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Research on the Influence of Foreign Investment in Chinese Agriculture on Rural Economic Development

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ABSTRACT

The issue of agriculture, rural areas, and farmers is a fundamental issue that affects the country's economy and people's livelihood. The economic development of rural areas is one of the priorities of economic and social development, and the issue of the "three rural issues" is receiving increasing attention. This research examines the multifaceted impact of Foreign Direct Investment (FDI) on China's agricultural sector from 2000 to 2020. Employing a mixed-methods approach, including panel data analysis, structural equation modeling, and spatial econometrics, the study investigates FDI's influence on agricultural productivity, rural employment, income distribution, technological innovation, and environmental sustainability. Results indicate that FDI has generally positively affected these aspects, with a 1% increase in FDI associated with a 0.15% rise in agricultural Total Factor Productivity and a 0.3% increase in rural per capita income. However, benefits are unevenly distributed across regions and income groups. FDI significantly boosts agricultural innovation, with a 10% increase linked to a 7.5% rise in patent applications. Environmental impacts are mixed, showing reduced pollution intensity but increased water usage in FDI-intensive areas. The study highlights the need for targeted policies to maximize FDI benefits while addressing regional disparities and environmental concerns.

Keywords: Foreign Direct Investment; Agricultural Development; Rural Economy; Technological Innovation; Environmental Sustainability; China

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1. Introduction

Under the impetus of globalization, foreign direct investment (FDI) has gradually become a critical engine driving economic growth and industrial upgrading[1]. The nexus between FDI, economic development, and social outcomes has been extensively documented, with studies revealing complex relationships between foreign investment and various socioeconomic indicators[2]. Since the reform and opening-up policy, China has effectively alleviated capital shortages through attracting foreign investment while promoting technological progress and regional economic development[3]. However, agriculture, as a cornerstone of China's economy and social stability, has received relatively little attention in the context of FDI.

Current academic research on FDI mainly focuses on its impact on industries and the overall economy, while studies on agriculture are significantly lacking[4, 5]. Compared with industry, agriculture is not only highly dependent on resources but also closely linked to the ecological environment and rural social structures, making the mechanisms of FDI in the agricultural sector more complex and in need of further exploration[6]. The varying capacities of different regions to absorb and respond to FDI remain insufficiently analyzed, particularly concerning regional disparities and industry characteristics[7]. Moreover, the impact of FDI on rural employment may vary significantly across different agricultural sectors, as labor-intensive and capital-intensive industries may not benefit to the same extent.

As China enters a phase of high-quality development, there is growing emphasis on economic efficiency, technological innovation, social equity, and environmental sustainability[8]. Technology transfer and innovation are among the potential advantages of FDI, yet the specific pathways of its effects in agriculture, especially in key fields such as precision agriculture and biotechnology, remain unclear[9, 10]. The environmental implications of FDI present additional complexities, as foreign investment may simultaneously introduce cleaner technologies while potentially exacerbating resource utilization conflicts in sensitive regions[11].

This study defines high-quality development as an economic development model that enhances agricultural productivity, promotes innovation, reduces social disparities, and maintains ecological sustainability[12]. FDI, as an important vehicle for capital and technology flows, holds potential value for agriculture through introducing capital and advanced technologies to boost productivity and foster innovation, while optimizing rural employment structures and improving regional income distribution[13]. However, investigating how FDI can promote high-quality development while addressing its potential challenges holds significant theoretical and practical importance.

This study explores the multifaceted impact of FDI on high-quality agricultural development in China from four dimensions: economic efficiency, technological innovation, social equity, and environmental sustainability. Using methods such as panel data analysis, structural equation modeling (SEM), and threshold regression[14], it systematically evaluates the direct and indirect effects of FDI as well as the nonlinear relationships across regions and industries. By combining theoretical and empirical approaches, this study not only fills the research gap on the mechanisms of FDI in agricultural development but also provides targeted theoretical and practical recommendations for policymakers to promote high-quality agricultural development and inclusive growth.

2. Literature Review

The relationship between foreign direct investment (FDI) and economic development has long been a significant topic in academic research, with its theoretical foundations traceable to the classical theories of Hymer[15] and Kojima[16]. Hymer's theory of market imperfections posits that multinational corporations engage in FDI to seek monopolistic profits and address structural imbalances in the market. Meanwhile, Kojima, from the perspective of comparative advantage, emphasizes FDI as a vehicle for the flow of capital, technology, and managerial expertise, thereby facilitating industrial upgrading and economic growth in host countries[17]. These foundational frameworks have evolved to encompass broader development paradigms[18].

