agriculture

MDPI

Article

Addressing Rural Decline: China's Practices in Rural Transformation and Farmers' Income Growth

Deshuo Zhang †, Qingning Lin † and Shiping Mao *

Institute of Agricultural Economics and Development, Chinese Academy of Agricultural Sciences, Beijing 100081, China; zhangdeshuo97@163.com (D.Z.); linqingning@caas.cn (Q.L.)
* Correspondence: maoshiping@caas.cn; Tel.: +86-10-8210-8388
† These authors contributed equally to this work.

Abstract: In the context of global rural decline, fostering endogenous momentum through rural transformation to increase farmers' incomes is a challenge that nations worldwide must address. This study utilizes the 2022 "China Rural Micro-Economic Data" to construct a multidimensional rural transformation index system at the village level, encompassing demographic, land, industrial, social, digital, and ecological transformations. This study evaluates the levels of rural transformation across 15 surveyed provinces in China. Furthermore, it empirically examines the impact of rural transformation on farmers' incomes, the underlying mechanisms, and the heterogeneity of different transformation models. The findings are as follows: (1) Coastal economically developed regions exhibit higher levels of rural transformation, while inland agricultural provinces show significant lag; (2) Rural transformation effectively promotes the upgrading of agricultural value chains, increases farmers' market participation, and enhances their access to financial services, thereby boosting farmers' incomes; and (3) The impact of different transformation models on farmers' incomes varies significantly; industrial, social, and demographic transformations contribute most prominently to income growth. While digital transformation shows some positive effects, it remains relatively limited. Land and ecological transformations have yet to demonstrate a significant positive impact on farmers' incomes.

Keywords: rural transformation; farmers' income; heterogeneity; mechanism

Citation: Zhang, D.; Lin, Q.; Mao, S. Addressing Rural Decline: China's Practices in Rural Transformation and Farmers' Income Growth. *Agriculture* **2024**, *14*, 1654. https://doi.org/10.3390/agriculture14091654

Academic Editor: Jean-Paul Chavas

Received: 12 August 2024
Revised: 17 September 2024
Accepted: 19 September 2024
Published: 22 September 2024

1. Introduction

With the acceleration of globalization and industrialization, labor migration from agriculture to more productive non-agricultural sectors has become prevalent [1–3]. This shift has led to the economic decline of rural areas. For instance, in the BRICS countries, the rural population percentage from 1960 to 2023 decreased by 21% in Russia, 18% in India, 22% in South Africa, 42% in Brazil, and a significant 49% in China (World Bank Data). This trend is widespread globally and more pronounced in rapidly developing countries (see Figure 1). The drastic reduction in rural populations not only triggers rural decline [4] but also severely threatens the sustainable livelihoods of farmers. Rural decline is typically characterized by a downward spiral of diminishing employment opportunities, depopulation, economic depression, and deteriorating quality of life in rural areas [5–9]. In countries like Nigeria and India, the massive influx of impoverished farmers has exceeded the urban job market's capacity. Combined with the economic deterioration of rural areas and ineffective rural transformation strategies, this has led to the formation of slums [10,11]. However, research and data suggest that implementing effective rural transformation strategies can lead to faster, more stable, and inclusive economic growth [12–14]. Therefore, exploring and implementing rural transformation strategies that are tailored to national contexts to foster endogenous rural development and explore practical solutions for increasing farmers' incomes is a global challenge that needs to be addressed.

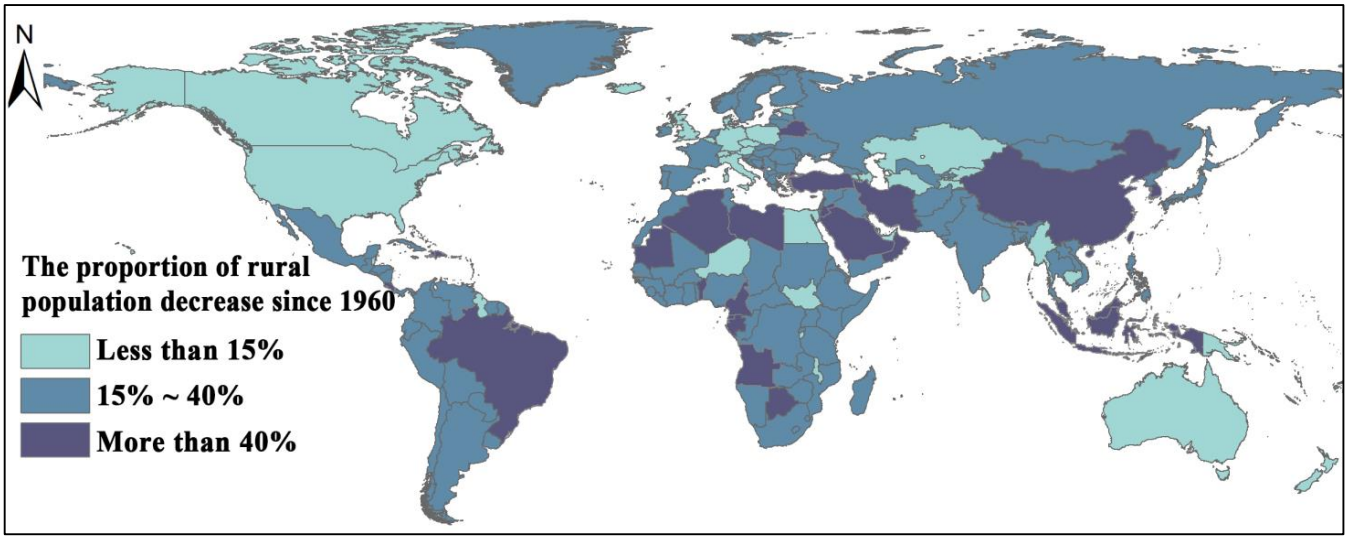

Figure 1. The proportion of rural population decrease around the world from 1960 to 2023.

The Chinese government places great importance on farmers' incomes. The No. 1 Central Document highlights the need to "improve rural industries, construction, and governance to increase farmers' incomes", providing a solid policy foundation and clear direction for China's future rural transformation. Data show that by 2023, Chinese farmers' incomes had increased fivefold compared to the beginning of the century, underscoring the significant achievements in rural economic development. Nonetheless, China's rural development still faces several constraints, such as a single agricultural industrial structure, low added value of agricultural products, and insufficient agricultural technology support, which hinder sustainable rural development and the potential for farmers' income growth [15–17]. Therefore, to fundamentally solve the dilemma of increasing farmers' incomes, breakthroughs must be sought within rural areas by promoting rural transformation to expand value-added and efficiency-enhancing opportunities [18–20]. Against this backdrop, this study focuses on the common issues of global rural decline and examines the practical cases from a Chinese perspective to explore the relationship between rural transformation and farmers' income, aiming to provide valuable insights for global rural development and transformation.

Existing research highlights that the causes and strategies for addressing rural decline vary across countries. In Europe, rural decline is primarily driven by population outflows and reductions, severely impacting the social fabric of rural communities [21,22]. North America's rural issues stem from globalization and economic restructuring, leading to the hollowing out of rural industries and the erosion of traditional social order [23,24]. In Japan, rural decline is closely linked to post-war, urban-focused reconstruction policies and an aging population [25,26]. To counter these challenges, countries have adopted diverse rural transformation strategies. The U.S. supports rural revitalization through economic rejuvenation plans and infrastructure improvements [27]. The European Union implements the Common Agricultural Policy (CAP) and promotes rural tourism [28,29]. Japan addresses rural decline through initiatives like the "Sixth Industrialization" and comprehensive rural revitalization strategies [30]. Collectively, these countries prioritize rural transformation as a core approach to promoting sustainable rural development. Research on rural transformation has accumulated substantial findings. Huang et al. (2020) define rural transformation as the process encompassing increased agricultural productivity, commercialization, diversification of production models and livelihoods, and the shift towards non-agricultural employment [31]. Kim and Yang (2016) and Wu et al. (2022) use the "Population-Land-Industry" (PLI) index, establishing a three-dimensional system to measure rural transformation [32,33]. Long et al. (2011) further subdivide rural transformation into three aspects: rural development, transformation, and urban-rural

coordination, providing a more detailed assessment method [34]. Dong and Chen (2023) categorize rural transformation into four factors: productivity, rurality, inclusiveness, and sustainability [35].

