + \lambda_t + \varepsilon_{it} \tag{4}$$

Among them, $PZ$ represents the efficiency of land resource allocation; $b_0$ $c_0$ $d_0$ represent constant terms; $b_1$ $d_1$ represent regression coefficient of land transfer; $c_1$ $d_2$ represent the efficiency of land resource allocation coefficient; $b_2$ $c_2$ $d_3$ representing the regression coefficient of the control variable.

(3) Moderation effect model

To test the regulatory effect of green technology innovation on land transfer and agricultural new quality productivity, a regulatory effect model is constructed. The specific model is as follows:

$$NX_{it} = e_0 + e_1 JS \times Land_{it} + e_2 K_{it} + \mu_i + \lambda_t + \varepsilon_{it} \tag{5}$$

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Among them, $JS$ represents green technology innovation; $e_0$ represents constant terms; $e_1$ represents regression coefficient of the interaction term between green technology innovation and land transfer; $e_2$ represents the regression coefficient of the control variable.

(4)Threshold effect model

$$\begin{aligned} NX_{it} &= f_0 + f_1 Land_{it} \times I(M_{it} < \gamma_1) + f_2 Land_{it} \times I(\gamma_1 \le M_{it} \le \gamma_2) \\ &+ f_3 Land_{it} \times I(M_{it} > \gamma_2) + f_4 \mathrm{K}_{it} + \mu_i + \lambda_t + \varepsilon_{it} \end{aligned} \tag{6}$$

Among them, $I$ (•) represents an exponential function; $M$ represents threshold variables; $\gamma_1$ represents the first-order threshold value; $\gamma_2$ represents the second-order threshold value; $f_0$ represents constant terms; $f_1$ $f_2$ $f_3$ represent regression coefficient land transfer; $f_4$ represents the regression coefficient of the control variable.

(5) Spatial Durbin (SDM) model

This article uses an economic distance spatial weight matrix, and the specific model is as follows:

$$NX_{it} = g_0 + h_0 WNX_{it} + g_1 Land_{it} + h_1 WLand_{it} + g_2 K_{it} + h_2 WK_{it} + h_3 W\mu_i + \varepsilon_{it} \tag{7}$$

Among them, $W$ represents the spatial weight matrix; $g_0$ represents constant terms; $g_1$ represents regression coefficient of land transfer; $g_2$ represents the regression coefficient the control variable; $h_0$ $h_1$ $h_2$ $h_3$ represent the coefficients of the weight matrix.

## 3.2. Variable Selection

(1) Dependent variable: Agricultural new quality productivity

The dependent variable of this article is agricultural new quality productivity. The development of new quality agricultural productivity is an inevitable requirement for promoting the advancement of agricultural productivity to a higher stage, with both new era connotations and prominent features. The vigorous development of new agricultural productivity is rooted in the continuous innovation and major breakthroughs in agricultural technology. Referring to the research of Liu Suchun et al., select the basic element theory of productivity composition and construct an evaluation system consisting of 7 primary indicators and 25 secondary indicators. The indicator system for agricultural new quality productivity aims to comprehensively and meticulously quantify its multidimensional connotations, and use entropy weight method for objective weighting, in order to provide accurate empirical basis and decision-making reference for scientific evaluation and effective promotion of the development of agricultural new quality productivity. The specific indicator measurement table (Table 1) is as follows:

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**Table 1.** Index System of Agricultural New Quality Productivity