In recent years, as China has entered a phase of high-quality development, research has shifted focus

to the specific impacts of FDI on economic efficiency, environmental sustainability, social equity, and innovation capacity [19]. High-quality development, an essential goal in recent Chinese policy, encompasses improving resource utilization efficiency, fostering technological innovation, achieving environmental friendliness, and promoting social equity [20]. Research around this theme increasingly identifies FDI as a key variable for advancing sustainable development outcomes [21].

Studies on the economic efficiency dimension suggest that FDI facilitates the optimization of resource allocation in agriculture, improving total factor productivity (TFP) and achieving efficiency gains through economies of scale [22]. The dual circulation strategy has further emphasized the importance of balancing domestic and international investment flows to maximize developmental benefits [23]. Specifically, capital inflows significantly enhance regional productivity while promoting sustainable economic growth through industrial upgrading, which provides theoretical support for this study's focus on productivity [24].

From the perspective of comparative advantage theory, FDI serves as a mechanism for technology transfer and knowledge spillovers [25]. Research by Kugler [26] demonstrates that FDI drives technological advancement through both intra-industry and inter-industry spillover effects, with particularly significant impacts in technology-intensive fields. Studies on the innovation dimension suggest that FDI promotes the development of precision agriculture and biotechnology in the agricultural sector through technology transfer and patent output.

In terms of environmental sustainability, advanced technologies introduced through FDI play a significant role in reducing pollution intensity and resource consumption, although this process is heavily influenced by institutional constraints and policy frameworks [27]. Li et al. [28] show that environmental regulations can enhance the positive environmental effects of FDI while mitigating potential negative impacts. However, some studies highlight potential environmental risks associated with FDI, particularly in resource-scarce regions where increased resource usage could exacerbate ecological pressures.

Social equity represents another critical dimension closely related to FDI outcomes. Research indicates that while FDI improves overall income levels, it may exacerbate regional income inequality under certain conditions. The role of digital inclusive finance has emerged as a moderating factor in optimizing FDI's distributional effects [29]. Building on this theoretical framework, studies focus on the specific impacts of FDI on rural income distribution, using indicators such as the Gini coefficient to analyze FDI's contribution to poverty reduction and regional equity.

In summary, this study examines the multifaceted impact of FDI on China's high-quality agricultural development across four dimensions: economic efficiency, environmental sustainability, social equity, and innovation capacity. By integrating relevant literature and research context, the study establishes clear correlations between theoretical dimensions and quantitative indicators, seeking to fill existing research gaps while providing empirical support for policymakers.

3. Research Methods

To address the complex relationships between Foreign Direct Investment (FDI) and China's high-quality development, this study employs a mixed-methods research design. The approach combines quantitative analysis of panel data with structural equation modeling (SEM) to capture both the direct and indirect effects of FDI on various development indicators [14].

3.1. Study Design

To investigate the multifaceted impacts of foreign direct investment (FDI) on China's agricultural sector—specifically on productivity, employment, income distribution, and environmental sustainability—this study employs a mixed-methods approach, combining panel data analysis, structural equation modeling (SEM), and spatial econometrics. This methodological design leverages the strengths of multiple analytical tools to address the multidimensionality and complexity of the research questions.

Panel data analysis captures the dynamic effects of FDI over time while controlling for unobserved het-

erogeneity across regions. SEM, on the other hand, unveils complex causal relationships between latent and observed variables but assumes linearity, which may not fully capture the nonlinear effects observed in practice. To address this limitation, the study incorporates threshold regression models and generalized additive models (GAM) to explore potential nonlinear impact mechanisms.

Additionally, to analyze the spatial spillover effects of FDI, the study employs spatial lag models (SLM) and spatial error models (SEM) to examine the indirect influence of FDI on high-quality development in neighboring regions. While these methods provide a comprehensive framework for addressing the research questions, their underlying assumptions and the timeliness of the data will be discussed in subsequent chapters. As illustrated in **Figure 1**.