In terms of driving factors, the advancement of rural industrialization and urbanization is considered crucial for rural transformation [36]. The improvement of transportation networks is also seen as a significant driving force [37]. Regarding the social welfare effects of rural transformation, Sudaryanto et al. (2023) analyze data from Indonesia, revealing that rural transformation promotes agricultural growth and economic diversification in rural areas, significantly increasing the proportion of non-agricultural employment and positively impacting rural household incomes and poverty reduction [38]. Farooq and Farah (2023) also find that rural transformation in Pakistan plays a vital role in increasing farmers' incomes and reducing poverty [39]. Rola-Rubzen et al. (2023) highlight that rural transformation significantly enhances women's employment opportunities, rights, and income levels [40].

The existing literature extensively explores the causes and strategies of rural decline across different countries but often lacks empirical evidence from China. This study addresses this gap by analyzing micro-level data from 15 Chinese provinces, revealing unique rural transformation pathways and outcomes specific to China. While most research focuses on traditional dimensions like population, land, and industry, our study incorporates digital and ecological factors, creating a comprehensive evaluation framework. Additionally, the mechanisms through which rural transformation affects income growth remain underexplored, often treated as a "black box". This study aims to unpack these mechanisms, offering both theoretical insights and practical guidance for rural revitalization in China and globally and providing valuable references for inclusive rural development strategies.

The remainder of the paper is organized as follows: Section 2 presents the theoretical analysis and research hypotheses; Section 3 outlines the data, variables, and identification strategy; Section 4 discusses the empirical analysis and findings; Section 5 provides a discussion of the results and their implications, and Section 6 concludes with research conclusions and policy recommendations.

2. Theoretical Analysis and Research Hypotheses

2.1. Impact of Rural Transformation on Farmers' Income

Rural transformation refers to the complex process in which rural areas shift from traditional agricultural societies to modern agricultural and non-agricultural societies amid the backdrop of accelerated economic globalization, urbanization, and rapid development of information technology [10,41]. This transformation plays a crucial role in increasing farmers' incomes. First, rural transformation diversifies the agricultural production structure, allowing farmers to transition from traditional grain production to high-value agricultural products. By cultivating cash crops, developing livestock, and engaging in aquaculture, farmers can achieve higher returns compared to traditional grain crops [14,38,42]. Second, rural transformation facilitates the movement of rural labor from agriculture to non-agricultural sectors, providing farmers with additional income sources and mitigating the single and unstable nature of agricultural income [43,44]. Lastly, policy support plays a vital role in the rural transformation process. Governmental innovations and policy support, such as the implementation of the household responsibility system, land use rights reforms, and the promotion of agricultural mechanization services, have improved agricultural productivity and provided a solid foundation for increasing farmers' incomes. Based on these insights, we propose the following hypothesis:

H1. *Rural transformation promotes an increase in farmers' incomes.*

2.2. Mechanisms through Which Rural Transformation Increases Farmers' Incomes

2.2.1. Rural Transformation and the Upgrading of Agricultural Value Chains

The upgrading of agricultural value chains refers to the process of maximizing the value of agricultural products through the integration and extension of production, processing, and sales stages. This process is a key driver of rural economic development and income growth for farmers [45]. Rural transformation facilitates the integration and extension of agricultural value chains by introducing modern industrial technologies and concepts, thereby creating new income pathways for farmers through the development of deep processing and branding of agricultural products [46]. This shift enhances the market competitiveness and value of agricultural products. Furthermore, as farmers diversify their business strategies, they can expand their income sources by participating in multiple stages of the agricultural value chain, maximizing economic benefits [47]. In summary, rural transformation provides a foundation for the expansion and extension of agricultural value chains, achieving multi-level and multi-link value addition to agricultural products through the "multiplier effect" of the value chain, ultimately leading to increased farmers' incomes.

2.2.2. Rural Transformation and Farmers' Market Participation

Farmers' market participation refers to the extent and depth of farmers' engagement in market economic activities. Rural transformation not only promotes the integration of smallholder farmers with modern agriculture but also significantly enhances their ability to participate in the modern market economy. Firstly, throughout the process of rural transformation, guided and supported by policies, various effective economic cooperation models have emerged, such as "enterprise + farmer" and "enterprise + cooperative + farmer". These cooperation models not only economically link smallholder farmers with larger enterprises but also facilitate the sharing of technology and market information, significantly improving the market integration of smallholder farmers. Secondly, rural transformation has led to the emergence of new sales channels, such as rural e-commerce, wholesale markets, farmer cooperatives, direct sales points, and contract farming. By reducing intermediate links in the transaction process, these channels optimize the efficiency of agricultural product circulation, thereby enhancing farmers' market participation [48–51]. Additionally, the market orientation and demand response mechanisms in rural transformation have gradually improved, shifting agricultural production from a traditional production-driven model to a market-driven model.

2.2.3. Rural Transformation and Farmers' Financial Accessibility

Farmers' financial accessibility refers to the degree to which farmers can access and utilize financial services, including loans, savings, insurance, and other financial products and services. Traditional rural financial models face high transaction costs and information asymmetry issues. Coupled with farmers' lack of sufficient collateral, many rural households are excluded from the financial system, leading to low financial accessibility [52–56]. This limits their ability to invest in new agricultural technologies or entrepreneurial activities [57]. However, with rural transformation, the establishment of more rural financial outlets and the widespread adoption of digital financial services enable farmers to access a diverse range of convenient financial services. Firstly, based on information economics theory, digital finance can significantly reduce transaction costs and information asymmetry, overcoming the geographical limitations of traditional rural financial outlets and enhancing the inclusivity of financial services for farmers [16,58,59]. Secondly, improved financial accessibility can effectively alleviate farmers' financing constraints, providing the necessary capital for entrepreneurship, production expansion, and equipment upgrades, thereby enhancing economic efficiency.

Based on the above theoretical analysis, we construct the theoretical framework depicted in Figure 2 and propose the following hypothesis:

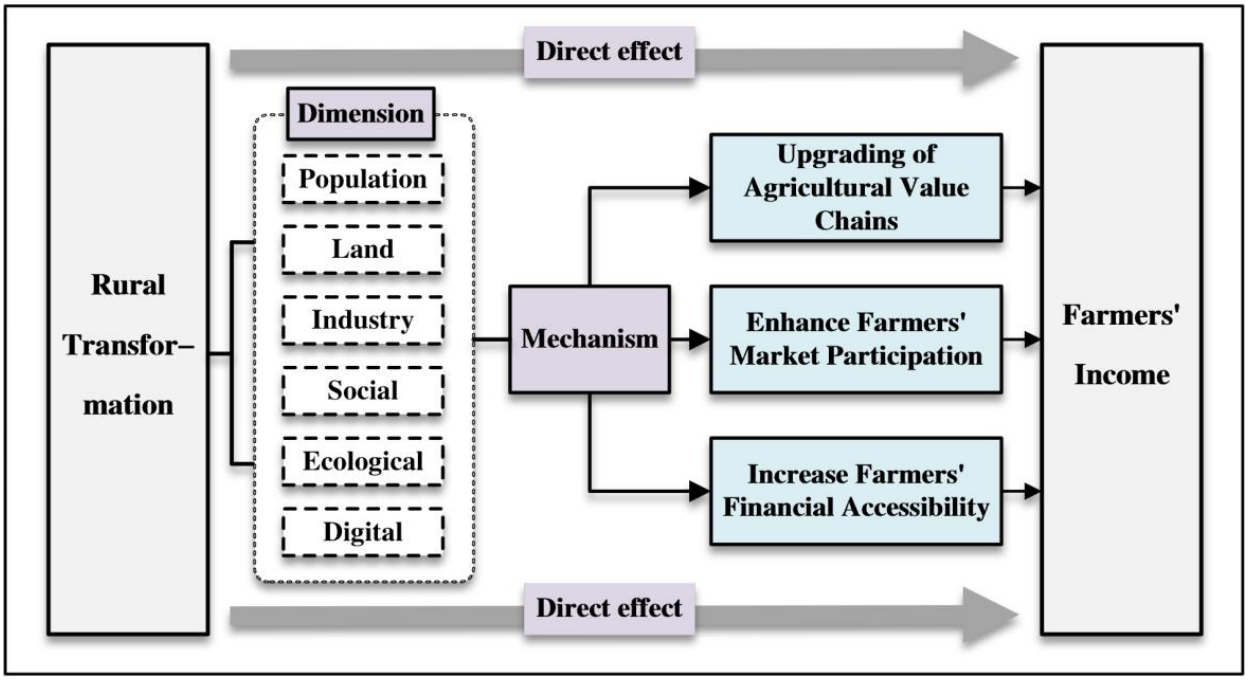

Figure 2. Theoretical analysis framework.