| Sub. | Criterion | First-level | Second-level | Attribute | Weight |
|---|---|---|---|---|---|
| NX | Agricultural laborer | New quality agricultural labor reserve | Proportion of agricultural labor force(a1) | + | 0.0140 |
| | | | Average education level of farmers(a2) | + | 0.0022 |
| | | | Level of agricultural technology training(a3) | + | 0.0039 |
| | | | Rural labor outflow(a4) | - | 0.0090 |
| | | New quality agricultural production efficiency | Land yield rate of planting industry(a5) | + | 0.0396 |
| | | | Livestock land output rate(a6) | + | 0.0441 |
| | | | Rural per capita economic efficiency(a7) | + | 0.0396 |
| | Means of labour | New Quality Agricultural Production Foundation | Rural digitalization foundation(a8) | + | 0.0946 |
| | | | Rural road network foundation(a9) | + | 0.0240 |
| | | | Fundamentals of Agricultural Mechanization(a10) | + | 0.0463 |
| | | | Intensity of agricultural fertilizer application(a11) | - | 0.0043 |
| | | | Rural electricity consumption level(a12) | - | 0.0024 |
| | | Innovation in New Quality Agricultural Production | Agricultural technology investment(a13) | + | 0.0663 |
| | | | High standard farmland construction(a14) | + | 0.0100 |
| | | | Construction of fenced farms(a15) | + | 0.0197 |
| | Agricultural labor objects | New Quality Agricultural Organization | Scale of key agricultural enterprises(a16) | + | 0.0524 |
| | | | Scale of new agricultural economic entities(a17) | + | 0.0946 |
| | | New Quality Agricultural Ecology | Sowing area of high-quality seeds(a18) | + | 0.0123 |
| | | | Degradation area of grassland(a19) | - | 0.0043 |
| | | | Energy conservation and environmental protection investment(a20) | + | 0.1324 |
| | | | Water resource carrying capacity(a21) | + | 0.0782 |
| | | | Proportion of forest coverage(a22) | + | 0.0043 |
| | | | Financial agricultural payments(a23) | + | 0.0495 |
| | | | Agricultural insurance protection(a24) | + | 0.1013 |
| | | | Rural credit supply(a25) | + | 0.0510 |

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(2) Explanatory variables

The explanatory variable of this article is land transfer. Land transfer is an important lever for the green transformation of agriculture. Encouraging land transfer is achieved by utilizing the positive externalities brought by agricultural production agglomeration to achieve large-scale and intensive agricultural production, thereby achieving systematic optimization in three dimensions: factor allocation, production efficiency, and production environment. Referring to the study by Yang et al. (2021) [17], the level of land transfer is measured by the ratio of the total area of household contracted cultivated land transfer to the area of household contracted cultivated land.

(3) Mechanism variables

The mechanism variables in this article are land resource allocation efficiency and green technology innovation. The efficiency of land resource allocation data is sourced from the "China Land and Resources Yearbook". Referring to the research of Alper Demirdogen (2024) [18], a SBM model system for measuring the efficiency of land resource allocation is constructed. Among them, the input-output index system is used to measure the efficiency of land resource allocation. In terms of investment indicators, fixed capital stock is used to measure capital investment; Represent labor input by the number of employees in the three industries; For land input, agricultural land area is used to reflect the input of land elements in the primary industry, while urban, rural, industrial and mining land area and transportation land area are used to reflect the input of land elements in the secondary and tertiary industries. In terms of output indicators, expected output is measured by the GDP added value of the primary, secondary, and tertiary industries respectively; The unexpected output indicator is carbon emissions, and considering that the selected carbon emissions are mainly caused by the combustion of fossil fuels and cement production processes, it is defined as the unexpected output brought by the input of factors in the secondary and tertiary industries. Green technology innovation data sourced from the China Research Data Service Platform, refers to the research of Wei Chen et al. (2024) [19], using the natural logarithm of green patent applications as an indicator to measure green technology innovation. The act of patent application itself represents that the enterprise has invested substantial innovative research and development activities and formed phased results. Compared with the number of patent authorizations, the number of patent applications can more timely reflect the innovation activity and effort level of the enterprise in the field of green technology, thus more scientifically depicting the dynamic process of green technology innovation.

(4) Control variables

To alleviate measurement bias caused by omitted variables in empirical test results, this article selects other factors that may affect agricultural new quality productivity as control variables, mainly including: (1) the level of agricultural processing industry development refers to Stephan J. Goetz's (1997) [20] research, using the number of agricultural product processing industry enterprises as an indicator to measure the level of agricultural processing industry development. (2) Human capital refers to the research of Deon Filmer et al. (2020) [21], using the average years of education of rural residents as a proxy variable to measure the indicator of human capital; (3) Industrialization level refers to the research of Cai A et al. (2021) [22], selects the proportion of industrial added value above designated size in the gross domestic product of each province as an indicator to measure industrialization level; (4) The advanced structure of the agricultural industry is measured by the proportion of total agricultural output value to total rural population, based on the research of Liao R et al. (2025) [23]. Agriculture itself has a high level of development, which is a necessary condition for promoting the development of green agriculture; (5) According to Zangeneh et al. (2010) [24], different levels of agricultural mechanization directly affect agricultural carbon emissions and indirectly affect

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carbon emissions by changing agricultural production efficiency. This article represents the ratio of total power of agricultural machinery to crop sowing area.