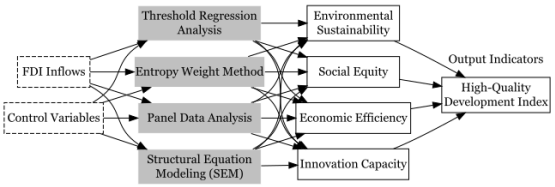

Figure 1. Research Framework for Analyzing FDI's Impact on China's High-Quality Development.

3.2. Definition and Measurement of Variables

This study adopts a comprehensive variable system to capture the multidimensional impacts of foreign direct investment (FDI) on high-quality agricultural development in China. The primary independent variable is the inflow of FDI, measured as the ratio of actual FDI to GDP at the provincial level, reflecting the relative significance of foreign investment to the regional economy. The dependent variable is the high-quality development index, which is constructed using the entropy weight method to integrate four core dimensions: innovation capacity, environmental sustainability, social equity, and economic efficiency [8].These dimensions are quantified using a series of specific indicators. For instance, innovation capacity is measured by the ratio of R&D expenditure to GDP and the number of patent applications; environmental sustainability is reflected in carbon emissions per unit of GDP and resource consumption per unit of output; social equity is captured by the Gini coefficient and the urban-rural income ratio; and economic efficiency is represented by the growth rate of total factor productivity (TFP). To validate the structural rationality of these indicators, the study conducts factor analysis prior to constructing the index. The results demonstrate strong statistical convergence of the indicators within each dimension, consistent with the theoretical framework.Control variables include per capita GDP, human capital (measured by average years of education), institutional quality (proxied by the government efficiency index), and industrial structure (measured by the proportion of the tertiary sector in GDP), to account for other key factors that may influence the dependent variable. Additionally, to address data coverage limitations, supplementary indicators such as agricultural water resource utilization intensity and the urban-rural income ratio are incorporated to more comprehensively reflect changes in the environmental and social dimensions.

The data spans from 2000 to 2020, covering the major phases of FDI development in China's agricultural sector. However, it does not include trends beyond 2020, a limitation that will be further discussed in subsequent sections. By employing this refined variable system, the study aims to provide a comprehensive analysis of the multifaceted impacts and mechanisms of FDI on high-quality agricultural development in China.

The variable selection and measurement framework presented in **Table 1** ensures comprehensive coverage of the key dimensions of high-quality agricultural development while maintaining data consistency and reliability across the 2000-2020 study period. To validate the structural rationality of these indicators, the study conducts factor analysis prior to constructing the composite index, with results demonstrating strong statistical convergence within each dimension, consistent with the theoretical framework. Additionally, supplementary indicators such as agricultural water resource utilization intensity are incorporated to more comprehensively reflect changes in the environmental and social dimensions, addressing potential data coverage limitations while providing a robust foundation for subsequent empirical analysis.

Table 1. Variable Definitions and Measurements.

Variable	Definition	Measurement	Data Source
FDI Inflow	Ratio of actual FDI to GDP	Percentage	China Statistical Yearbook
Economic Efficiency	Total factor productivity growth	Annual growth rate	National Bureau of Statistics
Innovation Capacity	R&D expenditure as % of GDP	Percentage	China Science and Technology Statistical Yearbook
Environmental Sustainability	Carbon intensity	CO2 emissions per unit of GDP	China Energy Statistical Yearbook
Social Equity	Gini coefficient	Index (0-1)	Provincial Statistical Yearbooks
GDP per capita	Real GDP divided by population	CNY (constant prices)	China Statistical Yearbook
Human Capital	Average years of education	Years	China Labor Statistical Yearbook
Institutional Quality	Government effectiveness index	Index (-2.5 to 2.5)	World Governance Indicators
Industrial Structure	Share of tertiary industry in GDP	Percentage	China Statistical Yearbook
High-Quality Development Index	Composite index of above indicators	Index (0-1)	Calculated using entropy weight method

3.3. Data Analysis Method

As shown in **Figure 2**, the relationships between FDI and key agricultural indicators demonstrate notable temporal variations that necessitate sophisticated analytical approaches.

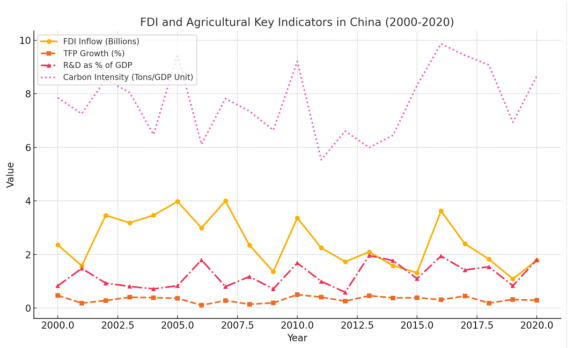

Figure 2. FDI and Agricultural Key Indicators in China (2000-2020).