H2. *Rural transformation promotes the upgrading of agricultural value chains, enhances farmers' market participation, and increases farmers' financial accessibility, thereby boosting farmers' incomes.*

3. Materials and Methods

3.1. Data Source

This study utilizes data from the "China Rural Micro-Economic Data" collected by the Institute of Agricultural Economics and Development at the Chinese Academy of Agricultural Sciences in 2022. The data focus on micro-economic information at the administrative village and household levels. The village survey collects data across five dimensions: basic village information, economic development, governance, social development, and ecological construction. The household survey includes 344 indicators covering basic household information, production and business activities, household income and expenditure, and evaluations of service needs and village governance participation.

This study's sample selection covered 15 provinces across China's eastern, central, and western regions, specifically Anhui, Fujian, Hebei, Henan, Heilongjiang, Hubei, Hunan, Jilin, Jiangsu, Shandong, Sichuan, Xinjiang, Yunnan, Zhejiang, and Chongqing. The choice of these provinces was due to China's vast geographical diversity and logistical constraints, which made full nationwide coverage impractical. These selected provinces are highly representative as they encompass various regional types, including coastal, inland, and minority areas, capturing a wide range of economic and social conditions. This approach ensures a robust reflection of China's rural transformation and farmers' income dynamics.

To ensure representativeness and randomness, the sampling rule was to select three counties (or cities/districts) per province, three administrative villages per county, and 20 households per village for questionnaire surveys. This method resulted in a large sample of individual farmers, with 5520 valid farmer samples retained for empirical research after excluding samples with missing data.

3.2. Variable Selection

3.2.1. Core Explanatory Variable

The core explanatory variable in this study is rural transformation (RT). Drawing from existing research [13,32–34] and incorporating the significance of the digital economy and

green development for rural transformation, we constructed an indicator system from six dimensions: demographic transformation, land transformation, industrial transformation, social transformation, ecological transformation, and digital transformation (Table 1). The specific indicators are as follows:

1. Demographic Transformation: This includes three indicators: the proportion of non-agricultural employment (a1), reflecting the shift of rural labor to non-agricultural sectors; the proportion of labor force (a2), indicating the adequacy of labor resources; and the proportion of residents with high school education or above (a3), indicating the level of human capital in rural areas.
2. Land Transformation: This dimension emphasizes land use efficiency. The proportion of arable land (a4) reflects the share of arable land in the total land area, with a lower ratio indicating a more diversified land use structure. Land mobility (a5) shows the status of land market transactions and scale operations. Land productivity (a6) assesses the economic output per unit of land.
3. Industrial Transformation: This focuses on optimizing and enhancing the efficiency of rural industrial structures. Crop diversity (a7) indicates the shift from grain-based monoculture to a more diversified crop structure dominated by cash crops. The proportion of tertiary industry income (a8) reflects the development level and advancement of the rural industry structure. Agricultural labor productivity (a9) measures the output efficiency of labor input in production.
4. Social Transformation: This dimension reflects the development of basic rural services. The number of courier service points (a10) and the number of farmers' markets (a11) indicate the development level of rural markets and services. Per capita investment in public facilities (a12) assesses the investment in living quality for rural residents.
5. Ecological Transformation: This emphasizes the integration of the ecological environment with rural economic development [60]. Indicators include the proportion of pollution-free crop cultivation (a13) and village greening rate (a14), reflecting the quality of the rural ecological environment. Tourism income (a15) indicates the development potential of eco-tourism in rural areas.
6. Digital Transformation: This dimension represents the penetration and application of digital technology in rural transformation [61,62]. Indicators include the number of e-commerce entrepreneurs (a16), the proportion of households with cable TV (a17), and the proportion of households with internet access (a18), showcasing the digital infrastructure and degree of digital transformation in rural areas.

Table 1. Indicator system for rural transformation.

Dimension Layer	Indicator Layer	Calculation Method	Direction	Weight
Demographic Transformation	Proportion of Non-Agricultural Employment (a1)	Secondary and Tertiary Industry Workers/Total Village Population	+	2.463
	Proportion of Labor Force (a2)	Labor Force/Total Village Population	+	0.605
	Proportion of Population with High School Education and Above (a3)	Number of People with High School Education and Above/Total Village Population	+	1.634
Land Transformation	Proportion of Arable Land (a4)	Total Arable Land Area/Total Village Land Area	-	5.044
	Land Mobility (a5)	Land Transfer Area/Total Arable Land Area	+	17.657
	Land Productivity (a6)	Total Agricultural Income/Total Arable Land Area	+	3.898

Table 1. *Cont.*

Dimension Layer	Indicator Layer	Calculation Method	Direction	Weight
Industrial Transformation	Crop Structure (a7)	Grain Crop Sowing Area/Total Crop Sowing Area	-	3.210
	Proportion of Tertiary Industry Income (a8)	Tertiary Industry Income/Total Agricultural Income	+	6.454
	Agricultural Labor Productivity (a9)	Total Agricultural Income/Number of People	+	8.047
Social Transformation	Number of Courier Service Points (a10)	Number of Courier Service Points	+	11.921
	Number of Farmers' Markets (a11)	Number of Farmers' Markets	+	7.191
	Per Capita Investment in Public Facilities (a12)	Investment in Public Facilities/Total Village Population	+	3.351
Ecological Transformation	Proportion of Green and Pollution-Free Crop Cultivation (a13)	Green and Pollution-Free Crop Cultivation Area/Total Crop Sowing Area	+	15.654
	Village Greening Rate (a14)	Village Greening Rate	+	8.955
	Tourism Income (a15)	Total Tourism Income	+	2.133
Digital Transformation	Number of E-Commerce Entrepreneurs (a16)	Number of E-Commerce Entrepreneurs	+	1.073
	Proportion of Households with Cable TV (a17)	Number of Households with Cable TV/Total Village Population	+	0.695
	Proportion of Households with Internet Access (a18)	Number of Households with Internet Access/Total Village Population	+	0.016

After establishing the measurement indicator system, the entropy method was used to assign weights to ensure objectivity and scientific accuracy. The weighted indicators were then aggregated to determine the level of rural transformation for each village.

3.2.2. Dependent Variable

The dependent variable in this study is the total annual personal income of farmers in 2022 (Income). This variable aims to analyze and quantify the impact of rural transformation on farmers' incomes. Additionally, the income data is log-transformed. The reason for this approach is that income data often exhibit high variability and right-skewness, leading to heteroscedasticity, which can undermine the robustness and reliability of regression estimates. Logarithmic transformation compresses extreme values, making the data distribution more symmetric and reducing heteroscedasticity. By stabilizing variance, log transformation ensures more consistent and accurate analysis of the impact of rural transformation on income.