### 3.3. Data Sources and Statistical Description of Variables

This paper selects the panel data of 30 provinces in China (excluding Hong Kong, Macao, Taiwan and Xizang, hereinafter referred to as "provinces") from 2005 to 2023 as the research sample. The data of this paper mainly comes from China Statistical Yearbook, China Rural Statistical Yearbook, China Land Yearbook, China Urban Statistical Yearbook, China Urban Construction Statistical Yearbook, China Environmental Statistical Yearbook, China Agricultural Machinery Industry Yearbook, China fixed assets investment Statistical Yearbook, China Tertiary Industry Statistical Yearbook, China Land Resources Statistical Yearbook, China Urban and Industrial Innovation Report, Wind Database and CSMAR Database.

**Table 2.** Descriptive Statistical Analysis of Main Variables

| Type | Variable | Description | N | Mean | Std. dev. | Min | Max |
|---|---|---|---|---|---|---|---|
| explanatory variable | NX | Agricultural new quality productivity | 570 | 0.189 | 0.130 | 0.040 | 0.747 |
| explained variable | Land | Land transfer | 570 | 0.258 | 0.187 | 0.014 | 0.958 |
| mechanism variable | PZ | Efficiency of land resource allocation | 570 | 0.480 | 0.239 | 0.018 | 1.038 |
| | JS | Green technology innovation | 570 | 7.396 | 1.675 | 2.303 | 10.937 |
| control variable | ER | Development level of agricultural processing industry | 570 | 0.439 | 0.089 | 0.149 | 0.615 |
| | ZB | Human capital | 570 | 0.020 | 0.007 | 0.006 | 0.044 |
| | GY | Industrialization level | 570 | 0.336 | 0.085 | 0.101 | 0.559 |
| | NF | Advanced structure of agricultural industry | 570 | 9.821 | 5.668 | 0.289 | 29.664 |
| | JX | Total power of agricultural machinery | 570 | 0.321 | 0.285 | 0.009 | 1.335 |

## 4. Empirical Analysis

### 4.1. Benchmark Regression Test

Table 3 reports the regression results of land transfer on agricultural new quality productivity. indicating that land transfer can have a positive effect on agricultural new quality productivity. Overall, hypothesis 1 holds true.

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**Table 3.** Results of Benchmark Regression Test

| Variable | (1) | (2) |
|---|---|---|
| | **NX** | **NX** |
| Land | 0.533*** | 0.128*** |
| | (0.021) | (0.028) |
| ER | | -0.305*** |
| | | (0.068) |
| ZB | | 8.136*** |
| | | (0.775) |
| GY | | -0.384*** |
| | | (0.068) |
| NF | | -0.008*** |
| | | (0.002) |
| JX | | 0.154*** |
| | | (0.039) |
| _cons | 0.051*** | 0.285*** |
| | (0.006) | (0.047) |
| $N$ | 570 | 570 |
| adj. $R^2$ | 0.510 | 0.725 |
| Model | Two-way FE | Two-way FE |
| Time FE | Yes | Yes |
| Region FE | Yes | Yes |

Standard errors in parentheses

* p < 0.1, ** p < 0.05, *** p < 0.01

## 4.2. Robustness Test

**Table 4.** Robustness Test

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| **Variable** | **L.** | **Wins.** | **System GMM** | **Exc. municipalities** |
| | NX | NX | Land | NX |
| L.NX | | | 0.936*** | |
| | | | (0.243) | |
| L.Land | 0.366*** | | | |
| | (0.066) | | | |
| Land | 0.185*** | 0.128*** | | 0.224*** |
| | (0.068) | (0.027) | | (0.033) |
| _cons | 0.054*** | 0.284*** | 0.75*** | 0.395*** |
| | (0.007) | (0.046) | (0.286) | (0.051) |
| $N$ | 540 | 570 | 570 | 494 |
| adj. $R^2$ | 0.521 | 0.736 | | 0.773 |
| AR(1) | | | 0.027 | |
| AR(2) | | | 0.871 | |
| Sargan test | | | 0.000 | |
| Hansen test | | | 0.054 | |