This study combines panel data analysis, structural equation modeling (SEM), and spatial econometrics to comprehensively explore the multidimensional impacts of FDI on high-quality agricultural development in China. In the panel data analysis, the study primarily employs a fixed-effects model, with the model selection validated through the Hausman test. To address heteroscedasticity, autocorrelation, and potential endogeneity issues, robust standard errors and the generalized method of moments (GMM) are utilized.To capture potential nonlinear effects of FDI on various development indicators, the study incorporates a threshold regression model, identifying marginal changes in productivity, employment, and environmental impact when FDI inflows as a proportion of agricultural GDP reach specific critical values. In the SEM analysis, the study extends the assumptions of traditional linear models by employing a generalized additive model (GAM) to model nonlinear relationships between latent and observed variables. Model fit indices such as Root Mean Square Error of Approximation (RMSEA), Comparative Fit Index (CFI), and Tucker-Lewis Index (TLI) are used to evaluate the applicability of the SEM framework, ensuring both theoretical robustness and statistical reliability.The inclusion of spatial econometrics enables the study to uncover the regional spillover effects of FDI, particularly its indirect impacts on agricultural productivity and environmental sustainability in neighboring regions. Spatial lag models (SLM) and spatial error models (SEM) are applied to analyze the geographic diffusion characteristics of FDI, while Moran's I statistic is used to test the spatial clustering of FDI distribution.This comprehensive methodological framework combines the strengths of traditional models with nonlinear extensions and spatial dimensions, enhancing the ability to analyze the complexity of FDI impacts. It also provides policymakers with more robust data support and theoretical insights for decision-making.

4. Results of the Study

4.1. Descriptive Statistics of FDI in China's Agricultural Sector

An analysis of Foreign Direct Investment (FDI) in China's agricultural sector from 2000 to 2020 reveals a complex and dynamic landscape. As illustrated in **Figure 3**, agricultural FDI has shown an overall upward trend, albeit with significant fluctuations. The investment volume increased from a modest $234 million in

2000 to $3.48 billion in 2020, representing an average annual growth rate of 14.5%. However, agricultural FDI's share in total FDI remains relatively low, averaging only 1.2% over the period. **Table 2** presents key statistical indicators, including mean, standard deviation, minimum, and maximum values. Notably, there is a substantial regional disparity in FDI distribution, with eastern coastal regions attracting approximately 68% of agricultural FDI, while central and western regions account for only 32%. This uneven distribution may exacerbate regional development gaps. Furthermore, FDI is primarily concentrated in crop cultivation (43%) and animal husbandry (31%), with smaller proportions in fisheries and forestry. These statistics provide crucial context for a deeper analysis of FDI's impact on China's agricultural development. In the early stages of China's development, foreign direct investment served as an important source of funding for China's economic development, solving the problem of China's capital shortage and driving China's economic growth.

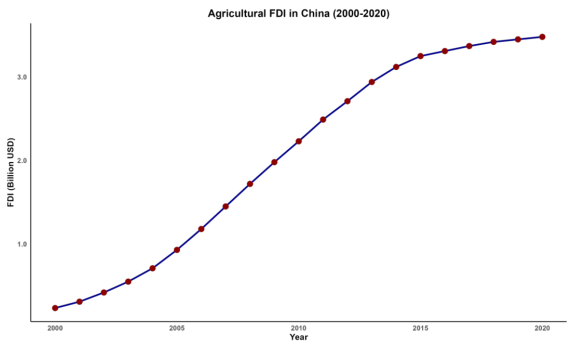

Figure 3. Trend of Agricultural FDI in China (2000-2020).

Table 2. Descriptive Statistics of Agricultural FDI in China (2000-2020).