3.2.3. Mechanism Variables

1. Agricultural Value Chain Upgrading (Upgrade): This is a key indicator for measuring the progress of rural transformation and an important mechanism through which rural transformation promotes income growth for farmers. The rise and development of new agricultural business entities are significant features of the upgrading process. These new entities, such as family farms, farmer cooperatives, and agricultural enterprises, play crucial roles in resource aggregation, innovation, and technology application. Therefore, this study uses the natural logarithm of the number of new agricultural business entities in the village as a proxy variable for agricultural value chain upgrading.
2. Farmers' Market Participation (Market): The degree of farmers' market participation can be assessed by the diversity of sales channels they use. In highly market-oriented

rural areas, farmers typically use multiple sales channels to sell their agricultural products. Accordingly, this study quantifies responses to the questionnaire item "What sales channels are you currently using to sell your agricultural products?" Farmers using a single sales channel are assigned a score of 1, while those using multiple channels receive a score corresponding to the number of different channels used.

3. Farmers' Financial Accessibility (Access): This is measured based on the household's investment and loan status. This study combines the total external investment of the household at the end of 2022 with the balance of loans from formal financial institutions to reflect the financial accessibility of farmers, and this combined value is log-transformed.

3.2.4. Control Variables

To capture the multifaceted factors influencing farmers' incomes, this study introduces a series of control variables at the individual, household, and village levels, referencing existing research [63,64].

Individual-level variables include gender (Gender), age (Age), health status (Health), educational attainment (Edu), non-agricultural vocational training (Train), and agricultural technical training (Tech). These variables are selected to control for the potential impacts of personal capabilities, health status, and human capital on income.

Household-level variables consider the political background of the household (Status) and whether any family member holds a village cadre position (Position), aiming to assess the impact of social capital on farmers' economic activities, whether positive or negative.

Village-level variables include village type (Center) and geographical characteristics (Geogra) to reflect the influence of geographical location, infrastructure, and natural resources on farmers' incomes. The specific meanings and assignment details of these variables are presented in Table 2.

Table 2. Variables' meaning and assignment details.

Category	Variable Name	Symbol	Definition
Dependent Variable	Income	Income	Total annual income of farmers in 2022 (in RMB), logarithmically transformed
Explanatory Variable	Rural Transformation	RT	Calculated according to the indicator system outlined above
Mechanism Variables	Agricultural Value Chain Upgrade	Upgrade	Number of new agricultural business entities in the village (including family farms, farmer cooperatives, and agricultural enterprises), logarithmically transformed
	Market Participation	Market	Evaluated through different sales channels. Each sales channel is assigned a value of 1. Households using multiple sales channels are assigned values based on the number of channels used. Sales channels include market trade, wholesale markets, farmer cooperatives' joint sales or direct sales, supermarket docking, chain operations, e-commerce, and contract farming
	Financial Accessibility	Access	Sum of 'total external investments held by the household at the end of 2022' and 'loan balance from formal financial institutions such as banks and credit cooperatives', logarithmically transformed
Individual Characteristics	Gender	Gender	Male = 1; Female = 0
	Age	Age	Actual age of rural residents
	Health Status	Health	Healthy = 1; chronically ill, severely ill, or disabled = 0
	Education Level	Edu	No schooling = 0; primary school = 1; junior high school = 2; high school and technical secondary school = 3; junior college and above = 4
	Vocational Training	Train	Received non-agricultural vocational education in 2022? Yes = 1; No = 0
	Agricultural Training	Tech	Received agricultural technical training in 2022? Yes = 1; No = 0
Household Characteristics	Party Member in Household	Status	Party member in household. Yes = 1; No = 0
	Village Cadre in Household	Position	Village cadre in household. Yes = 1; No = 0
Village Characteristics	Village Type	Center	Is the village the location of a township government? Yes = 1; No = 0
	Village Topography	Geogra	Plain = 1; Plateau, basin, hill, mountain = 0

3.3. Descriptive Statistics

Descriptive statistics for all variables are presented in Table 3. The descriptive statistics for the core explanatory variable "RT" show a mean value of 0.2286 and a standard deviation of 0.1389, indicating that there is still significant room for improvement in the level of rural transformation across China, with considerable variability and imbalance. Regarding individual characteristics, the data for gender (Gender) indicate that the majority of the sample consists of male respondents. The age (Age) variable ranges from 10 to 93 years, with an average age of 57.24 years, reflecting the aging population in rural China. The relatively high average age likely highlights the prevalent trend of younger labor migrating to urban areas, which impacts rural labor supply, social welfare needs, and the talent pool necessary for rural transformation. The statistical analysis of other variables provides limited additional insights and is therefore not discussed in detail here.

Table 3. Descriptive statistics of variables.

Variables	Obs	Mean	Std.dev.	Min	Max
Income	5520	10.906	1.3606	4.6052	17.224
RT	5520	0.2286	0.1389	0.1017	0.9822
Upgrade	5520	1.9979	1.1569	0.0000	5.8944
Market	5520	1.0123	0.9546	0.0000	5.0000
Access	5520	0.6853	0.8748	0.0000	3.9512
Gender	5520	0.8491	0.3580	0.0000	1.0000
Age	5520	57.237	10.952	10.000	93.000
Health	5520	0.8174	0.3864	0.0000	1.0000
Edu	5520	1.8078	0.8809	0.0000	4.0000
Train	5520	0.1101	0.3131	0.0000	1.0000
Tech	5520	0.1964	0.3973	0.0000	1.0000
Status	5520	0.2319	0.4221	0.0000	1.0000
Position	5520	0.1219	0.3272	0.0000	1.0000
Center	5520	0.1239	0.3295	0.0000	1.0000
Geogra	5520	0.3487	0.4766	0.0000	1.0000

3.4. Model Specification

Given that the target variable, farmers' income, is continuous, a multiple regression model based on Ordinary Least Squares (OLS) is employed. The baseline model is specified as follows:

$$Income_i = \alpha_0 + cRT_i + \alpha_1 Control_i + \epsilon_i \quad (1)$$

In Equation (1), i represents the individual farmer, and α_0 is the intercept term, representing the logarithm of the average income of farmers in the absence of any explanatory variables. c is the estimated coefficient of the core explanatory variable "RT" and its impact on farmers' income. *Control* denotes a series of control variables, including individual characteristics (such as gender, age, health status, and education level), household characteristics (such as whether there are party members or village cadres in the household), and village characteristics (such as village type and geographical features). ϵ_i is the random error term, encompassing all other factors affecting farmers' income that are not captured by the model. The coefficient *cRTi* will reveal how farmers' income changes with each unit increase in the level of rural transformation.

To address endogeneity issues arising from omitted variables, measurement errors, and reverse causality, this study uses two-stage least squares (2SLS) methods. The 2SLS approach specifically addresses endogeneity by using valid external instruments that are correlated with the endogenous explanatory variables but uncorrelated with the error term.

First Stage Regression: The endogenous variable (*RT*) is regressed on the instrument (*Distance*) and other exogenous variables:

$$RT_i = \alpha_0 + \alpha_1 Distance_i + \alpha_2 Control_i + \epsilon_i \quad (2)$$

where $Distance_i$ represents the distance from the village to the county government.

Second Stage Regression: The predicted values from the first stage $\hat{RT}_i$ are used in the second regression to estimate the impact on the dependent variable (*Income*):

$$Income_i = \alpha_0 + c\widehat{RT_i} + \alpha_1 Control_i + \epsilon_i \quad (3)$$

Furthermore, based on the theoretical analysis presented earlier, this study posits that the income-increasing effects of rural transformation may stem from the promotion of agricultural value chain upgrading, enhanced farmers' market participation, and improved financial accessibility for farmers. Thus, the following mechanism verification model is specified:

$$M_i = \alpha_0 + cRT_i + \alpha_1 Control_i + \epsilon_i \quad (4)$$

In Equation (4), *Mi* represents the mechanism variables of interest in this study, namely agricultural value chain upgrading, farmers' market participation, and farmers' financial accessibility. The other symbols retain the same meanings as in Equation (1).