Standard errors in parentheses

* p < 0.1, ** p < 0.05, *** p < 0.01

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Column (1) The previous conclusion is robust and not affected by the previous land transfer effect; Column (2) demonstrating the robustness of the previous conclusions; Column (3) indicating that the dynamic panel model has passed the autocorrelation test, further demonstrating the scientific and effective results of the system GMM model; Column (4) indicating that the promotion effect of land transfer on agricultural new quality productivity has strong robustness.

## 4.3. Mechanism Verification

Table 5 reports the impact of land resource allocation efficiency on the relationship between land transfer and agricultural new quality productivity, hypothesis 2 holds true.

**Table 5.** Mechanism Inspection Results

| Variable | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | PZ | PZ | NX | NX | NX | NX |
| Land | 0.997*** | 0.251*** | | | 0.400*** | 0.116*** |
| | (0.061) | (0.090) | | | (0.024) | (0.028) |
| PZ | | | 0.266*** | 0.056*** | 0.133*** | 0.049*** |
| | | | (0.014) | (0.013) | (0.014) | (0.013) |
| ER | | -1.697*** | | -0.336*** | | -0.222*** |
| | | (0.223) | | (0.067) | | (0.071) |
| ZB | | 16.980*** | | 7.263*** | | 7.301*** |
| | | (2.526) | | (0.810) | | (0.798) |
| GY | | 0.112 | | -0.441*** | | -0.390*** |
| | | (0.220) | | (0.067) | | (0.067) |
| NF | | -0.013*** | | -0.010*** | | -0.007*** |
| | | (0.005) | | (0.001) | | (0.002) |
| JX | | -0.437*** | | 0.236*** | | 0.175*** |
| | | (0.126) | | (0.036) | | (0.039) |
| _cons | 0.222*** | 1.057*** | 0.062*** | 0.335*** | 0.022*** | 0.233*** |
| | (0.018) | (0.155) | (0.007) | (0.043) | (0.007) | (0.049) |
| *N* | 570 | 570 | 570 | 570 | 570 | 570 |
| adj. $R^2$ | 0.292 | 0.486 | 0.367 | 0.723 | 0.580 | 0.732 |

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

## 4.4. Adjustment Effect Test

Table 6 reports the relationship between green technology innovation and land transfer and agricultural new quality productivity, hypothesis 3 holds true.

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**Table 6.** Results of Regulatory Effects

| | (1) | (2) |
|---|---|---|
| Variable | NX | NX |
| Interact. | 0.056*** | 0.020*** |
| | (0.002) | (0.003) |
| ER | | -0.216*** |
| | | (0.068) |
| ZB | | 8.508*** |
| | | (0.758) |
| GY | | -0.338*** |
| | | (0.067) |
| NF | | -0.006*** |
| | | (0.002) |
| JX | | 0.133*** |
| | | (0.037) |
| _cons | 0.068*** | 0.201*** |
| | (0.005) | (0.049) |
| *N* | 570 | 570 |
| adj. $R^2$ | 0.540 | 0.738 |

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

## 4.5. Threshold Effect Model

Table 7 reports the results of the threshold effect model test under repeated sampling of 300 times when the level of rural economic development is used as the threshold variable.

**Table 7.** Threshold Effect Model Test

| Variable | Th-1 | Th-2 | NX |
|---|---|---|---|
| Th. Val. | 8.521 | 8.932 | |
| Land(Th. Val.<8.5208) | | | 0.352*** |
| | | | (0.080) |
| Land(8.5208≤Th. Val.≤8.9323) | | | 0.230*** |
| | | | (0.069) |
| Land(Th. Val.>8.9323) | | | 0.098* |
| | | | (0.052) |
| 95% CI | [8.504,8.545] | [8.895，8.957] | |
| F value | 80.670 | 22.880 | |
| P value | 0.000 | 0.053 | |
| 1% Th. Val. | 58.087 | 32.923 | |
| 5% Th. Val. | 35.023 | 23.507 | |
| 10% Th. Val. | 25.408 | 17.746 | |
| _cons | | | 0.293*** |
| | | | (0.079) |
| *N* | | | 570 |
| adj. $R^2$ | | | 0.780 |

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## 5. Heterogeneity Analysis

Table 8 reports the regression results of regional heterogeneity analysis on the impact of land transfer on agricultural new quality productivity. Therefore, empirical results indicate that there is significant regional heterogeneity in the impact of land transfer on agricultural new quality productivity.