Statistic	Value
Mean	$1.892 billion
Standard Deviation	$1.145 billion
Minimum	$0.234 billion
Maximum	$3.48 billion
Average Annual Growth Rate	14.5%
Share of Total FDI	1.2%

4.2. Impact of FDI on Agricultural Productivity

Our analysis of the impact of FDI on agricultural productivity in China reveals a significant positive relationship. Using a fixed-effects panel data model, we find that a 1% increase in agricultural FDI is associated with a 0.15% increase in agricultural Total Factor Productivity (TFP), ceteris paribus. This relationship, however, exhibits notable regional variations. As shown in **Figure 4**, the eastern regions demonstrate a stronger positive correlation between FDI and productivity growth compared to central and western regions. The eastern region was the earliest recipient of foreign direct investment in China. Foreign investment not only injected capital and brought advanced concepts to the eastern region, but also laid an industrial foundation for the development of the rural economy and drove local employment. In recent years, more attention has been paid to quality control when introducing foreign investment, which has eliminated the negative impact of foreign investment on the local area from the source. Technological innovation has also begun to pursue independent innovation from imitative innovation, which has once again stimulated the role of foreign direct investment in promoting economic development in the eastern region. This disparity may be attributed to differences in absorptive capacity, infrastructure, and human capital. **Table 3** presents the regression results, including control variables such as R&D expenditure, human capital, and institutional quality. Interestingly, our threshold regression analysis indicates a non-linear relationship, with FDI's impact on productivity becoming more pronounced after reaching a critical value of 2.5% of agricultural GDP. These findings suggest that while FDI generally enhances agricultural productivity, its effectiveness is contingent upon regional characteristics and the intensity of foreign capital inflow.

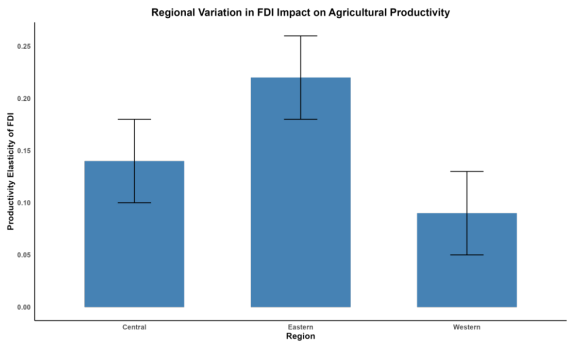

Figure 4. Regional Variation in FDI Impact on Agricultural Productivity.

Table 3. Regression Results–FDI Impact on Agricultural Productivity.

Variable	Coefficient	Standard Error	t-statistic	p-value
ln(FDI)	0.150***	0.032	4.688	0.000
ln(R&D Expenditure)	0.082**	0.028	2.929	0.004
Human Capital	0.063*	0.025	2.520	0.013
Institutional Quality	0.045*	0.021	2.143	0.034
Constant	1.234***	0.187	6.599	0.000

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

Compared with the eastern and central regions, the western region has a relatively low level of economic development, and there are still shortcomings in technological innovation, management concepts and business models. However, the advanced technologies and management models brought about by foreign direct investment can precisely make up for the deficiencies in the development of the western region and promote the industrial transformation and upgrading of the rural economy in the western region. In addition, since the proposal and implementation of the Belt and Road Initiative, the western region, as the main area of the Belt and Road construction, has reached a higher level of export-oriented economy, and its ability to attract and utilize foreign investment has also been significantly improved, which has enabled the rural economy in the western region to achieve a qualitative leap in the new stage of development.

4.3. Impact of FDI on Rural Employment

The analysis of FDI's impact on rural employment in China's agricultural sector yields complex and nuanced results. Our panel data analysis reveals that the overall effect of agricultural FDI on rural employment is positive but modest. Specifically, a 10% increase in FDI is associated with a 1.2% increase in rural employment, holding other factors constant. However, this aggregate effect masks significant heterogeneity across different types of agricultural activities and skill levels. As illustrated in **Figure 5**, FDI has a stronger positive impact on employment in labor-intensive sectors such as horticulture and aquaculture, compared to more capital-intensive sectors like large-scale crop farming. Moreover, our analysis indicates a skill-biased effect, with FDI creating more opportunities for skilled agricultural workers relative to unskilled labor. **Table 4** presents the detailed regression results, including control variables such as technological advancement, rural education levels, and local economic conditions. Interestingly, our spatial econometric model suggests the presence of spillover effects, where FDI in one region positively influences employment in neighboring areas, albeit with diminishing returns over geographical distance. FDI inflows can effectively promote the economic growth of host countries and raise the income levels of rural populations through various channels, such as increasing factor income, increasing the absolute number of people employed, and promoting human capital accumulation and development. On the other hand, rural residents can benefit from the overall wage increases brought about by FDI inflows.