4. Results and Analysis

4.1. Evaluation of Rural Transformation Levels

This study uses the previously constructed indicator system and the entropy method to quantitatively assess the average level of rural transformation across the 15 sample provinces in China. The ranking of rural transformation levels from highest to lowest is as follows: Fujian, Hebei, Jiangsu, Chongqing, Sichuan, Shandong, Zhejiang, Jilin, Xinjiang, Yunnan, Anhui, Hubei, Heilongjiang, Hunan, and Henan. To present the results more intuitively, a combination of geographical distribution and bar charts is depicted in Figure 2, facilitating a straightforward comparison between provinces and an analysis of spatial distribution characteristics.

The results in Figure 3 show that Fujian, Hebei, and Jiangsu rank at the top, aligning well with the high levels of economic development and infrastructure in these regions. Specifically, these eastern coastal provinces generally have higher economic output and well-developed infrastructure, which contribute to their advanced rural transformation levels. This indicates that economic development and infrastructure construction are crucial drivers of rural transformation. In contrast, central provinces like Henan and Hunan, which are major agricultural regions, face more challenges in the rural transformation process due to their significant agricultural shares, leading to relatively slower transformation progress.

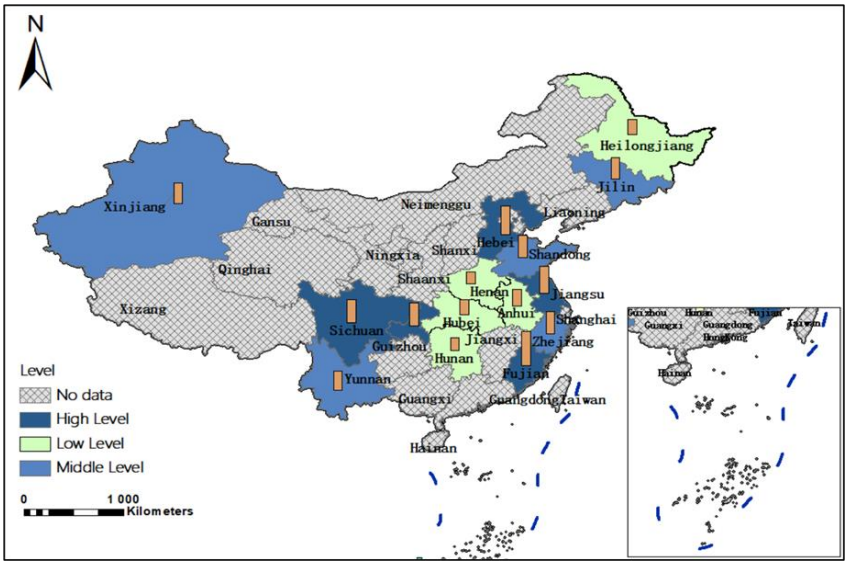

Figure 3. Spatial distribution between provinces in rural transformation. 'no data' refers to provinces not included in the study.

4.2. Baseline Regression

To examine the impact of rural transformation on farmers' incomes, this study conducts an empirical analysis using the OLS method. The specific results are presented in Table 4. Model (1) is a univariate regression model containing only the explanatory and dependent variables, while Models (2) to (4) progressively incorporate individual-level, household-level, and village-level control variables.

Table 4. Basic regression.

	(1)	(2)	(3)	(4)
Variables	**Income**	**Income**	**Income**	**Income**
RT	1.201 ***	1.012 ***	1.018 ***	0.958 ***
	(0.1360)	(0.1300)	(0.1310)	(0.1330)
Gender		0.0388	0.0344	0.0317
		(0.0508)	(0.0510)	(0.0510)
Age		−0.0167 ***	−0.0174 ***	−0.0173 ***
		(0.0018)	(0.0018)	(0.0018)
Health		0.203 ***	0.203 ***	0.194 ***
		(0.0479)	(0.0479)	(0.0480)
Edu		0.163 ***	0.143 ***	0.139 ***
		(0.0224)	(0.0243)	(0.0244)
Train		0.156 ***	0.141 **	0.145 **
		(0.0584)	(0.0587)	(0.0586)
Tech		0.133 ***	0.123 **	0.125 **
		(0.0508)	(0.0514)	(0.0514)
Status			0.114 **	0.116 **
			(0.0480)	(0.0481)
Position			−0.0047	−0.0036
			(0.0575)	(0.0575)
Center				0.0304
				(0.0580)
Geogra				0.0868 **
				(0.0361)
Constant	10.63 ***	11.10 ***	11.15 ***	11.14 ***
	(0.0362)	(0.1410)	(0.1440)	(0.1440)
Observations	5520	5520	5520	5520
R-squared	0.015	0.074	0.075	0.076

Note: ** $p < 0.05$, and *** $p < 0.01$. Robust standard errors are given in parentheses.

The results in Table 4 indicate that rural transformation (RT) consistently has a significant positive impact on farmers' income (Income) across all regression models, even as control variables are added incrementally. The coefficient for rural transformation decreases from 1.201 in Model (1) to 0.958 in Model (4), suggesting that for each unit increase in rural transformation, the log of farmers' average income increases by at least 0.958 units, thereby validating Hypothesis H1. This underscores the importance of advancing rural transformation as a key strategy for increasing farmers' incomes and highlights the broader economic and livelihood benefits of accelerating rural transformation.

Regarding control variables, their effects generally align with expectations. For individual characteristics, age (Age) shows a significant negative relationship with farmers' income, indicating that the ability and likelihood of engaging in high-income activities decrease with age. Health status (Health) is positively correlated with farmers' income, emphasizing the critical role of good health in income generation. Education level (Edu) also has a significant positive effect on income, underscoring the importance of human capital in enhancing farmers' earnings. For household characteristics, the presence of party members in the household (Status) has a significant positive coefficient, suggesting that higher social capital can effectively boost household income. At the village level, the terrain

(Geogra) being flat has a significant positive impact on farmers' income, indicating the importance of favorable agricultural conditions in increasing income.

4.3. Endogeneity and Robustness

To address the endogeneity issue arising from the bidirectional causality between rural transformation and farmers' income, this study employs the Two-Stage Least Squares (2SLS) method. We select the "distance from the village to the county government" (Distance) as the instrumental variable (IV) for rural transformation for the following reasons: firstly, this distance reflects the extent to which rural areas benefit from the spillover effects of urbanization, which is closely related to rural transformation; and secondly, the distance variable does not directly determine individual farmers' income, thus meeting the exogeneity condition of the instrumental variable.

As shown in Table 5, column (1) results indicate that the distance variable (Distance) is significantly negatively correlated with rural transformation (RT), suggesting that the farther a village is from the county center, the lower its level of rural transformation, highlighting the driving role of urbanization in rural transformation. The regression results in column (2) show that the coefficient of rural transformation on farmers' income is 1.198 and is statistically significant at the 1% level. This indicates that, after addressing endogeneity bias, our core hypothesis H1 remains valid.

Table 5. Endogeneity and robustness.

	(1)	(2)	(3)	(4)
Variables	**RT**	**Income**	**Income(1–99%)**	**Income(5–95%)**
Distance	−0.0815 ***			
	(0.0092)			
RT		1.198 ***	0.956 ***	0.867 ***
		(0.1370)	(0.1290)	(0.1170)
Individual Characteristics	YES	YES		
Household Characteristics	YES	YES		
Village Characteristics	YES	YES		
Constant	0.215 ***	10.70 ***	11.13 ***	11.16 ***
	(0.0142)	(0.3560)	(0.1380)	(0.1250)
Observations	5520	5520	5520	5520
R-squared	0.004	0.032	0.078	0.081

Note: *** $p < 0.01$. Robust standard errors are given in parentheses.

To verify the robustness of the results, we applied trimmed regression by trimming the top and bottom 1% and 5% of farmers' income data to mitigate the distorting effects of extreme values and enhance the reliability of the estimates. As shown in columns (3) and (4) of Table 5, the positive impact of rural transformation (RT) on farmers' income remains significant, with coefficients of 0.956 (1–99% trimmed) and 0.867 (5–95% trimmed), consistent with the baseline regression results, thus confirming the robustness of the core hypothesis H1.