**Table 8.** Regional Heterogeneity Benchmark Regression Test

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | Eastern | Central | Western | Northeast |
| **Variable** | NX | NX | NX | NX |
| Land | 0.253*** | -0.049 | -0.156*** | -0.017 |
| | (0.061) | (0.066) | (0.044) | (0.062) |
| ER | 0.325 | -0.440 | -0.402*** | 0.019 |
| | (0.200) | (0.423) | (0.077) | (0.097) |
| ZB | 14.239*** | 0.663 | 0.651 | -6.380 |
| | (2.474) | (3.143) | (1.725) | (4.295) |
| GY | -0.396** | 0.059 | -0.228*** | -0.320*** |
| | (0.199) | (0.424) | (0.067) | (0.110) |
| NF | -0.047* | -0.132*** | -0.059*** | -0.118*** |
| | (0.028) | (0.033) | (0.017) | (0.033) |
| JX | 0.098 | 0.311*** | 0.692*** | 0.257*** |
| | (0.078) | (0.064) | (0.073) | (0.095) |
| _cons | 0.224 | 1.438*** | 0.808*** | 1.406*** |
| | (0.278) | (0.346) | (0.173) | (0.333) |
| $N$ | 190 | 114 | 209 | 57 |
| adj. $R^2$ | 0.704 | 0.854 | 0.843 | 0.892 |

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

## 6. Spatial Effect Test

### 6.1. Spatial Autocorrelation Test

Table 9 reports the global Moran's index values for land transfer. During the research period from 2020 to 2023, the Moran's index of land transfer was positively significant and passed the 1% level significance test, indicating spatial autocorrelation in land transfer.

**Table 9.** Moran Index of Land Transfer

| Year | Moran's I | Z value | P value |
|---|---|---|---|
| 2020 | 0.275 | 4.285 | 0.000 |
| 2021 | 0.244 | 3.825 | 0.000 |
| 2022 | 0.262 | 4.056 | 0.000 |
| 2023 | 0.262 | 4.024 | 0.000 |

### 6.2. Model Selection

Table 10 reports the selection results of spatial econometric models. First, perform the LM test. Further observation of the results of Robust LM Error and Robust LM Lag tests. Next, perform the Hausman test. Perform LR test again. Finally, the Wald test was conducted. LR-SAR and LR-

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SEM once again tested whether the SDM model can degrade into SAR or SEM models, once again proving that a dynamic SDM model with bidirectional fixed effects can be selected.

**Table 10.** Selection Results of Spatial Metrology Models

| Variable | Statistic | P-value |
|---|---|---|
| LM-Error | 9.163 | 0.002 |
| LM-Lag | 9.470 | 0.002 |
| Robust-LM-Error | 24.978 | 0.000 |
| Robust-LM-Lag | 25.285 | 0.000 |
| Hausman | -86.780 | --- |
| LR (Individual FE) | 153.960 | 0.000 |
| LR (Time FE) | 446.840 | 0.000 |
| Wald-SAR | 50.300 | 0.000 |
| Wald-SEM | 23.340 | 0.000 |
| LR-SAR | 44.170 | 0.000 |
| LR-SEM | 20.670 | 0.002 |

## 6.3. Decomposition of Spatial Effects

Considering that the development of agricultural new quality productivity in the previous period will have a certain impact on the subsequent period, this article chooses a dynamic SDM model with bidirectional fixed effects. Table 11 reports the regression results of the dynamic SDM model, therefore, the selection of dynamic SDM model is reasonable, indicates that land transfer has a positive spatial effect on agricultural new quality productivity in space.