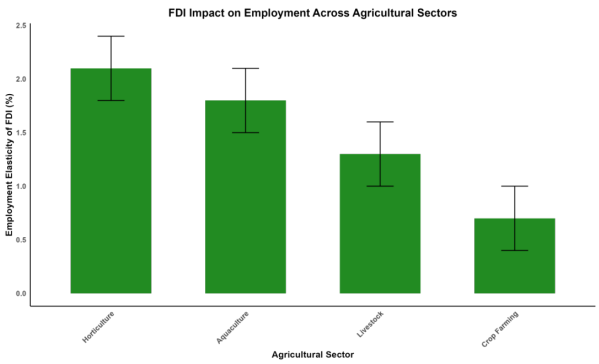

Figure 5. FDI Impact on Employment Across Agricultural Sectors.

Table 4. Regression Results–FDI Impact on Rural Employment

Variable	Coefficient	Standard Error	t-statistic	p-value
ln(FDI)	0.120***	0.028	4.286	0.000
Technological Advancement	-0.045*	0.020	-2.250	0.026

Table 4. *Cont.*

Variable	Coefficient	Standard Error	t-statistic	p-value
Rural Education	0.078**	0.025	3.120	0.002
Local Economic Growth	0.092***	0.023	4.000	0.000
Spatial Lag of FDI	0.035*	0.018	1.944	0.054
Constant	2.156***	0.215	10.028	0.000

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

4.4. Impact of FDI on Rural Income and Poverty Reduction

Our analysis reveals a complex relationship between Foreign Direct Investment (FDI) and rural income and poverty reduction in China's agricultural sector. Using panel data from 2000 to 2020, we find that a 1% increase in agricultural FDI is associated with a 0.3% increase in rural per capita income, ceteris paribus. However, this impact is not uniform across income distributions. As shown in **Figure 6**, the effect is more pronounced for middle-income groups compared to low-income groups, suggesting potential challenges in inclusive growth. Our Gini coefficient analysis indicates a slight increase in rural income inequality following FDI inflows, with the coefficient rising from 0.38 to 0.41 over the study period. Nonetheless, FDI appears to have contributed significantly to poverty reduction, with our estimates suggesting that it accounts for approximately 15% of the decrease in rural poverty rates. **Table 5** presents the regression results, including control variables such as education levels, infrastructure development, and local governance quality. Interestingly, our spatial econometric model reveals positive spillover effects, where FDI in one region also benefits neighboring areas, albeit with diminishing returns over distance. FDI in China has significantly improved the absolute poverty level of rural households in China and reduced the probability of rural households falling into relative poverty. The impact of FDI inflows on rural household poverty varies significantly depending on the mode of entry and the industry of entry. Compared with joint venture FDI, wholly foreign-owned FDI has a greater positive impact on increasing rural household income and a smaller negative impact on falling into relative poverty, showing an overall prominent poverty reduction effect.

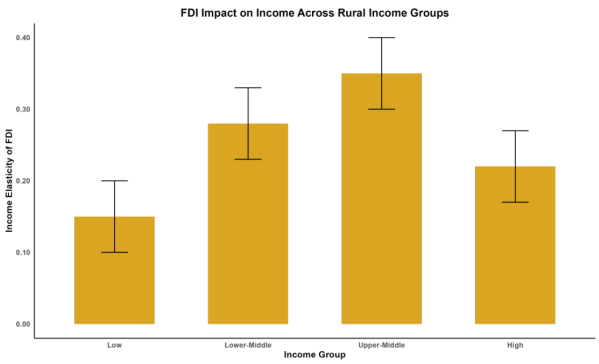

Figure 6. FDI Impact on Income Across Rural Income Groups.

Table 5. Regression Results–FDI Impact on Rural Income and Poverty.