4.4. Mechanism Examination

In this section, we empirically test the mechanisms through which rural transformation promotes farmers' income according to the method specified in Equation (2). As shown in column (1) of Table 6, rural transformation has a significant positive impact on agricultural value chain upgrading (Upgrade), with a coefficient of 0.392. This indicates that for each unit increase in rural transformation, the degree of agricultural value chain upgrading increases by 0.392 units, validating the "rural transformation → agricultural value chain upgrading → farmers' income growth" pathway mechanism. Secondly, as shown in column (2), rural transformation also has a significant positive impact on farmers' market participation (Market), with a coefficient of 0.139. This suggests that the development of the digital economy alongside rural transformation has introduced new sales platforms

and marketing models, enabling farmers to sell their products through more diversified channels, thereby significantly enhancing agricultural producers' economic benefits. Additionally, the impact of rural transformation on increasing farmers' financial accessibility (Access) has a coefficient of 0.263, indicating that during the rural transformation process, farmers' financial accessibility has significantly improved, providing the necessary financial support for their production and livelihood activities, effectively promoting income growth.

Table 6. Results of the impact mechanism analysis.

	(1)	(2)	(3)
Variables	**Upgrade**	**Market**	**Access**
RT	0.392 ***	0.139 ***	0.263 ***
	(0.1490)	(0.0301)	(0.0522)
Individual Characteristics	YES	YES	YES
Household Characteristics	YES	YES	YES
Village Characteristics	YES	YES	YES
Constant	1.853 ***	1.482 ***	0.234 ***
	(0.1560)	(0.1020)	(0.0637)
Observations	5520	5520	5520
R-squared	0.035	0.038	0.027

Note: *** $p < 0.01$. Robust standard errors are given in parentheses.

In summary, rural transformation facilitates agricultural value chain upgrading, enhances farmers' market participation, and improves financial accessibility, thereby effectively increasing farmers' income. This validates our research hypothesis H2. By revealing the transmission mechanisms through which rural transformation promotes income growth, we unpack the "black box", providing a deeper understanding of the intrinsic logic of how rural transformation impacts farmers' income. This also offers insights for other countries facing rural decline and challenges in increasing farmers' income.

4.5. Heterogeneous Effects of Different Rural Transformation Modes

Rural transformation is a multidimensional process involving demographic, land, industrial, social, ecological, and digital transitions, each of which may have distinct impacts on farmers' incomes. To evaluate these differences, columns (1) to (6) of Table 7 present independent regression analyses for each dimension of rural transformation, maintaining consistent model specifications and control variables to ensure comparability. This approach allows for a scientific assessment of the magnitude and statistical significance of the impact coefficients across different transformation modes, highlighting the varying effects of each dimension on farmers' income.

As shown in Table 7, the effects of different rural transformation modes on farmers' income exhibit significant variability. Specifically, industrial and social transformations have the most pronounced effects on increasing farmers' income, with coefficients of 1.613 and 1.369, respectively, both significant at the 1% level. This is because these transformations are directly related to employment and quality of life for farmers. Demographic transformation also has a relatively large impact, with a coefficient of 0.902, significant at the 1% level, highlighting the importance of improving the quality of agricultural labor and facilitating non-agricultural employment for income growth. In contrast, while digital transformation (coefficient 0.513, significant at the 10% level) has introduced new opportunities for farmers, its impact is still relatively limited, possibly due to the incomplete maturity of digital technology adoption in rural China. Ecological transformation and land transformation are not statistically significant, indicating that their positive effects have yet to materialize, which may require a longer-term perspective to evaluate their impact on farmers' income.

Therefore, future directions for China's rural transformation should focus on deepening demographic, industrial, and social transformations, enhancing farmers' digital literacy to boost the economic benefits of digital transformation, and emphasizing ecological pro-

tection and sustainable development by establishing diverse mechanisms to realize the value of rural ecological products.

Table 7. Impact of different rural transformation models on farmers' income.

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	**Income**	**Income**	**Income**	**Income**	**Income**	**Income**
Demographic Transformation	0.902 ***					
	(0.182)					
Land Transformation		−0.0216				
		(0.220)				
Industrial Transformation			1.613 ***			
			(0.202)			
Social Transformation				1.369 ***		
				(0.201)		
Ecological Transformation					0.0118	
					(0.136)	
Digital Transformation						0.513 *
						(0.297)
Individual Characteristics	YES	YES	YES	YES	YES	YES
Household Characteristics	YES	YES	YES	YES	YES	YES
Village Characteristics	YES	YES	YES	YES	YES	YES
Constant	11.17 ***	11.34 ***	11.45 ***	11.30 ***	11.34 ***	11.32 ***
	(0.144)	(0.141)	(0.140)	(0.141)	(0.143)	(0.142)
Observations	5520	5520	5520	5520	5520	5520
R-squared	0.071	0.067	0.078	0.074	0.067	0.068

Note: * $p < 0.1$, *** $p < 0.01$. Robust standard errors are given in parentheses.

5. Discussion

This study highlights that rural transformation significantly influences farmers' income in China, primarily through the mechanisms of upgrading agricultural value chains, enhancing market participation, and improving financial accessibility. Coastal regions exhibit higher levels of transformation due to better infrastructure and economic conditions, while inland provinces face slower progress due to their heavy reliance on agriculture.

Our research enhances the global discourse by incorporating empirical evidence from China, highlighting how the country addresses rural decline through tailored transformation strategies, complementing the measures observed in other countries [27–30]. Additionally, we broaden the dimensions of rural transformation to include ecological and digital aspects, which are often overlooked [31–35]. This study successfully validates the distinct impacts of different transformation models, revealing the varied effectiveness of each approach and contributing to a deeper understanding of rural transformation's multifaceted nature.

This study provides empirical evidence on the transmission mechanisms behind rural transformation, unpacking the "black box" of how transformation directly affects income. By revealing that value chain upgrades, market access, and financial inclusion are key pathways, our findings offer actionable insights for policymakers to refine existing rural development strategies.

While this study provides valuable insights, it is limited by its cross-sectional nature, which captures the impact of rural transformation at a single point in time. Future research should consider longitudinal data to assess the long-term effects and sustainability of different transformation modes. Moreover, our focus on China's specific context may limit the generalizability of the findings to other countries with different socio-economic dynamics.

Future studies should explore the evolving role of digital and ecological transformations in rural income growth as these dimensions develop further. Comparative studies involving multiple countries could also provide deeper insights into how different transfor-

mation strategies perform under varied economic, cultural, and policy environments. Such research would enhance our understanding of rural transformation's global applicability and offer more tailored recommendations for diverse contexts.

6. Conclusions and Recommendations

6.1. Conclusions

This study uses 2022 micro-survey data from China to empirically examine the effects of rural transformation on farmers' incomes, elucidate the transmission mechanisms, and explore the differential impacts of various modes of rural transformation. It provides practical insights and examples from a Chinese perspective to address rural decline and explore pathways for increasing farmers' incomes globally. The main conclusions are as follows:

Coastal developed regions exhibit higher levels of rural transformation due to their substantial economic output and well-developed infrastructure. In contrast, major inland agricultural provinces face more significant challenges in the transformation process due to their large agricultural shares, resulting in slower progress. This highlights the external driving role of economic development and infrastructure construction in rural transformation.

Advancing rural transformation effectively promotes farmers' income growth. The primary mechanisms include upgrading agricultural value chains, enhancing farmers' market participation, and improving financial accessibility for rural households.

The impact of different transformation modes on farmers' incomes varies significantly. Industrial, social, and demographic transformations contribute most prominently to income growth, while the positive effects of digital transformation are relatively limited. The impacts of land and ecological transformations on farmers' incomes have yet to materialize.