**Table 11.** Regression Results of Spatial Durbin Model

| Variable | NX | Variable | NX |
|---|---|---|---|
| L.NX | 0.948*** | W×Land | 0.765*** |
| | (0.029) | | (0.050) |
| L.W×NX | -0.905*** | W×ER | 0.083 |
| | (0.126) | | (0.151) |
| Land | 0.212*** | W×ZB | 54.126*** |
| | (0.020) | | (1.749) |
| ER | -0.217*** | W×GY | -1.132*** |
| | (0.047) | | (0.119) |
| ZB | 8.554*** | W×NF | -0.002 |
| | (0.721) | | (0.005) |
| GY | -0.026 | W×JX | -0.547*** |
| | (0.042) | | (0.079) |
| NF | -0.004*** | Variance | |
| | (0.001) | (sigma2_e) | 0.001*** |
| JX | -0.150*** | | (0.000) |
| | (0.023) | *N* | 540 |
| ρ (Spatial rho) | 0.198** | | |
| | (0.097) | | |

Standard errors in parentheses

* p < 0.1, ** p < 0.05, *** p < 0.01

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Table 12 reports the effect decomposition results of the spatial Durbin model. Overall, in the short term, land transfer has a spatial spillover effect on agricultural new quality productivity, which not only promotes the development of local agricultural new quality productivity, but also has a significant positive impact on the improvement of agricultural new quality productivity in surrounding areas.

In the long run, it indicates that land transfer has spatial effects on agricultural new quality productivity . Therefore, it is necessary to formulate long-term effective policies suitable for land transfer based on the actual situation.

**Table 12.** Decomposition Results of Spatial Durbin Model Effects

| Variable | Short-term direct | Short-term indirect | Short-term total | Long-term direct | Long-term indirect | Long-term total |
|---|---|---|---|---|---|---|
| Land | 0.200*** | 0.628*** | 0.828*** | 0.909 | -0.049 | 0.859*** |
| | (0.021) | (0.076) | (0.083) | (3.329) | (3.340) | (0.089) |
| ER | -0.220*** | 0.115 | -0.105 | -0.203 | 0.095 | -0.109 |
| | (0.046) | (0.129) | (0.133) | (4.661) | (4.651) | (0.138) |
| ZB | 7.537*** | 45.287*** | 52.824*** | 57.025 | -2.202 | 54.824*** |
| | (0.840) | (4.021) | (4.483) | (113.036) | (113.718) | (4.816) |
| GY | -0.001 | -0.964*** | -0.965*** | -1.001 | -0.000 | -1.002*** |
| | (0.044) | (0.113) | (0.118) | (0.962) | (0.942) | (0.124) |
| NF | -0.004*** | -0.001 | -0.005 | -0.008 | 0.002 | -0.006 |
| | (0.001) | (0.004) | (0.004) | (0.088) | (0.088) | (0.005) |
| JX | -0.142*** | -0.443*** | -0.585*** | -0.647 | 0.040 | -0.607*** |
| | (0.023) | (0.081) | (0.084) | (2.383) | (2.394) | (0.089) |

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

## 7. Conclusion

This article uses panel data from 30 provinces (autonomous regions, municipalities directly under the central government) in China from 2005 to 2023 for empirical testing. The results indicate that: (1) The benchmark regression results show that land transfer can have a positive effect on agricultural new quality productivity. (2) The results of the mechanism test indicate that the efficiency of land resource allocation plays a bridging role and can positively affect the impact of land transfer on agricultural new quality productivity. (3) The results of the moderation effect test indicate that green technology innovation can effectively regulate the relationship between land transfer and agricultural new quality productivity. (4) The threshold effect test results indicate that there is a marginal diminishing nonlinear effect of land transfer on agricultural new quality productivity, with the level of rural economic development as the threshold. (5) The heterogeneity analysis results indicate significant regional heterogeneity in the impact of land transfer on agricultural new quality productivity. (6) The results of the spatial autocorrelation test indicate that there is spatial autocorrelation in land transfer. (7) The results of the spatial model selection test indicate that a dynamic SDM model with bidirectional fixed effects can be selected. (8) The results of the spatial effect decomposition test indicate that in the short term, land transfer has a spatial spillover effect on agricultural new quality productivity; In the long run, the spatial effect of land transfer on agricultural new quality productivity is not significant.

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