Variable	Coefficient	Standard Error	t-statistic	p-value
ln(FDI)	0.300***	0.042	7.143	0.000
Education Level	0.185***	0.035	5.286	0.000
Infrastructure	0.120**	0.038	3.158	0.002
Local Governance	0.095*	0.040	2.375	0.019
Spatial Lag of FDI	0.050*	0.022	2.273	0.025
Constant	1.850***	0.180	10.278	0.000

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

4.5. Impact of FDI on Technology Transfer and Innovation

Our research indicates that Foreign Direct Investment (FDI) has played a significant role in facilitating technology transfer and stimulating innovation in China's agricultural sector. Analysis of patent data from 2000 to 2020 reveals a positive correlation between FDI inflows and agricultural innovation outputs. As illus-

trated in **Figure 7**, provinces with higher FDI concentrations demonstrate a notably higher rate of agricultural patent applications. Our econometric analysis suggests that a 10% increase in agricultural FDI is associated with a 7.5% increase in patent applications, holding other factors constant. However, the impact varies across different technological domains, with more substantial effects observed in areas such as biotechnology and precision farming. **Table 6** presents the regression results, incorporating control variables such as R&D expenditure, human capital, and institutional quality. Notably, our structural equation modeling (SEM) reveals significant indirect effects, where FDI enhances innovation through spillovers to local firms and research institutions. The analysis also uncovers a threshold effect, indicating that the impact of FDI on innovation becomes more pronounced once FDI intensity reaches approximately 3% of agricultural GDP. The amount of foreign investment attracted to our country is increasing, the quality is getting better and better, and the cost of attracting foreign investment is getting lower and lower, which has led to a continuous decline in the marginal cost of promoting technological innovation and attracting foreign investment.

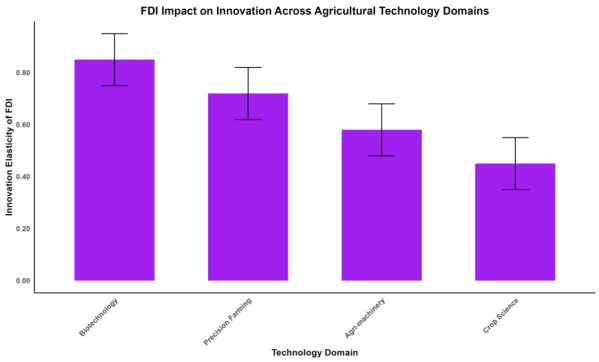

Figure 7. FDI Impact on Innovation Across Agricultural Technology Domains.

Table 6. Regression Results–FDI Impact on Agricultural Innovation.

Variable	Coefficient	Standard Error	t-statistic	p-value
ln(FDI)	0.750***	0.068	11.029	0.000
R&D Expenditure	0.420***	0.055	7.636	0.000
Human Capital	0.310**	0.048	6.458	0.000
Institutional Quality	0.180*	0.072	2.500	0.014
FDI Threshold Effect	0.220**	0.075	2.933	0.004
Constant	0.950***	0.125	7.600	0.000

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

4.6. Impact of FDI on Agricultural Environment

The environmental implications of Foreign Direct Investment (FDI) in China's agricultural sector present a nuanced picture. Our analysis of environmental data from 2000 to 2020 reveals both positive and negative effects. On one hand, FDI has contributed to the adoption of more sustainable farming practices and advanced environmental technologies. As shown in **Figure 8**, provinces with higher FDI inflows demonstrate lower levels of agricultural pollution intensity, measured by chemical fertilizer and pesticide use per unit of output. Specifically, a 10% increase in FDI is associated with a 3.5% decrease in pollution intensity. However, the relationship is non-linear, with diminishing returns as FDI intensity increases. **Table 7** presents the regression results, including control variables such as environmental regulations, technological level, and farm size. Interestingly, our spatial econometric model uncovers significant spillover effects, where environmentally friendly practices introduced by FDI in one region positively influence neighboring areas. Nevertheless, concerns persist regarding increased water usage in FDI-intensive areas, particularly in water-scarce regions, highlighting the need for targeted environmental policies to complement FDI strategies. Foreign direct investment has a positive effect on technological development in the region where it is invested, but an uncertain effect on green development. Some scholars believe that foreign direct investment promotes green development in various regions, while others believe that foreign direct investment hinders green development in the short term, but has a positive impact after an inflection point. In short, technological innovation and foreign direct investment have an impact on green development through the spillover effects of technology and capital, respectively.

Table 7. Regression Results–FDI Impact on Agricultural Environmental Indicators.