6.2. Policy Implications

6.2.1. Promote Comprehensive Agricultural Value Chains and Improve Agricultural Efficiency

Countries worldwide should focus on developing large-scale, modern agricultural industries by concentrating on high-value, high-efficiency specialty agricultural products. International cooperation and technology exchange should be promoted to introduce advanced agricultural processing technologies and management practices, enhancing the deep processing and value addition of agricultural products. Additionally, emphasis should be placed on international marketing and brand building by learning from successful global agricultural brand promotion experiences to increase the international competitiveness of agricultural products.

6.2.2. Strengthen Rural Digital Talent Development and Foster Digital Transformation

Nations should prioritize the construction and upgrading of rural digital infrastructure to ensure the widespread application of digital technologies in agriculture and rural economies. The cultivation and attraction of digital talent should be emphasized, with efforts to disseminate essential digital knowledge and e-commerce practices to drive rural digital transformation. Moreover, digital technologies should be applied to optimize agricultural management, utilizing the internet and big data to enhance agricultural production and management and develop digital agricultural service industries.

6.2.3. Explore Rural Ecological Transformation Models and Establish Diverse Mechanisms for Shared Prosperity

Globally, there should be a concerted effort to explore rural ecological transformation models suitable for different countries and regions, improving the value assessment and market transaction mechanisms for ecological products. Successful international experiences should be leveraged to promote market-based approaches such as ecological compensation and carbon trading in rural ecological transformation. Additionally, diverse mechanisms for shared prosperity should be established to foster cooperation among gov-

ernments, enterprises, and farmers, forming mutually beneficial interest linkages. Finally, social capital investment in rural ecological industries should be encouraged to drive sustainable rural development, achieving both ecological and economic benefits.

Author Contributions: Conceptualization, D.Z., Q.L. and S.M.; methodology, D.Z., Q.L. and S.M.; software, D.Z. and Q.L.; validation, Q.L. and S.M.; data acquisition, S.M.; writing—original draft preparation, D.Z., Q.L. and S.M.; writing—review and editing, D.Z., Q.L. and S.M.; visualization, D.Z.; supervision, S.M.; project administration, S.M.; funding acquisition, S.M. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the Innovation Project of the Chinese Academy of Agricultural Science and Technology Innovation Program "Research on the Impact of Digital Economy on the Transformation and Development of Agricultural Industry" (10-IAED-RC-03-2024-2).

Institutional Review Board Statement: Not applicable.

Data Availability Statement: The data presented in this study are available on request from the corresponding author.

Conflicts of Interest: The authors declare no conflicts of interest.

References

1. Kaya, Y. Globalization and industrialization in 64 developing countries, 1980–2003. *Soc. Forces* **2010**, *88*, 1153–1182. [CrossRef]
2. Diao, X.; McMillan, M.; Rodrik, D. *The Recent Growth Boom in Developing Economies: A Structural-Change Perspective*; Springer International Publishing: Berlin/Heidelberg, Germany, 2019.
3. Xiang, J. China's Rural Industrialization and Urbanization: 40 Years of Urban and Rural Labor Transfer. In *Chinese Research Perspectives on Population and Labor*; Brill: Leiden, The Netherlands, 2022; Volume 7, pp. 75–90.
4. Li, Y.; Westlund, H.; Liu, Y. Why some rural areas decline while some others not: An overview of rural evolution in the world. *J. Rural Stud.* **2019**, *68*, 135–143. [CrossRef]
5. Gallaher, A.; Padfield, H. *The Dying Community*; University of New Mexico Press: Albuquerque, NM, USA, 1981.
6. Forth, G. The future of Australia's declining country towns: Following the yellow brick road. *Reg. Policy Pract.* **2000**, *9*, 4–10.
7. Ono, A. *Sanson Kankyo-Shakaigaku Josetsu [Introduction to the Environmental Sociology of Communities in Mountainous Areas]*; Nobunkyo: Tokyo, Japan, 2005.
8. Carr, P.J.; Kefalas, M.J. *Hollowing out the Middle: The Rural Brain Drain and What It Means for America*; Beacon Press: Boston, MA, USA, 2009.
9. Li, Y.; Westlund, H.; Zheng, X.; Liu, Y. Bottom-up initiatives and revival in the face of rural decline: Case studies from China and Sweden. *J. Rural Stud.* **2016**, *47*, 506–513. [CrossRef]
10. Liu, Y.; Li, Y. Revitalize the world's countryside. *Nature* **2017**, *548*, 275–277. [CrossRef]
11. Sahasranaman, A.; Bettencourt, L.M.A. Life between the city and the village: Scaling analysis of service access in Indian urban slums. *World Dev.* **2021**, *142*, 105435. [CrossRef]
12. Kumar, R.; Deb, U.; Bantilan, C.; Bhattarai, M. Economic growth and rural transformation in Eastern India: Strategies for Inclusive Growth. In Proceedings of the Pre-Conference Symposium on "Transformation in Rural Economy and Employment Opportunities in Eastern India: Implications for Inclusive Growth", Ranchi, India, 17 December 2014.
13. Huang, J. Facilitating inclusive rural transformation in the Asian developing countries. *World Food Policy* **2018**, *4*, 31–55. [CrossRef]
14. Shi, P.; Huang, J. Rural transformation, income growth, and poverty reduction by region in China in the past four decades. *J. Integr. Agric.* **2023**, *22*, 3582–3595. [CrossRef]
15. Yu, Z.; Lin, Q.; Huang, C. Re-measurement of agriculture green total factor productivity in China from a carbon sink perspective. *Agriculture* **2022**, *12*, 2025. [CrossRef]
16. Li, H.; Lin, Q.; Wang, Y.; Mao, S. Can Digital Finance Improve China's Agricultural Green Total Factor Productivity? *Agriculture* **2023**, *13*, 1429. [CrossRef]
17. Li, J.; Lin, Q. Threshold effects of green technology application on sustainable grain production: Evidence from China. *Front. Plant Sci.* **2023**, *14*, 1107970. [CrossRef] [PubMed]
18. Gollin, D.; Parente, S.; Rogerson, R. The role of agriculture in development. *Am. Econ. Rev.* **2002**, *92*, 160–164. [CrossRef]
19. Han, J. Prioritizing agricultural, rural development and implementing the rural revitalization strategy. *China Agric. Econ. Rev.* **2020**, *12*, 14–19. [CrossRef]
20. Shi, J.; Yang, X. Sustainable development levels and influence factors in rural China based on rural revitalization strategy. *Sustainability* **2022**, *14*, 8908. [CrossRef]
21. Collantes, F. The decline of agrarian societies in the European countryside: A case study of Spain in the twentieth century. *Agric. Hist.* **2007**, *81*, 76–97. [CrossRef]
22. Gómez Valenzuela, V.; Holl, A. Growth and decline in rural Spain: An exploratory analysis. *Eur. Plan. Stud.* **2024**, *32*, 430–453. [CrossRef]