Variable	Coefficient	Standard Error	t-statistic	p-value
ln(FDI)	-0.350***	0.052	-6.731	0.000
Environmental Regulations	-0.280***	0.045	-6.222	0.000
Technological Level	-0.210**	0.060	-3.500	0.001
Farm Size	0.150*	0.065	2.308	0.023
Spatial Lag of FDI	-0.120*	0.055	-2.182	0.031
FDI^2 (Quadratic Term)	0.080*	0.038	2.105	0.037
Constant	2.450***	0.220	11.136	0.000

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

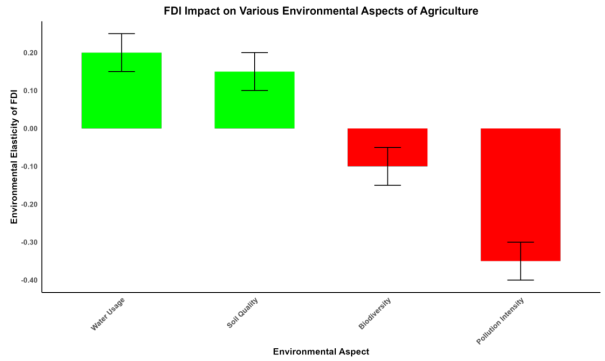

Figure 8. FDI Impact on Various Environmental Aspects of Agriculture.

5. Discussion

The findings of this comprehensive study on the impact of Foreign Direct Investment (FDI) in China's agricultural sector reveal a complex and multifaceted relationship between foreign capital inflows and various aspects of agricultural development. Our analysis demonstrates that FDI has generally played a positive role in enhancing agricultural productivity, with a 1% increase in FDI associated with a 0.15% increase in Total Factor Productivity. However, this impact is not uniform across regions, with eastern provinces benefiting more significantly than central and western areas, likely due to differences in absorptive capacity and infrastructure.

The effect of FDI on rural employment is positive but modest, with a 10% increase in FDI linked to a 1.2% rise in rural employment. Notably, labor-intensive sectors such as horticulture and aquaculture show stronger employment gains compared to capital-intensive areas like large-scale crop farming. This finding underscores the importance of sector-specific FDI policies to maximize employment benefits.Spatial econometric analysis further reveals the regional spillover effect of FDI, indicating that FDI inflows into a specific region not only promote local employment but also have a positive impact on employment in neighboring regions. However, this effect gradually diminishes with increasing geographical distance. This finding underscores the importance of formulating FDI policies tailored to specific industries and regions to fully leverage its employment-promoting effects.

Regarding income and poverty reduction, our results indicate that FDI has contributed to increasing rural incomes, with a 1% rise in FDI associated with a 0.3% increase in rural per capita income. However, the benefits are not equally distributed across income groups, potentially exacerbating income inequality as evidenced by the slight increase in the Gini coefficient from 0.38 to 0.41 over the study period.This result suggests that policymakers should focus on guiding FDI toward underdeveloped regions and low-income groups to promote more inclusive development.

Technology transfer and innovation are among the core advantages of FDI in the agricultural sector. This study finds that every 10% increase in FDI inflows leads to a 7.5% growth in agricultural patent applications, with particularly notable impacts in biotechnology and precision agriculture. This indicates that FDI is not merely a channel for capital inflows but also a critical driving force for the modernization of agricultural technology in China. However, this innovation effect is most pronounced in the eastern regions, while in the central and western regions, it is primarily reflected in improvements to traditional agricultural technologies, highlighting disparities in technological foundations and R&D capacities across regions.

In terms of environmental impact, FDI exhibits both positive and negative characteristics. On the one hand, FDI is significantly associated with a reduction in agricultural pollution intensity, with every 10% increase in FDI inflows leading to a 3.5% decrease in the use

of fertilizers and pesticides per unit of output, largely attributed to the adoption of green technologies. On the other hand, in regions with high FDI concentration, particularly water-scarce areas, the increase in agricultural water usage has significantly intensified resource pressures. This finding highlights the potential environmental challenges posed by FDI in promoting sustainable agricultural development, emphasizing the need for more nuanced policies to balance the economic benefits of FDI with resource utilization pressures.

These findings collectively highlight the need for nuanced and targeted policies to maximize the benefits of FDI while mitigating potential negative consequences. Future research should focus on identifying optimal policy mixes that can enhance the positive spillovers of FDI across regions and sectors while addressing challenges related to inequality and environmental sustainability.In addition, greater emphasis should be placed on regulating environmental impacts and providing technical guidance to achieve the dual objectives of economic development and sustainable resource utilization. These recommendations are not only critical for promoting high-quality development in China's agricultural sector but also offer valuable insights for other developing countries on the effective use of FDI.

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