23. Merrett, C.D.; Struthers, C. Globalization and the Future of Rural Communities in the American Midwest. *Transnat'l L. Contemp. Probs.* **2002**, *12*, 33.
24. Bailey, C.; Jensen, L.; Ransom, E. *Rural America in a Globalizing World*; West Virginia University Press: Morgantown, WV, USA, 2014.
25. Matanle, P. Shrinking Sado: Education, employment and the decline of Japan's rural regions. *Shrinking Cities-Complet. Work.* **2005**, *3*, 42–53.
26. Goh, S.K.; McNown, R. Macroeconomic implications of population aging: Evidence from Japan. *J. Asian Econ.* **2020**, *68*, 101198. [CrossRef]
27. Wilkinson, K.P. *The Community in Rural America*; University Press of Colorado: Denver, CO, USA, 2023.
28. Guth, M.; Smędzik-Ambroży, K.; Czyżewski, B.; Stępień, S. The economic sustainability of farms under common agricultural policy in the European Union countries. *Agriculture* **2020**, *10*, 34. [CrossRef]
29. Pe'er, G.; Bonn, A.; Bruelheide, H.; Dieker, P.; Eisenhauer, N.; Feindt, P.H.; Hagedorn, G.; Hansjürgens, B.; Herzon, I.; Lomba, Â.; et al. Action needed for the EU Common Agricultural Policy to address sustainability challenges. *People Nat.* **2020**, *2*, 305–316. [CrossRef] [PubMed]
30. Assmann, S. *Sustainability in Contemporary Rural Japan*; Taylor & Francis: Abingdon, UK, 2015.
31. Huang, J.; Rozelle, S.; Zhu, X.; Zhao, S.; Sheng, Y. Agricultural and rural development in China during the past four decades: An introduction. *Aust. J. Agric. Resour. Econ.* **2020**, *64*, 1–13. [CrossRef]
32. Kim, T.; Yang, S. Construction of the rural development index: The case of Vietnam. *J. Rural Dev./Nongchon-Gyeongje* **2016**, *39*, 113–142.
33. Wu, K.S.; Kong, D.Y.; Wang, Y.; Yang, X.J. The study on influencing factors of rural transformation development and their spatial differentiation of effects: Take Shaanxi province as an example. *J. Nat. Resour.* **2022**, *37*, 2033–2041. [CrossRef]
34. Long, H.; Zou, J.; Pykett, J.; Li, Y. Analysis of rural transformation development in China since the turn of the new millennium. *Appl. Geogr.* **2011**, *31*, 1094–1105. [CrossRef]
35. Dong, W.; Chen, C.; Findlay, C. A review of rural transformation studies: Definition, measurement, and indicators. *J. Integr. Agric.* **2023**, *22*, 3568–3581.
36. Li, Y.; Jia, L.; Wu, W.; Yan, J.; Liu, Y. Urbanization for rural sustainability–Rethinking China's urbanization strategy. *J. Clean. Prod.* **2018**, *178*, 580–586. [CrossRef]
37. Khandker, S.R.; Samad, H.A. Bangladesh's Structural Transformation: The Role of Infrastructure. In *Economic and Social Development of Bangladesh*; Miracle and Challenges; Palgrave Macmillan: Cham, Switzerland, 2018; pp. 71–92.
38. Sudaryanto, T.; Dermoredjo, S.K.; Purba, H.J.; Rachmawati, R.R.; Irawan, A.R. Regional rural transformation and its association with household income and poverty incidence in Indonesia in the last two decades. *J. Integr. Agric.* **2023**, *22*, 3596–3609. [CrossRef]
39. Farooq, S.; Farah, N.A.Z. Developing strategy for rural transformation to alleviate poverty in Pakistan: Stylized facts from panel analysis. *J. Integr. Agric.* **2023**, *22*, 3610–3623.
40. Rola-Rubzen, M.F.; Vuong, H.T.; Doll, C.; Rollins, C.; Sarmiento, J.M.; Alam, M.J.; Begum, I.A. Gender and Rural Transformation: A Systematic Literature Review. *J. Integr. Agric.* **2023**, *22*, 3624–3637. [CrossRef]
41. Huang, J. China's rural transformation and policies: Past experience and future directions. *Engineering* **2022**, *18*, 21–26. [CrossRef]
42. Xie, W.; Zhu, A.; Ali, T.; Zhang, Z.; Chen, X.; Wu, F.; Jikun, H.; Davis, K.F. Crop switching can enhance environmental sustainability and farmer incomes in China. *Nature* **2023**, *616*, 300–305. [CrossRef] [PubMed]
43. Liao, W.; Qiao, J.; Xiang, D.; Peng, T.; Kong, F. Can labor transfer reduce poverty? Evidence from a rural area in China. *J. Environ. Manag.* **2020**, *271*, 110981. [CrossRef] [PubMed]
44. Li, L. An empirical analysis of rural labor transfer and household income growth in China. *J. Chin. Hum. Resour. Manag.* **2023**, *14*, 106–116. [CrossRef]
45. German, L.A.; Bonanno, A.M.; Foster, L.C.; Cotula, L. "Inclusive business" in agriculture: Evidence from the evolution of agricultural value chains. *World Dev.* **2020**, *134*, 105018. [CrossRef]
46. Yan, Z.; Peng, L.; Wu, X. Evaluation System for Agricultural and Rural Modernization in China. *Agriculture* **2023**, *13*, 1930. [CrossRef]
47. Bojnec, Š.; Knific, K. Farm household income diversification as a survival strategy. *Sustainability* **2021**, *13*, 6341. [CrossRef]
48. Couture, V.; Faber, B.; Gu, Y.; Liu, L. Connecting the countryside via e-commerce: Evidence from China. *Am. Econ. Rev. Insights* **2021**, *3*, 35–50. [CrossRef]
49. Karine, H. E-commerce development in rural and remote areas of BRICS countries. *J. Integr. Agric.* **2021**, *20*, 979–997.
50. Wang, C.C.; Miao, J.T.; Phelps, N.A.; Zhang, J. E-commerce and the transformation of the rural: The Taobao village phenomenon in Zhejiang Province, China. *J. Rural Stud.* **2021**, *81*, 159–169. [CrossRef]
51. Li, G.; Qin, J. Income effect of rural E-commerce: Empirical evidence from Taobao villages in China. *J. Rural Stud.* **2022**, *96*, 129–140. [CrossRef]
52. Stiglitz, J.E.; Weiss, A. Credit rationing in markets with imperfect information. *Am. Econ. Rev.* **1981**, *71*, 393–410.
53. Ghatak, M. Group lending, local information and peer selection. *J. Dev. Econ.* **1999**, *60*, 27–50. [CrossRef]
54. Wang, X.; He, G. Digital financial inclusion and farmers' vulnerability to poverty: Evidence from rural China. *Sustainability* **2020**, *12*, 1668. [CrossRef]
55. Ji, X.; Wang, K.; Xu, H.; Li, M. Has digital financial inclusion narrowed the urban-rural income gap: The role of entrepreneurship in China. *Sustainability* **2021**, *13*, 8292. [CrossRef]

56. Wang, X.; Fu, Y. Digital financial inclusion and vulnerability to poverty: Evidence from Chinese rural households. *China Agric. Econ. Rev.* **2022**, *14*, 64–83. [CrossRef]
57. Conning, J.; Udry, C. Rural financial markets in developing countries. *Handb. Agric. Econ.* **2007**, *3*, 2857–2908.
58. Cao, S.; Nie, L.; Sun, H.; Sun, W.; Taghizadeh-Hesary, F. Digital finance, green technological innovation and energy-environmental performance: Evidence from China's regional economies. *J. Clean. Prod.* **2021**, *327*, 129458. [CrossRef]
59. Lin, B.; Ma, R. How does digital finance influence green technology innovation in China? Evidence from the financing constraints perspective. *J. Environ. Manag.* **2022**, *320*, 115833. [CrossRef]
60. Zhu, C.; Lin, Y.; Zhang, J.; Gan, M.; Xu, H.; Li, W.; Yuan, S.; Wang, K. Exploring the relationship between rural transition and agricultural eco-environment using a coupling analysis: A case study of Zhejiang Province, China. *Ecol. Indic.* **2021**, *127*, 107733. [CrossRef]
61. Zhang, S.; Wu, S. Evaluation of Digital Rural Development from the Perspective of Rural Revitalization–Take Zhejiang Province as an Example. *Strateg. Plan. Energy Environ.* **2021**, *40*, 121–144. [CrossRef]
62. Li, H.; Yang, S. The road to common prosperity: Can the digital countryside construction increase household income? *Sustainability* **2023**, *15*, 4020. [CrossRef]
63. Danso-Abbeam, G.; Dagunga, G.; Ehiakpor, D.S. Rural non-farm income diversification: Implications on smallholder farmers' welfare and agricultural technology adoption in Ghana. *Heliyon* **2020**, *6*, e05393. [CrossRef] [PubMed]
64. Xiong, F.; Zhu, S.; Xiao, H.; Kang, X.; Xie, F. Does social capital benefit the improvement of rural households' sustainable livelihood ability? Based on the survey data of Jiangxi Province, China. *Sustainability* **2021**, *13*, 10995. [CrossRef]